International Journal of Development and Conflict
9(2019) 19–42

PRENATAL STRESS AND BIRTH WEIGHT: EVIDENCE FROM THE EGYPTIAN REVOLUTION

RONIA HAWASH*
Assistant Professor at Butler University,
Lacy School of Business,
4600 Sunset Avenue,
Indianapolis, Indiana 46208.

The Egyptian Revolution that ignited in January 2011 resulted in intense violent conflict between protestors and former regime allies. This generated a significant amount of fear and stress among people who lived in proximity to such events. We use this exogenous shock as a natural experiment to test the causal relationship between prenatal stress and birth weight. *Governorate*-level fatalities resulting from this conflict will be used as an exogenous indicator for prenatal stress. Using fixed effects and difference-in-difference analysis, results show that higher prenatal stress resulting from political conflict during the first and second trimesters of pregnancy has a significant negative impact on child birth weight. This finding is robust to restricting the sample to siblings' data and using mother fixed effects, suggesting that neither observable nor unobservable characteristics of mothers are driving the results.

Keywords: Stress, Pregnancy, Birth Weight, Violence, Egypt, Revolution

JEL Classification: D74, I12, I14, I18, J13

Introduction:

The fetal origins hypothesis argues that negative health shocks to pregnant women have adverse effects on fetus health. Empirical work supported this hypothesis showing that that there is a significant association between in–utero conditions and short-term and long-term health, educational and other socioeconomic outcomes. To capture the causal relationship between in-utero conditions and later outcomes, prenatal exogenous shocks have been used in an attempt to overcome selection problems prevalent in most of the association studies. In previous literature, famines experienced by pregnant women were used as natural experiments to show that children undernourished as a fetus have lower educational attainment (Almond, 2006; Almond, Chay, & Lee, 2005), higher risks of cardiovascular

*Email : rhawash@butler.edu

Declarations of Interest: None.
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

diseases (Roseboom *et al.*, 2000), and lower incomes and labor supply as adults (Chen & Zhou, 2007).

Other in-utero conditions such as prenatal stress are assumed by medical literature to have a negative impact on fetus. In fact, prenatal psychological stress has proven to increase the Corticotrophin Releasing Hormone (CRH) which is the hormone responsible for regulating the duration of pregnancy and fetal maturation (Glynn, et al. Wadhwa, Dunkel-Schetter, Chicz-DeMet, & Sandman, 2001; Wadhwa, Sandman, Porto, Dunkel-Schetter, & Garite, 1993). Other channels include neuroendocrine changes, lower immunity, and behavioral changes which are stimulated by prenatal stress and are expected to have a negative impact on birth outcomes (Dunkel-Schetter, 2010; Mulder et al., 2002). Accordingly, it is hypothesized by medical literature that mothers experiencing acute stressful events during pregnancy will have worse birth outcomes in comparison to pregnant women who have not been exposed to such stressful events.

Even though substantial empirical evidence has shown the negative impact of prenatal undernourishment on child health, studies investigating the causal relationship between prenatal psychological stress and child health at birth have been relatively limited. The main problem with examining the causal relationship between both variables is the “selection / omitted variable bias” problem which suggests that pregnant women reporting high levels of stress may also be characterized by other observable and unobservable attributes that may also lead to worse birth outcomes. Natural experiments, a recently popular method used in economics literature, are an attempt to minimize the selectivity problem by exploiting a random shock that becomes a source of exogenous variation in the “treatment” under examination. Hurricanes (Currie & Rossin-Slater, 2013), earthquakes (Torche, 2011), terrorist attacks (Camacho, 2008), wars (Mansour & Rees, 2012), recessions (Bozzoli & Quintana-Domeque, 2014), and racial discrimination against Arabs after the September 11th attack in 2001 (Lauderdale, 2006) have been used as natural experiments to identify the causal relationship between prenatal stress and birth outcomes. However, some of these exogenous shocks have their own problems as identification strategies. For example, natural disasters usually take place in regions prone to such disasters which make it to some extent expected by pregnant women. Accordingly, they may take their precautions against such disasters or migrate to other regions. Furthermore, recessions last for a long period resulting in not only higher stress but also other financial problems including unemployment and lower incomes which in turn affect a child’s health outcomes. The same applies to wars that lead to family displacements and difficulty of access to health services and prenatal care. Along with stress, all of the previous conditions are also expected to negatively affect child health.

