

ONLY A MATTER OF TIME: FASTING AND COGNITIVE PERFORMANCE

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INTRODUCTION

MOTIVATION

- A large body of research demonstrates that improved nutrition enhances cognitive development and academic performance (Berongan, et al., 2019).
 - The bulk of literature has focused on the effects of food deprivation in underprivileged regions, e.g. under-nutrition and food-insecurity, (Priya et al., 2017).
- Gap in investigating the effect of **food deprivation** on individuals who are well-nourished.

INTRODUCTION

WHAT DO WE DO?

- **Research Question:**
 - Does fasting matter for cognitive performance?
 - **In this study** we evaluate exam performance of students randomly assigned to different fasting lengths.
- **Why do we care?**
 - **Better understanding** of the intimate relationship between nutrition and performance.

INTRODUCTION

HOW DO WE DO IT?

- We use administrative data on exam performances from one of the largest universities in UK, covering the period from 2014/15 to 2018/19;
 - Two sources of variation:
 - ① **Exam time:** In this institution, exam time is **quasi-randomly assigned**.
 - ② **Ramadan:** In 2017, 2018, and 2019, the holy month of Ramadan overlapped with the exam period.
 - **Natural experiment:** A Muslim student during Ramadan:
 - May take a 9 am exam after a “**short**” fast (\sim 6:30 hours).
 - May take 4:30 pm exam after a “**long**” fast (\sim 14 hours).
- Hence, by comparing Muslims taking exams at different time of day during Ramadan, we are able to gauge at the extent to which a long fast affects cognitive performances.

INTRODUCTION

WHAT DO WE FIND?

- **Primary Results:**
 - Our findings reveal that Muslim students randomly assigned an exam after a long fast perform significantly worse than their counter part.
- **Heterogeneity:**
 - The results show that effects are strongest during the first week of Ramadan.

INSTITUTIONAL SETTING

THE DATA

- Administrative **student-level panel** data from a large UK University
 - Five academic years: from 2014/2015 to 2018/2019
 - Focus on undergraduates (UG) and postgraduates (PGT)
 - Characteristics: age, gender, school, **religion**, etc.
 - **Exam mark**, final mark, and assignment(s) mark
 - **Exam scheduling**: date and time for each exam
- The **exam office** is in charge of exam schedules and follows a set of **clearly specified rules**:
 - 1 Number of exams;
 - 2 School requests;
 - 3 Exam duration.
- Controlling for these variables, exam time is **as good as randomly assigned (CIA)**.

INSTITUTIONAL SETTING

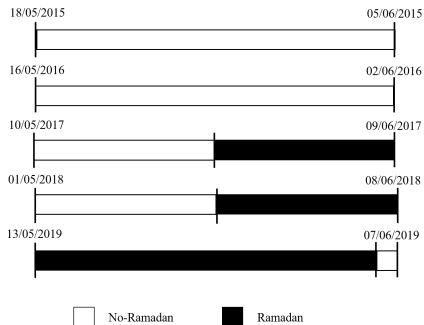
RAMADAN

- Ramadan is the ninth month of the Islamic lunar calendar.
- During Ramadan involves abstaining from food, drink, smoking, and other physical needs from dawn until sunset.
 - The dates of Ramadan change each year due to its adherence to the Islamic lunar calendar.
 - The timing of fasting during Ramadan varies depending on the geographical location, as it is determined by the local sunrise and sunset times.
- During the years 2017, 2018, and 2019, the holy month of Ramadan overlapped with the exam period.

