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Ramadan fasting, sex-ratio at birth, and birth weight: No effects on Muslim infants born in Germany

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HIGHLIGHTS

- I estimate the effect of Ramadan fasting on Muslim newborns in Germany.
- The analysis is based on more than one million observations.
- In contrast to earlier studies no evidence for any medically relevant effect is found.

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ABSTRACT

Recent economic studies have shown negative effects of intrauterine exposure to Ramadan on birth outcomes and long-term economic outcomes. I examine the effect of Ramadan fasting on birth weight and the fraction of male births in Germany, which has large and diverse Muslim communities. Using data on 1 million births to Muslim mothers from 1996 to 2010, I find virtually no effect of Ramadan exposure on either outcome. Earlier results from other countries based on smaller samples can therefore not be generalized.

1. Introduction

Intrauterine influences on later life outcomes have recently gained attention among economists (e.g. Almond and Currie, 2011; Chen and Zhou, 2007; Jürges, 2013). One focus is on wars or famines with large exogenous reductions in nutritional intake during pregnancy. Related studies analyze the effect of a mild form of malnutrition—daytime fasting during Ramadan (Almond and Mazumder, 2011; Schultz-Nielsen et al., 2014; Van Ewijk, 2011). Using data from Michigan, Almond and Mazumder (2011) (AM in short) exploit cross-year and cross-religious differences in Ramadan exposure to find negative effects on birth weight of on average 18 g, and negative effects on the fraction of male births of 6 percentage points for Ramadan exposure close to conception. Since their data do not contain information on Ramadan observance, the estimates are intention-to-treat effects and the causal effects of fasting could be larger. Diverging opinions exist on whether fasting is mandatory for pregnant women. Worldwide, estimates of the proportion of pregnant women fasting in pregnancy range from 50% to 90% (Cross et al., 1990; Joosoph et al., 2004; Robinson and Raisler, 2005).

I analyze the effect of Ramadan exposure on birth weight and sex-ratio using all births in Germany 1996–2010. The data have two advantages compared to AM's data. First, mother's religion is coded explicitly. In contrast, AM code Arabs in counties where the majority of Arabs are Muslims as Muslims. This neither excludes non-Islamic Arabs nor captures all Muslims. The true effect of intrauterine Ramadan exposure might thus be underestimated due to measurement error. Second, my data contain more than 1 m births to Islamic mothers, allowing more precise estimates.

My data also have drawbacks. First, Ramadan observance is unknown, thus my estimates must also be interpreted as ITT. Second, German birth registers are less informative on covariates such as education and on outcomes such as gestational age. Lack of

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Table 1
Effect of Ramadan exposure on birth weight (in grams).

Ramadan falls into …	Exposure dummy			Exposure in daylight hours		
	Islamic mother	Non-islamic mother	Difference	Islamic mother	Non-islamic mother	Difference
Panel A: Full sample						
Any time during pregnancy	2.08	−0.22	2.29	0.87	−1.61**	2.48
	(1.51)	(0.49)	(1.59)	(1.41)	(0.46)	(1.48)
First trimester	1.47	−1.88**	3.35	0.38	−3.70**	4.08*
	(1.81)	(0.59)	(1.90)	(1.74)	(0.56)	(1.83)
Second trimester	0.67	1.35*	−0.68	−0.63	−0.53	−0.09
	(2.01)	(0.66)	(2.12)	(1.85)	(0.60)	(1.94)
Third trimester	3.08	1.08	2.00	1.91	−0.26	2.17
	(1.84)	(0.60)	(1.94)	(1.71)	(0.55)	(1.79)
Observations	1,041,603	9,801,521		1,041,603	9,801,521	
Panel B: Normal weight births						
Any time during pregnancy	1.27	−0.17	1.43	0.87	−1.69**	2.55*
	(1.20)	(0.39)	(1.26)	(1.12)	(0.37)	(1.18)
First trimester	1.60	−0.53	2.13	1.62	−2.31**	3.92**
	(1.44)	(0.47)	(1.51)	(1.38)	(0.45)	(1.45)
Second trimester	−0.58	0.15	−0.73	−0.54	−1.33**	0.79
	(1.59)	(0.53)	(1.68)	(1.46)	(0.48)	(1.54)
Third trimester	1.40	0.12	1.28	0.77	−1.35**	2.12
	(1.45)	(0.48)	(1.53)	(1.35)	(0.44)	(1.42)
Observations	972,888	9,150,521		972,888	9,150,521	
Panel C: Pregnancies covering Ramadan (“intensive margin”)						
Any time during pregnancy				0.62	−1.41**	2.03*
				(0.85)	(0.27)	(0.89)
First trimester				0.59	−2.20**	2.80**
				(0.94)	(0.30)	(0.99)
Second trimester				0.10	−1.05**	1.15
				(0.93)	(0.30)	(0.97)
Third trimester				0.94	−1.08**	2.01*
				(0.92)	(0.30)	(0.97)
Observations				872,138	8,171,352	