In this study, the violent events associated with the Egyptian Revolution that ignited in January 2011 will be utilized as a relatively clean exogenous shock that is highly correlated with prenatal stress and at the same time avoids some of the problems associated with other identification strategies that have been used in previous studies. To our knowledge, this is the first study to investigate the impact of the 2011 Egyptian Revolution on birth outcomes. As a violence indicator and proxy for prenatal stress, the study uses the number of fatalities from the first day of the Egyptian Revolution on Jan 25th, 2011 until August 14th, 2013 (the break-up of the sit-in in Raba'a Square). The strength of this identification strategy is that the violence episodes taking place at the time of the revolution were random, unanticipated, short and extremely violent which makes it a good indicator for acute stress. Accordingly, these episodes are assumed to be exogenous and uncorrelated to any other unobserved factors affecting child birth weight. The study uses the number of fatalities that ranges from deaths due to the security vacuum, armed attacks from authorities or thugs, brute force by authorities in prisons, or curfew violations as the indicator for prenatal stress. It is worth noting that such fatalities have been experienced all over the country but with different levels of intensity varying by time of birth and location which resembles a quasi-experimental setting design.

Results of the study indicate that the first and second trimesters are the most critical and vulnerable to prenatal stress since they lead to lower birth weights of offspring. These results are in consensus with other previous studies that have identified the early trimesters of pregnancy as the most sensitive to prenatal stress (Torche, 2011; Camacho, 2008; Mansour & Rees, 2012) and are robust to using mother-fixed effects estimations.

2. The 2011 Egyptian Revolution:

Prior to the Egyptian Revolution that first sparked in January 2011, the Egyptian economy was showing reasonable progress in terms of GDP growth, foreign investments, and export promotion. However, the marginalized majority of Egyptians did not realize the fruits of this progress in a political system that favored only a thin social slice of the society; namely, corrupt politicians and their businessmen allies (Rodenbeck, 2010). In other words, Egypt suffered from significant income inequality, social injustice, and government corruption. Losing hope in a promised 'trickle down' effect has generated a general frustration among the more educated and active youth. People were also fueled by the police forces' frequent violations to human rights and their forceful abuse of power against people. Thanks to the spread of the internet access and social media, this anger was disseminated among the Egyptian youth who decided to revolt against prejudice calling for "Bread, Freedom, and Social Justice" (Minatullah Sohail & Chebib, 2011; Kinninmont, 2012).

On January 25th, millions of Egyptians took the streets calling for the end of the Mubarak era and more social justice. Tensions between the police forces and protestors at some points in time escalated resulting in extreme violence break out. The intensity of such conflicts varied across *governorate*s; however, Cairo where Tahrir Square was the focal point with millions of protestors, faced the highest levels of violence. On January 28th, this is also known as the "Friday of Anger", hundreds of thousands of people streamed out of mosques after the Friday noon prayer. Severe conflicts took place between the police forces and the protestors which consequently led to burning prisons and the ruling party headquarters. The police withdrew from the streets and the army became in charge of the security role (Kirkpatrick, January 28th 2011). Killers, thieves and thugs took control of the streets with complete access to the stolen weapons of the police forces. Consequently, the Egyptian streets suffered from a "severe security vacuum" resulting in Egyptians under risk of being hijacked, killed or kidnaped by escaped criminals. Families had to protect their own properties and houses with no support from the police forces (Kirkpatrick, January 29th 2011). During the 18 days ensuing, over a thousand protestors including women and children were killed and more than 6 thousand protestors were injured (The Guardian, February 2nd 2011). Such circumstances created significant acute stress and fear for those who live in proximity to such situations. On February 11th, 2011, former president Hosni Mubarak stepped down and people were celebrating their glorious victory all over the country. However, overthrowing Mubarak from power turned out to be only the first wave of violence people experienced.