RAMADAN AND EXAM PERIOD

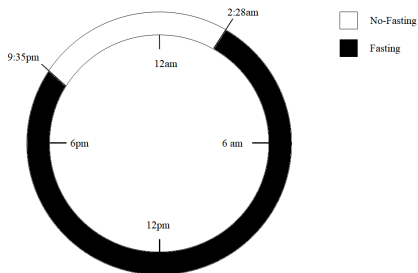
GRAPHICAL ILLUSTRATION

FIGURE: Ramadan and Exam period



RAMADAN FASTING HOURS

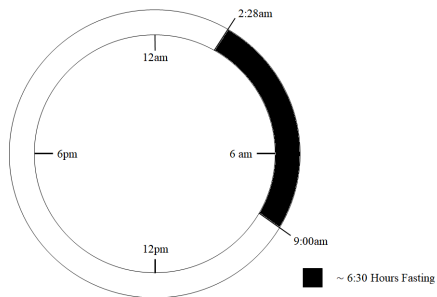
GRAPHICAL ILLUSTRATION



RAMADAN FASTING HOURS

GRAPHICAL ILLUSTRATION

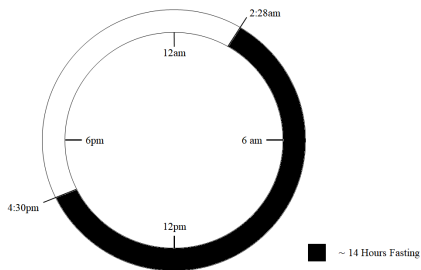
FIGURE: Exam at 9am



RAMADAN FASTING HOURS

GRAPHICAL ILLUSTRATION

FIGURE: Exam at 4:30am



ECONOMETRIC MODEL

DIFFERENCE-IN-DIFFERENCES

- We estimate:

$$Y_{i,e,t} = \beta_0 + \beta_1 T + \beta_2 R + \beta_3 T \times R + X'_{i,e,t} \gamma + \varepsilon_{i,e,t} \quad (1)$$

- where:

- $Y_{i,e,t}$ is the standardized mark achieved by student i , in exam e , in year t
- T : Indicator for whether the exam is at 4:30pm.
- R : Indicator for whether the exam is during Ramadan.
- β_3 : Effect of a long fast on cognitive performance.
- $X_{i,e,t}$: students' and exams' characteristics
- $\varepsilon_{i,e,t}$: unobservable shocks to students' exam mark

MAIN RESULTS

TABLE: EFFECT OF FASTING ON COGNITIVE PERFORMANCES

	(1)	(2)	(3)	(4)	(5)
$T \times R$	-0.141** (0.068)	-0.144** (0.063)	-0.147** (0.061)	-0.160** (0.066)	-0.170** (0.070)
CIA	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓
Day FE			✓		
Module FE				✓	
Module FE \times Year EF					✓
Clusters:	4427	4427	4427	4148	3992
Observations:	23988	23988	23988	23700	22946
Adjusted R^2 :	0.420	0.448	0.454	0.536	0.538

Notes:

HETEROGENEITY

WEEKS INTO RAMADAN

TABLE: EFFECT OF FASTING ON COGNITIVE PERFORMANCES

	(1)	(2)	(3)	(4)	(5)
Week 1	-0.325*** (0.121)	-0.361*** (0.132)	-0.366*** (0.130)	-0.345** (0.146)	-0.394** (0.157)
Week 2	0.070 (0.096)	-0.054 (0.116)	-0.017 (0.116)	-0.064 (0.081)	-0.085 (0.084)
Week 3	-0.053 (0.075)	-0.045 (0.085)	-0.100 (0.085)	-0.001 (0.097)	0.003 (0.098)
Week 4	0.004 (0.108)	-0.177 (0.116)	-0.166 (0.105)	-0.268* (0.143)	-0.248* (0.149)
CIA	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓
Day FE			✓		
Module FE				✓	
Module FE × Year EF					✓
Clusters:	4427	4427	4427	4148	3992
Observations:	23988	23988	23988	23700	22946
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Notes:

ROBUSTNESS CHECKS

- ① **Placebo analysis:** ✓
- ② **Triple Difference:** ✓
- ③ **Any other suggestions?**

CONCLUSIONS

- In this study we estimate the effect of a long fast (14 hours) on cognitive performances.
- Our results suggest that longer period of fasting lead to decreased cognitive performance.
- The findings suggest that effects are strongest when individuals are not accustomed to fasting.
- **Implications:**
 - Findings may extend beyond Muslim students, emphasizing the strong link between nutrition and cognitive performance.