Note: Robust standard errors in parentheses. Control variables: mother’s age (in five year age brackets), newborn sex, parity, mother’s marital status, year of birth and month of birth. Exposure hours are normalized to the empirical average of 260.
* $p < 0.05$.
** $p < 0.01$.

covariates also precludes analyzing potential selectivity of Ramadan births directly. Health-conscious mothers who believe that Ramadan fasting affects infant health might avoid pregnancies that cover Ramadan. I address this issue in alternative specifications that restrict the sample to pregnancies covering Ramadan and exploiting differences in Ramadan exposure due to seasonal and regional differences in the number of fasting (i.e., daylight) hours for identification.

2. Data and methods

The data are derived from official German birth statistics 1996–2010, covering all births in Germany. They contain 10 m births to non-Islamic and 1 m births to Islamic mothers, who are mostly of Turkish, North African or Middle Eastern origin. To estimate the effect of Ramadan exposure, I estimate the following linear regression model by OLS:

$$y_i = \alpha + \beta \mathbf{x}_i + \gamma \mathbf{z}_i + \varepsilon_i \quad (1)$$

where y_i is birth weight in grams or newborn sex (1 = boy; 0 = girl) and $\mathbf{z}_i$ are covariates: year of birth (1996, …, 2010), month of birth (Jan, …, Dec), parity, mother’s age and marital status, and newborn sex where appropriate. $\mathbf{x}_i$ measures intrauterine exposure to Ramadan. Similar to AM, I operationalize exposure in several ways:

(a) A dummy variable indicating if Ramadan falls into pregnancy at any time.
(b) A vector of three dummy variables for Ramadan falling into the first, second, or third trimester of pregnancy, respectively. If Ramadan falls into two adjacent trimesters, both pertaining dummy variables are set to one.
(c) A vector of nine dummy variables for Ramadan falling into the first, second, etc. month of pregnancy, respectively. Results of this specification are shown only for the fraction of male births as dependent variable.
(d) Since Ramadan follows the lunar calendar, it shifts by approximately two weeks each year. Thus fasting is shorter in winter than in summer. Moreover, it is longer in the North than in the South in summer but shorter in the winter. I computed the number of daylight hours for each day in 1996–2010 separately for each federal state capital in Germany. This variable was matched to each newborn by mother’s state of residence and number of exposure hours was computed for each pregnancy. To make results comparable across specifications, the number of fasting hours was finally divided by 260, the average number of Ramadan daylight hours per pregnancy in our sample.

Eq. (1) is first estimated only for births to Islamic mothers. Here identification rests on intertemporal variation in exposure. For instance, in specification (a), $\hat{\beta}$ reflects the difference in birth weight between children born to Islamic mothers who were exposed to Ramadan in utero and children born to Islamic mothers who were not exposed. Interpretation of this coefficient as causal