



# Labor market effects of intrauterine exposure to nutritional deficiency: Evidence from administrative data on Muslim immigrants in Denmark<sup>☆</sup>



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## ABSTRACT

This paper examines whether nutritional disruptions experienced during the stage of fetal development impair an individual's labor market productivity later in life. We consider intrauterine exposure to the month of Ramadan as a natural experiment that might cause shocks to the inflow of nutrients essential for fetal development. Specifically, we use administrative data from Denmark to investigate the impact of exposure to Ramadan in utero on labor market outcomes of adult Muslim males, including employment status, annual salary, hourly wage rate, and hours of work. Our findings indicate that potential exposure to nutritional disruptions during a critical stage of fetal development is likely to have scarring effects on the fetus expressed as poor labor market outcomes later in life. Specifically, exposure to Ramadan around the 7th month of gestation results in a lower likelihood of employment and, to a lesser extent, a lower salary, and reduced labor supply. For example, the 7th month intrauterine exposure to Ramadan is associated with a 2.6 percentage points reduction in the likelihood of employment among Muslim males. We do not find an impact on the wage rate. Finally, we also document suggestive evidence that these results may partially be driven by increased disability and to a lesser extent by poor educational attainment among those who were exposed to Ramadan during this particular period in utero.

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## 1. Introduction

The impact of intrauterine conditions on the well-being of infants at birth and during adulthood has been a focus of major interest in epidemiology since the pioneering study of Stein and Susser (1975) on the long-term health consequences of prenatal famine exposure. The proposition that fetal malnutrition could have long-term implications for an individual's health gained a new impulse in the 1990s following a series of studies by David Barker, who argued that many adult chronic diseases have origins in utero (Barker, 1990, 1995, 2002). This argument, which has

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become known as the “fetal origins hypothesis,” posits that adaptations to nutritional insufficiency during the intrauterine growth period may permanently alter the physiology and metabolism of the fetus through a process called fetal reprogramming, which, in turn, may increase the risk of disease in adulthood (Barker, 2002; Godfrey and Barker, 2000, 2001). The implications of the fetal origins hypothesis for health outcomes have been extensively studied in the epidemiological literature (e.g., Susser et al., 1996; Susser and Lin, 1992; Heijmans et al., 2008; Lumey et al., 2011; Susser and Clair, 2013).

More recently, the fetal origins hypothesis has also attracted the attention of economists. Motivated by the growing evidence establishing a causal relationship between initial endowments and early life investments and future health and human capital accumulation (e.g., Heckman, 2007; Doyle et al., 2009), research by economists has typically considered outcomes such as birthweight, health, test scores and educational attainment, labor market performance, and mortality (Almond, 2006; Almond and Mazumder, 2011; Almond et al., 2015; Majid, 2013; van Ewijk, 2011; Mansour and Rees, 2012; Neelsen and Stratmann, 2011; Hernández-Julián et al., 2014; Scholte et al., 2012; Greve et al., 2015).<sup>1</sup> One common thread through much of this research is the use of extreme real life events such as famines, war, and pandemics as the primary sources of variation for identification.<sup>2</sup> One advantage of this approach is that these events typically have well-defined start and end dates. Therefore, the birth cohorts exposed to these extreme events can be identified with relative certainty. But more importantly, these events are considered natural experiments, i.e., they are uncorrelated with other determinants of health, such as income, maternal education, or prenatal care. Therefore, the evidence obtained from these studies has a causal interpretation (Almond and Currie, 2011). However, the disadvantage of using extreme natural events is that they are relatively rare occurrences, especially in the context of societies in developed countries. Therefore, the generalizability of conclusions drawn from these events to milder, but more commonly experienced intrauterine shocks, such as undernourishment and disruptions to nutrients, is complicated (Almond and Currie, 2011). Since extreme natural events are not typically preventable by individual behaviors, evidence from these studies also provides little scope for public policies aimed at inducing behaviors that would mitigate the adverse consequences of extreme natural events (Almond et al., 2015). Additionally, most of the evidence on these extreme natural events either come from less developed countries (e.g., the Bangladeshi famine of 1974, the Chinese famine of 1959–61) or from western societies exposed to these shocks in the distant past (e.g., the Dutch famine of 1944–45, the 1957 avian flu pandemic in Britain, the 1918 influenza pandemic in the United

