



Long-term health effects on the next generation of Ramadan fasting during pregnancy

Reyn van Ewijk*,¹

University of Mainz, VU University Amsterdam, Tinbergen Institute, Netspar

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ABSTRACT

Each year, many pregnant Muslim women fast during Ramadan. Using Indonesian cross-sectional data and building upon work of Almond and Mazumder (2011), I show that people who were prenatally exposed to Ramadan fasting have a poorer general health than others. As predicted by medical theory, this effect is especially pronounced among older people, who also more often report symptoms indicative of coronary heart problems and type 2 diabetes. Among exposed Muslims the share of males is lower, which is most likely caused by death before birth. I show that these effects are unlikely the result of common health shocks correlated to the occurrence of Ramadan, or of fasting mainly occurring among women who would have had healthier children anyway.

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1. Introduction

Mothers' behavior during pregnancy, such as smoking and alcohol and coffee consumption, is known to have long-term effects on their children's health. Medical studies show that fasting during pregnancy in the form of skipping breakfast and other meals is another aspect of mothers' consumption and behavior that may have a negative effect on the health of their children, which may

* IMBEI, University Medical Centre Mainz, Obere Zahlbacher Str. 69, 55131 Mainz, Germany. Tel.: +49 6131 173 252.

E-mail address: vanewijk@imbei.uni-mainz.de

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last into adulthood. Each year, many pregnant women fast during daylight hours during the Islamic holy month of Ramadan. They do this, even though, according to most interpretations of Islam, they are exempted from the religious obligation to fast if they are worrying about their own health, or the health of their fetus. This paper shows that the health of people is negatively affected if their mother fasted during a Ramadan while they themselves were still in utero. This effect gets stronger as these people get older. Although effects on pregnant women and newborn babies with respect to Ramadan fasting have been measured in previous studies, very little research exists on the long-term effects of having a mother who observed Ramadan during pregnancy, and no research has yet examined effects on the serious health problems that are specifically predicted by medical theory, such as coronary heart disease and type 2 diabetes.

Almond and Mazumder (2011) are the first to systematically examine long-term effects of pre-birth Ramadan exposure. Using Michigan data, they first focus on short-term effects and demonstrate that exposure in utero is associated with lower birth weights and a lower share of male births. Next, they show that prenatally exposed Ugandan adults have higher probabilities of having sensory or mental disabilities and less wealth. Iraqi data corroborate these long-run effects. An important implication of their findings is that long-term effects of poor nutrition during pregnancy not only

occur for the severe and uncommon types of circumstances that are usually studied (notably famines) but also for milder and more common types of nutritional exposures that are more amenable to intervention.

My paper confirms the finding of Almond and Mazumder that prenatal Ramadan exposure affects later-life health in a different country and context. It moreover goes further in demonstrating the robustness of this general finding to alternative explanations: I not only demonstrate that selection on observables does not drive results by comparing parents of exposed and not exposed children. But I also use a mother fixed effects approach to show that unobservables that are time invariant within mothers do not drive my results. Furthermore, I am able to determine prenatal Ramadan exposure more precisely since I use exact date of birth instead of only month of birth, which reduces noise. Another major contribution of this paper is that, compared to Almond and Mazumder's analyses on long-term health effects which rely on rather crude measures of disabilities, the rich data set I use contains better and more detailed measures of people's general health, and adds indicators for high-prevalence serious health problems, including coronary heart disease, hypertension and type 2 diabetes. My analyses on different symptoms and age groups, moreover, closely follow, and confirm, specific predictions made by medical theory on how poor prenatal circumstances can lead to serious health problems much later in life.

The data I use consist of a cross-sectional sample of the population of Indonesia, which is the country with the largest Muslim population in the world. After showing that general health, especially that of older people, is negatively affected by exposure, I examine which aspects of health are affected. I find evidence that exposure leads to a higher likelihood of developing symptoms that are indicative for coronary heart disease, type 2 diabetes and kidney problems at older age. A point of overlap with Almond and Mazumder is that I also find a lower share of males among the exposed. This fits with medical theory, because in utero, males are more vulnerable to adverse conditions. Importantly, I investigate whether there are alternative explanations for these effects. I show that they are most probably not artifacts of selective timing of pregnancies: perhaps Muslims who care a lot about their offspring's health may avoid pregnancy during Ramadan. Using mother fixed effects and by comparing the characteristics of parents whose child was, vs. was not, in utero during a Ramadan, I refute this alternative explanation. Also, throughout this paper, to rule out that effects of Ramadan during pregnancy are caused by correlated common shocks to birth cohorts, I show that no effects of timing of Ramadan are found on non-Muslims.