A second wave of tension took place after the Supreme Council of Armed forces (SCAF) became in power. People started accusing the military for being tardy to hand the state to civil rule claiming that they had their own ambitions to stay in power. Few, relatively mild, episodes of violence took place during this period until the election of former president Mohamed Morsi in June 2012. As the Muslim Brotherhood came into power, a lot of tension took place between the secular forces and the Islamists leading to hundreds of demonstrations in Cairo and Alexandria. Secular forces supported by the military were able to overthrow Morsi from presidency in June 30th 2013 (Khosrokhavar, 2014). However, Morsi's supporters rallied in Cairo and Giza refusing to leave until Morsi returns as the legitimate president. On the 14th of August 2013, the military united with the police forces and broke up the sit-in of the Muslim brotherhood supporters which resulted in a high death toll reaching more than 1,000 fatalities (Human Rights Watch, August 12th 2014). Such random, intense, and short violence episodes are expected to be associated with high levels of stress within the country. We use these violence episodes in which women are at different stages of their pregnancies at times with more or less violence as a natural experiment to examine the causal relationship between prenatal stress and birth weight.

3. Previous empirical literature on prenatal stress and birth outcomes:

Natural disasters have previously been used as natural experiments in an attempt to capture the causal relationship between prenatal stress and birth weights. Torche (2011) uses the Tarapaka earthquake in Chile as an exogenous source of variation in acute maternal stress during pregnancy and examines its impact on birth weight and gestation age at birth. Using measurements of the intensity of the earthquake, Torche (2011) divided pregnant women into three groups: high, moderate, and low intensity of stress. Difference-in-difference estimations have shown that the first trimester is the most critical phase in pregnancy, as those exposed to high intensity of stress in the first trimester are born on average 51 grams less than those unexposed to the earthquake. This effect has been mediated by a lower gestational age rather than a slower intrauterine growth. Currie and Rossin-Slater (2013) use the universe of birth records of Texas births to identify the impact of mothers living in proximity to major hurricanes on birth outcomes including birth weight, gestation, and abnormal conditions of new born. They were able to account for mothers' migration by following them overtime using the birth records. Using siblings' data, they conclude that impacts of prenatal stress on birth weight and gestation are sensitive to the econometric specification. Yet, more robust results have shown that women living within 30 km of a major hurricane during the third trimester are 60 percent more likely to have a newborn with abnormalities and 30 percent more likely to have complications during delivery.

Other studies use terrorism as an indicator for prenatal stress. Camacho (2008) examines how landmine explosions during pregnancy affect birth weights in Colombia. Using residence and mother fixed effects, the study concludes that exposure to stress during early pregnancy, particularly the first and second trimesters, result in a lower average birth weight. Results indicate that children who were born in regions with at least one landmine explosion in each trimester of pregnancy are born with, on average, 27.76g lower weights than those unexposed to any explosions. Moreover, children who were exposed to landmine explosions in the first and second trimesters weighed 8.7 grams less at birth than their siblings who were not exposed to any landmine explosions in utero. Accordingly, he deduced that early phases of pregnancy are the most affected by prenatal stress. Yet, no significant impact was found on the incidence of low birth weight. Mansour and Rees (2012) use al-Alaqsa Intifada to examine how pregnant women's exposure to armed conflict affects birth weight. Using fixed effects estimations, the results indicate that higher conflict related fatalities 9 to 6 months before birth is associated with a small higher probability of low birth weight. Another study by Lauderdale (2006) examines how stress arising from discrimination may affect birth outcomes. The study uses the post-September 11th attack resentment towards Arabs as a natural experiment to compare birth outcomes of Arab-origin women in California to outcomes of similar women who were pregnant one year earlier. Using California birth certificates, the study identified the origin of the mothers using names for ethnic identification. Results of the logistic regression indicated that the relative risk of poor birth outcomes such as preterm birth and low birth weight have significantly increased for Arabic-named women after the attack. However, the study did not identify which trimester was the most critical. Catalano and Hartig (2001) use communal bereavement arising due to the murder of the Swedish prime minister and the sinking of the Estonia ship as exogenous sources of stress. Their results showed that fetuses whose mother experienced the assassination in the third trimester and those whose mothers experienced the sinking ship in the second trimester are at higher risk of being born at a very low weight.