States, the Greek famine of 1941–42). Finally, the majority of the studies on the impact of impairments in fetal development focuses on birth outcomes, while effects that may manifest themselves at later stages in life, especially in adulthood, are relatively under-researched.<sup>3</sup>

In this paper, we consider the labor market impacts of nutritional disruptions in utero among immigrant Muslim males between 25–54 years of age living in Denmark, exploiting the month of Ramadan as a natural experiment. In particular, we examine whether Muslim men living in Denmark who had been exposed to Ramadan during specific months of gestation differ in their labor market outcomes from Muslim men who had not been exposed to Ramadan in utero.

Our analysis considers only men because among Muslims living in Denmark, women have a particularly low and unstable labor market attachment with frequent interruptions.<sup>4</sup> Furthermore, for example, only 43 percent of Muslim women aged 25–54 are employed compared to 57 percent of Muslim men. In contrast, native Danish men and women have employment rates of 86 and 84 percent, respectively. Therefore, not only do native Danes have much higher rates of employment than Muslims, but the gap between men and women is also much narrower.<sup>5</sup> Using data drawn from the administrative records of various Danish registries, we examine a full spectrum of labor market outcomes, including employment status, annual salary, hourly wage rate, and annual hours of work.

Ramadan is the holiest month in Islam, during which healthy Muslims are expected to refrain from eating and drinking between sunrise and sunset. Therefore, any potential changes in dieting behavior among Muslim pregnant women during Ramadan may have significant implications for their offspring. It is important to note that fasting during Ramadan is not unconditionally obligatory. For example, those who are acutely ill, who are traveling, who are menstruating or who are pregnant can postpone

<sup>3</sup> In their discussion of promising avenues for future research, Almond and Currie (2011) state that the long-term effects of these experiments have not been fully determined. Therefore, they point to the importance of identifying the long-term effects of relatively less extreme events as an avenue for future research.

<sup>4</sup> The roles expected from or assigned to Muslim women in their communities may also be different from those of native Danish women. Accordingly, being employed need not necessarily be interpreted as a positive outcome, but rather be an indication of a poor financial situation. For example, on one hand Muslim women who have poorer health as a result of being exposed to Ramadan in utero may find it difficult to work. On the other hand, these women may also have poorer marriage prospects in terms of spousal income, an effect that may then exert pressure on them to seek jobs, including even low-paying ones.

<sup>5</sup> Despite these concerns, we estimated our empirical models for the female sample. Confirming our predictions, the results did not produce a systematic picture for the impact of intrauterine exposure to Ramadan on labor market outcomes among Muslim women. There appears to be a 7th month effect on their likelihood of employment, but the estimate is not statistically significant at conventional levels. Again, the impact on employment is not surprising given the low employment rate of Muslim women to begin with. Therefore, outcomes related to compensation are more likely to be a better indicator of labor market performance among Muslim women since they are conditioned on employment. In fact, we obtained more precisely estimated effects around the second and third trimesters for the models of annual salary and the wage rate.

<sup>1</sup> See Currie (2009) and Almond and Currie (2011) for extensive reviews of the economic literature on the analysis of the fetal origins hypothesis.

<sup>2</sup> A few exceptions include Currie and Schwandt (2013) who show that seasonal influenza is associated with preterm delivery and several studies demonstrating the impact of air pollution on birth outcomes (e.g., Currie and Neidell, 2005; Currie and Schneider, 2009; Currie and Walker, 2011).

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