The paper is structured as follows: [Section 2](#) gives background information on Ramadan and explores Muslims' beliefs on observing the Ramadan fast during pregnancy. [Section 3](#) discusses medical theory on how maternal fasting during pregnancy may exert a long-term effect on the health of her offspring. [Section 4](#) describes the data used. [Section 5](#) presents the results. It starts with effects on general health and some checks on the robustness of the results found. It next deals with effects on the sex ratio and then focuses on specific diseases, including coronary heart disease, diabetes, hypertension and anemia. [Section 6](#) discusses the implications of this research. Throughout this paper, I will complement the analyses with information obtained from interviews I held in Indonesia during Ramadan 2008 with doctors, midwives, health workers and others. These interviews and the observations made in hospitals and health clinics during my visits are not representative for a complete Indonesian population, nor do they serve to replace any quantitative analyses, but they do often shed more light on the local situation and the beliefs and experiences of Indonesians.

2. Background

Ramadan is the holiest month of Islam. It is one of the five "pillars" of Islam that Muslims have to fast during this month. No food and drinks are to be taken from dawn to sunset. Smoking, sexual intercourse and, according to some interpretations, the taking of oral medicine are also forbidden during these hours. In the evening, the fast is broken with sweet drinks and snacks. This is a very social happening, in which family and friends come together. If a Muslim misses a day of fasting, (s)he has to make up for it on a later day and often pay a penalty that is used to feed the poor. The timing of the Ramadan follows the Islamic calendar. This is a lunar calendar and since, depending on the exact moon cycle, the year is about 11 days shorter than the commonly used Gregorian calendar, each year Ramadan starts about 11 days earlier. After a bit more than 33 years, Ramadan will start around the same Gregorian date again. This "shifting over the years" makes it possible to separate effects of Ramadan from seasonal effects, a strategy similar to the one applied in [Almond and Mazumder \(2011\)](#), which I exploit in this paper. Season of birth may have a strong own effect on later life health ([Doblhammer and Vaupel, 2001](#)), so that it is essential that the former effects are not confounded with the latter.

Ramadan lasts about 30 days, but both the exact start and the end date depend on moon sightings and cannot be predicted exactly in advance. Because Indonesia lies on the equator, daylight times and thus length of fasting, are about the same each year (about 13 1/2 h), irrespective of the Gregorian month in which Ramadan falls. This makes Indonesia very well suited for the study of these effects, because the effect of fasting (which can be assumed to depend on the length of fasting) will be the same for each cohort. Hence, my results are not biased by correlation between length of Ramadan in utero and age.

Certain people are excluded from the religious obligation to fast, including children under 12, the sick, the traveling, women who are breastfeeding young babies and women in their period. Pregnant women are allowed to skip fasting if they are afraid that fasting may harm their own health or the health of their fetus. According to most people, they then have to do the fasting later and often pay a compensation in food or money that will go to the poor. Some Muslims explain this regulation as an obligation for all pregnant women to fast, unless there are specific reasons for abandoning fasting. These reasons, according to Indonesian doctors I interviewed who adhered to this interpretation, include pregnancy complications and maternal health problems that existed already before pregnancy. Other Muslims have the interpretation that pregnant women in any case have a dispensation from fasting. Even women adhering to the latter interpretation often do choose to fast. Reasons include having to make up for the fast later on their own, instead of fasting together with the whole community and family, a loss of the feeling of Ramadan and not actively deciding to fast: it is just the normal thing to do ([Robinson and Raisler, 2005](#); [Mirghani et al., 2003](#)). For poor Indonesians, the obligation to pay a compensation may play a role, and in orthodox areas negative reactions from other people may do the same. Also, many women think that fasting during pregnancy is not harmful ([Joosop et al., 2004](#)) and some believe it even to be beneficial. This follows the general conviction among Muslims that Ramadan fasting is good for health and beneficial in general, as it is the wish of God that they fast. The belief that fasting during pregnancy is not harmful plays an important role in decisions to fast, since many Muslims believe that it is a sin to fast if this is harmful ([Robinson and Raisler, 2005](#)). On the other hand, some women I talked to who believed fasting to be obligatory during pregnancy, gave up fasting because they found it too hard to continue. A great majority of 70–90% of pregnant Muslim women do fast, as is evidenced by research from around the world,

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