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Fetus, Fasting, and Festival: The Persistent Effects of in Utero Social Shocks

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ABSTRACT

Fetus, Fasting, and Festival: The Persistent Effects of *in Utero* Social Shocks*

The fetal origins hypothesis (hereafter FOH), put forward in the epidemiological literature and later flourished in the economics literature, suggests that the time *in utero* is a critical period for human development. However, much attention has been paid to the consequences of fetal exposures to more extreme natural shocks, while less is known about fetal exposures to milder but more commonly experienced social shocks. Using two examples of under-nutrition due to mild social shocks, i.e. Ramadan fasting and festival overspending, this paper summarizes our current knowledge, especially the contribution from economics, and key challenges in exploring fetal exposures to milder social shocks. I also discuss the salient added value of identifying milder versus more extreme fetal shocks. Finally, implications are drawn on individual decisions and public policy to improve children's well-being before they are born or even before their mothers realize that they are pregnant.

JEL Classification: I14, I18, Z12

Keywords: *in Utero*, maternal fasting, Ramadan, gift, ceremonies, early childhood development

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1. Introduction

A burgeoning body of literature on the FOH suggests that the intrauterine environment, nutrition in particular, programs the fetus to future diseases (1,2). Economists have tested a broader version of the hypothesis with a wider range of fetal shocks and economic outcomes. Their results demonstrate that various environmental factors can impose long-term negative impacts on the developing fetus, including later-life health, cognition and socioeconomic status, regardless of whether catch-up growth is ultimately achieved (3).

Because it is impossible to test the hypothesis using human subjects in a controlled experiment, the literature largely relies on severe natural shocks, such as the Dutch Famine of 1944 (4,5), the Great Chinese Famine (6), the Leningrad Siege (7), the 1918 influenza (8), and the Chernobyl radioactive fallout (9) to identify the casual effect of prenatal exposures to malnutrition on long-term health outcomes. However, in the event of severe shocks, the presence of mortality selection may determine that only the healthier survive, therefore the FOH may not be observed (3). Exposure to milder shocks, however, might facilitate the testing of FOH as scarring effects among survivors are less likely to be offset by selective mortality in mild fetal exposures.

While studies based on extreme natural shocks have provided tremendous insight on the FOH in extreme events, several stylized facts determine that understanding exposures to milder shocks further contributes to the public policy. First, estimating the effects of mild exposures is conducive to cost-benefit calculation. On the contrary, immediate mortality and economic disruptions from extreme natural shocks are sufficient to imply that any reasonable measure to prevent such catastrophes is likely to pass a cost-benefit calculation. Therefore, showing additional damage to fetal health from extreme natural shocks does not make much difference in decision-making (3).

Second, the size of population vulnerable to milder shocks is tremendous and much larger than those suffering from more extreme shocks. For example, early-life rainfall affects adult health, education and socioeconomic status in the agrarian society (10). Mild social shocks can be of much wider historical and contemporary interest. For example, Muslims have been fasting during day light hours for 29-30 consecutive days each year for over 1,400 years during the Islamic holy month of Ramadan. Over 1.2 billion Muslims were potentially exposed to their mother's fasting *in utero* as about 75 percent of all pregnancies overlap with Ramadan. This

number is more than twice the roughly 500 million directly affected by the 1918 influenza and 240 times the roughly 5 million directly affected by the 1944 Dutch Famine - two extreme events that have received much attention by social scientists.

Moreover, while most people, even the poor, do not often suffer from natural shocks as severe as great famines, they live in communities with culture and social norms that may impose long-lasting influences on their daily lives. Recent studies leverage the sharp predictions of the FOH regarding timing of pregnancy relative to shocks to carefully evaluate milder and more commonly-experienced exposures *in utero* (compared to famine and pandemic), such as air pollution, climate change, economic downturns, and maternal stress. Compared to these shocks, mild social shocks, such as fasting due to faith traditions and gift and festival spending, have received much less attention as it can be hard to realize culture and social norms are killing.

Fourth, in contrast to exposures to extreme natural shocks or war, mild behavioral choices, including food and nutrients intake, made during pregnancy on children are more under the control of decision makers such as mothers. The FOH implies that one can effectively help children (throughout their life course) by helping their mothers.

2. *In Utero* Exposure to Maternal Fasting

Fasting, in the form of restricted caloric intake, has been practiced since time immemorial in the East and the West by people with distinct faith traditions (11). Apart from Muslims fasting during Ramadan, Baha'is during Ala, Christians during Lent, Hindus during Durga Puja Navaratri, Jews during Yom Kippur, even one in four pregnant women outside faith traditions in the U.S. skip meals to restrict weight gain (12).

Fasting during pregnancy may cause "accelerated starvation" on the mothers and fetal damage (13). First, fetal under-nutrition leads to developmental adaptations that are beneficial for short-term survival but affect the general growth of the fetus and later in life, such as kidney diseases, type 2 diabetes, and coronary heart disease. Second, nutritional restrictions hamper the development of a placental enzyme that is required to convert cortisol into inactive cortisone, thereby exposing the fetus to excessive amount of cortisol (a stress hormone that potentially programs health in adulthood) during pregnancy. This exposure further leads to a reprogramming of the hypothalamic pituitary adrenal axis (HPA), which is linked with type 2 diabetes, high blood pressure, and cognitive impairment (14,15,16,17).