Thank you!

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MAIN RESULTS

PLACEBO

TABLE: EFFECT OF FASTING ON COGNITIVE PERFORMANCES

	(1)	(2)	(3)	(4)	(5)
$T \times R$	-0.022 (0.034)	-0.023 (0.032)	-0.031 (0.032)	0.001 (0.029)	-0.002 (0.029)
CIA	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓
Day FE			✓		
Module FE				✓	
Module FE \times Year EF					✓
Clusters:	7465	7465	7465	7416	7400
Observations:	430207	430207	430207	430150	429062
Adjusted R^2 :	0.429	0.447	0.451	0.518	0.525

Notes:

ROBUSTNESS

TRIPLE DIFFERENCE

TABLE: EFFECT OF FASTING ON COGNITIVE PERFORMANCES

	(1)	(2)	(3)	(4)	(5)
Week 1	-0.280*** (0.108)	-0.282** (0.110)	-0.284*** (0.108)	-0.265*** (0.102)	-0.265** (0.104)
Week 2	0.053 (0.092)	0.042 (0.097)	0.052 (0.095)	0.052 (0.079)	0.026 (0.071)
Week 3	-0.120 (0.085)	-0.110 (0.080)	-0.117 (0.080)	-0.104 (0.075)	-0.104 (0.074)
Week 4	-0.070 (0.094)	-0.076 (0.089)	-0.079 (0.085)	-0.111 (0.085)	-0.103 (0.087)
CIA	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓
Day FE			✓		
Module FE				✓	
Module FE* Year EF					✓
Clusters:	7498	7498	7498	7450	7434
Observations:	454199	454199	454199	454140	453054
Adjusted R^2 :	0.431	0.449	0.454	0.520	0.527

Notes:

DATA DESCRIPTION

TABLE: SUMMARY STATISTICS

	(1) Mean	S.D.	Min	Max
Key Variables:				
Exam mark	55.70	18.40	0	100
Exam Characteristics:				
9am Exam [0,1]	0.47	0.50	0	1
1:30pm Exam [0,1]	0.33	0.47	0	1
4:30pm Exam [0,1]	0.20	0.40	0	1
Ramadan [0,1]	0.33	0.47	0	1
Student Characteristics:				
Age	21.44	3.05	17	53
Female [0,1]	0.40	0.49	0	1
Academic Year:				
2014/15	0.11	0.32	0	1
2015/16	0.21	0.41	0	1
2016/17	0.21	0.41	0	1
2017/18	0.21	0.41	0	1
2018/19	0.26	0.44	0	1
Observations	24259			

Notes: The Table reports the mean and standard deviation of the main variables used in the paper.

BALANCING TEST

TABLE: DETERMINANTS OF EXAM TIME

	Muslims		Non-Muslims	
	(1)	(2)	(3)	(4)
Age	0.001 (0.001)	0.002 (0.002)	0.000 (0.001)	0.000 (0.001)
Female	0.010 (0.006)	0.003 (0.008)	-0.003 (0.002)	-0.003 (0.002)
Black	-0.009 (0.011)	-0.019 (0.012)	0.003 (0.003)	0.001 (0.004)
Undergraduate	0.033 (0.030)	0.011 (0.043)	0.037 (0.023)	0.039 (0.029)
Fall	0.030 (0.018)	0.054** (0.025)	0.012 (0.015)	0.008 (0.018)
Class size	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Exam order	0.001 (0.002)	0.001 (0.003)	-0.000 (0.001)	-0.000 (0.001)
Module Year	0.019 (0.016)	0.021 (0.020)	0.008 (0.009)	0.014 (0.011)
Number of Assignments	0.011 (0.008)	0.012 (0.010)	0.011 (0.007)	0.008 (0.007)
Average Mark Previous Semester		0.000 (0.000)		-0.000 (0.000)
Observations	24256	16685	435095	306486

Notes: .