The economics literature has focused on *in utero* exposure to the Islamic holy month of Ramadan during which millions of Muslims worldwide, including pregnant women, fast each year. Empirical evidence on Ramadan fasting comes from Muslims in multiple countries, including the U.S., the UK, Indonesia, Iran, Uganda, Iraq, Pakistan, and Bangladesh. Results show that exposure to maternal fasting during Ramadan has adverse effects on fetal health and beyond, such as fetal breathing, fetal heart rate, admission to the special care baby unit, mental and psychomotor development, symptoms of coronary heart problems, and type 2 diabetes in old age (18,19,20,21). Meanwhile, empirical evidence, especially from economic studies, suggests a persistently negative impact on childhood and adult life, such as birth weight, language ability during early childhood, number of males compared to females, learning disabilities for adults, crude wealth measures, general health, and math and reading test scores for children (12,22,23).

Several challenges impede this important research field from further advance. First, the economics literature rarely tests the exact channels whether Ramadan observance alters timing of food intake, diet quality, or caloric quantity and their relative importance in influencing fetal health. The identified overall impact may contain both the direct fasting effect and indirect effects due to Ramadan observance. While some studies find calorie deficiency over a 24-hour period encompassing Ramadan fasting (24), the evidence is mixed and subject to dietary customs. A change in the eating behavior that involves eating greasy, oily or other unhealthy foods may cause more harm than calorie restriction. Fasting may also affect fetal growth via altered timing of nutrients intake that affects blood chemistry, such as reduced blood glucose, even if the overall quantity and quality of food intake is unaffected (12). Moreover, the effect of Ramadan fasting seems not consistent with typical acute famine (25). Overall, richer and higher frequency food intake data from various Muslim countries is required to match with Ramadan observance to examine the precise mechanism(s) at work.

Second, economists generally make use of overlaps between Ramadan and pregnancy to estimate an intent-to-treat (ITT) effect of exposure to Ramadan, which may suffer from measurement error in treatment as actual Ramadan observance can be different. Information on religiosity may help mitigate this error. Religiosity may also aid in identifying potential heterogeneity in treatment and therefore reassure us that fasting due to religious faith is the pathway. However, actual Ramadan observance often suffers from selection bias and does not help improve identification.

Third, unobserved time-invariant family/mother characteristics may bias Ramadan fasting effect through selective timing of pregnancy, gap between actual and potential Ramadan fasting, etc. To mitigate this concern, some studies examine whether observable characteristics can predict the timing of pregnancy relative to Ramadan but fail to find any systematic correlation (12, 22, 23). Another remedy lies in comparing biological siblings potentially exposed to maternal Ramadan fasting with those who were not to remove these unobservables. Most existing studies do not apply this strategy as few datasets follow biological siblings, especially over a long period. An exception is (22).

Moreover, there has been mixed evidence on compensating and reinforcing investment responses to shocks during early childhood development (26). To the extent that mothers may minimize health consequences via making compensating investment in the fetus, the estimated effect of Ramadan might be biased toward zero. More attention, however, should be paid to potential overestimates of the effect if reinforcing investment dominates.

Fifth, no study to date has evaluated Ramadan exposure for same people across distinct stages and multiple dimensions of the life cycle. We do not know, for example, whether it persistently affects fetal health, cognitive and non-cognitive skills formation during childhood, and labor market performance and well-being during adulthood.

Furthermore, Ramadan fasting generates heterogeneous effects for different outcomes, and different periods of gestation matter differently for different outcomes. For example, unlike the Dutch Famine, the mixed evidence in the Ramadan literature cannot isolate fasting effects by trimester on low birth weight or cognitive function (12,13). Future studies should try to achieve internally coherent and robust estimations.

Lastly, the credibility of the Ramadan design depends heavily on disentangling season of birth/conception effects from Ramadan exposure. Since Ramadan occurs throughout the Western calendar year, studies have to use a large number of birth cohorts. Studies that cover very few cohorts for whom Ramadan concentrated over a few months may suffer from seasonality bias. Some of the remedies include controlling for season of birth dummies, difference-in-difference with non-Muslims or placebo tests on non-Muslims.

3. *In Utero* Exposure to Ceremonies

Participating in and presenting gifts at funerals, weddings, and other events held by relatives, friends and neighbors have been regarded as social norms in many parts of the world for thousands of years (27). Part of the reason is that individuals do not want to lose face when the social custom is to spend a lot on such occasions (28). Avoiding being isolated from informal networks and signaling socioeconomic status may also contribute to the observed pattern. Different from Ramadan fasting due to faith traditions, festival overspending, shaped by social norms, affects fetuses through tightened budget of gift presenters that may squeeze out basic consumption of their pregnant wives.

Apart from its well-documented function of strengthening social networks to pool future risks and smooth future consumption (29,30,31), gift-giving defrays part of the large cost of a ceremony (32). However, in order to receive a gift, certain occasional events, such as weddings, funerals, and childbirth, have to occur in this family. Thus, gift-giving is not very reciprocal for many people who have to contribute without receiving any gift for years. Presenting gifts can be of huge burden in years with frequent social events. Even in the ideal case when gift-giving in a community is perfectly reciprocal, a receiver has to pay back gift later according to the escalating market price (33,34). Moreover, ceremonies are often very costly. Ceremonies on average cost more than twice the gifts received or several times of average income and become even more costly, making hosting ceremonies a net loss of money, let alone the inflated gift debt to be paid back later (35). People spend most time during ceremonies exchanging toasts and speeches, and much of the food served is wasted. Due to the large cost incurred during ceremonies, gift exchanges do not net to zero in each community. Though gift-giving activities have become more and more costly as a result of rapid economic growth in developing countries, the customs have evolved over hundreds of years and may adapt to rapid economic changes at a slower pace.

Participating in social occasions is especially burdensome for the poor. Because the poor often lack the necessary resources, they are forced to cut back on basic consumption in order to afford a gift to attend social festivals. In South Africa and Ghana, poor families often spend so lavishly on funerals that they skimp on food for months afterwards (36,37). Families in rural China are unable to afford a refrigerator yet spent on gift they can barely cover (38). Costly entertainment, social festivals and malnutrition are ubiquitous in many developing countries (39). An unresolved puzzle states that children's calorie consumption and nutritional status have barely improved in the past decades in some fast growing developing countries (40). Though a

well-preserved tradition of festival spending is unlikely to be the most important contributor to the observed puzzle, large and escalated gift and festival spending to some extent may prevent more economic resources from being spent on improving maternal nutrition status during pregnancy (27). However, rich datasets on food consumption and festival spending from multiple fast developing countries are required to test this hypothesis.

One important issue with the identification of milder shocks, especially the ceremony case, is that the shocks are more diffused in terms of timing, so that comparisons are less sharp. Fortunately, similar to the relatively fixed timing of Ramadan each year, ceremonies in countries under investigation tend to be organized around the major festival when migrants come back to celebrate with income earned during the year. Meanwhile, the nearly universal ceremony participation and gift-giving mitigate the concern of endogenous fetal exposure to ceremonies. Moreover, selective pregnancy timing are ruled out for both Ramadan and ceremonies studies. The still large estimated effects of milder fetal health shocks suggest that it is possible to consider milder and more common social exposures.

Collecting data from impoverished rural China that experiences high income growth, it is found that families cut basic food consumption, especially cash food expenditure that more directly compete with cash gift-giving, and increase gift and festival spending when they are exposed to frequent social events hosted by fellow villagers. Moreover, those born to mothers who were exposed to frequent social events during their pregnancies are more likely to display higher rates of stunting at age five (41). Compared to other shock exposures in the literature, the cumulative impact of gift and ceremony spending on the poorest households in rural China is even bigger than that of civil conflict or crop failure in Rwanda (42) and may have a far-reaching negative impact on cognitive development and educational achievements (43), adult height, income and asset accumulation, risk of obesity, and diabetes and hypertension in later life (2).

4. Discussion and Policy Implication

Rituals and norms during pregnancy can have persistent effect in the life course through, for example, fasting and festival overspending that squeezes out basic food consumption. Recent studies on mild social shocks have enriched our understanding of the earlier FOH literature, of which the implications have mainly revolved around averting famines or pandemics during pregnancy. The finding that mild social shocks matter justifies a role played by policy that

targets other types of nutritional interventions. Though this paper focuses on Ramadan fasting and festival related undernutrition, their implications may extend to other policy areas and are of interest to not only academics, policy makers, but current and future mothers.The grave consequences of *in utero* exposure to mild social shocks on the life course suggest that fasting and festival overspending during pregnancy (and during child-bearing age when many women are unaware of the early pregnancy) should be discouraged. Even if public health may not be a priority for policy makers in many developing countries, as reflected in their low government health budgets, the fact that economic outcomes are affected by the fetal environment makes a stronger case for improving reproductive health on a purely economic basis.

Existing public health interventions may provide effective channels through which social shocks *in utero* can be mitigated. For example, the World Bank's Safe Motherhood Program in Indonesia seeks to improve the quality and quantity of midwives in developing countries. Access to midwives may lead to more informed health choices, which may contribute to optimal fasting and minimize losses for children from maternal fasting and malnutrition during pregnancy. Meanwhile, this facilitates new interventions, such as through media highlights, to promote awareness about the adverse health and socioeconomic effects of maternal fasting and malnutrition during pregnancy. Moreover, this may encourage husbands to take their pregnant wives to the local doctors for regular health checks in general, and during Ramadan, in particular. Further, worship leaders can be encouraged to raise awareness on this issue during preaching and allow delayed fasting when negative health effects are detected, as allowed by the Islamic law.

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