Several insights may be drawn from the previous literature on the impact of stress on birth outcomes. First, it is important to differentiate between chronic and acute stress. With the exception of wars and racial discrimination, most of the natural experiments used in previous studies investigate acute stress rather than chronic stress. Second, there is mixed evidence on which trimester is the most critical during pregnancy. While some studies have considered early pregnancy as the most critical (Camacho, 2008; Mansour & Rees, 2012, Torche, 2011), other studies show that the later phases of pregnancy, namely, the third trimester as the most sensitive to stress (Catalano & Hartig, 2001; Currie & Rossin-Slater, 2013). Finally, sources of stress differ from one study to another ranging from stress due to natural disasters, political conflict, communal bereavement, and racial discrimination. It is important to take the source of stress into account since each of these identification strategies has its own limitations which may affect the results of the study.

4. Identification Strategy:

Violence episodes during the Egyptian Revolution tend to be random, unanticipated, and sporadic. Figure 1 displays the monthly distribution of fatalities during the period from January 25th, 2011 till September 30th, 2013. With the exception of the first 18 days of the revolution, periods between violence episodes were characterized by being almost normal denoting people returning to their regular everyday life routine. The highest spikes occurred in particular incidents specifically, January 28th and January 29th, 2011, well-known as the "Friday of Anger", more than 700 fatalities took place all over the country. We call this incident "Shock 1". The second shock which is considered to be the most violent episode during that period was the mass killing of the supporters of the former President Morsi whose death tolls exceeded 1,000 supporters between August 14th and August 16th of year 2013. By observing Figure 1, it can be noticed that there is no clear pattern for the incidence of violence overtime which confirms the study's assumption of randomness of the shock to prenatal stress.

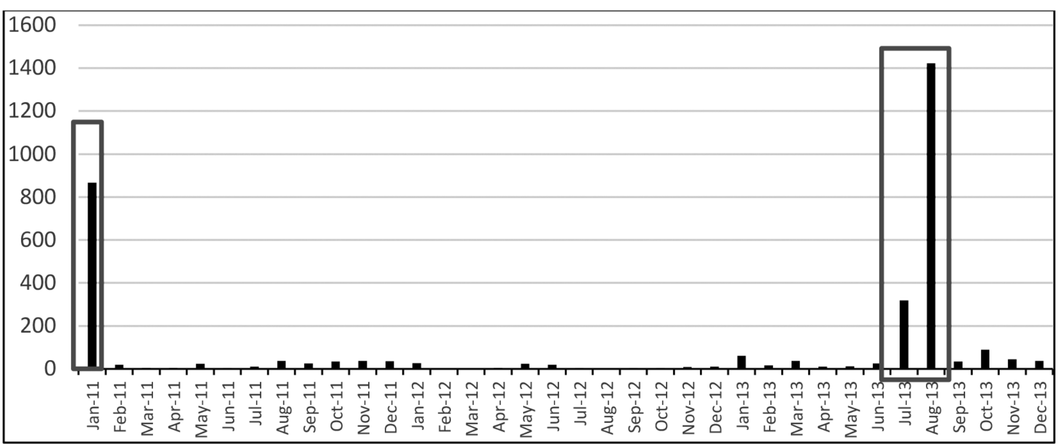

Figure 1: Total Fatalities from January 2011 to December 2013

*Governorate*s have shown substantial variation in the number of fatalities over the period of study as shown in Figure 2; however, that the majority of fatalities were concentrated in Cairo, more specifically Tahrir Square. Accordingly, the number of fatalities by *governorate* may be considered to be a good indicator for an exogenous shock to prenatal stress. Considering the random nature of the violence episodes and its intensity, we assume the number of fatalities by *governorate* as an appropriate indicator for prenatal stress. In other words, the we assume that the higher the number of fatalities in the *governorate* of residence, the higher the stress levels of the pregnant woman.

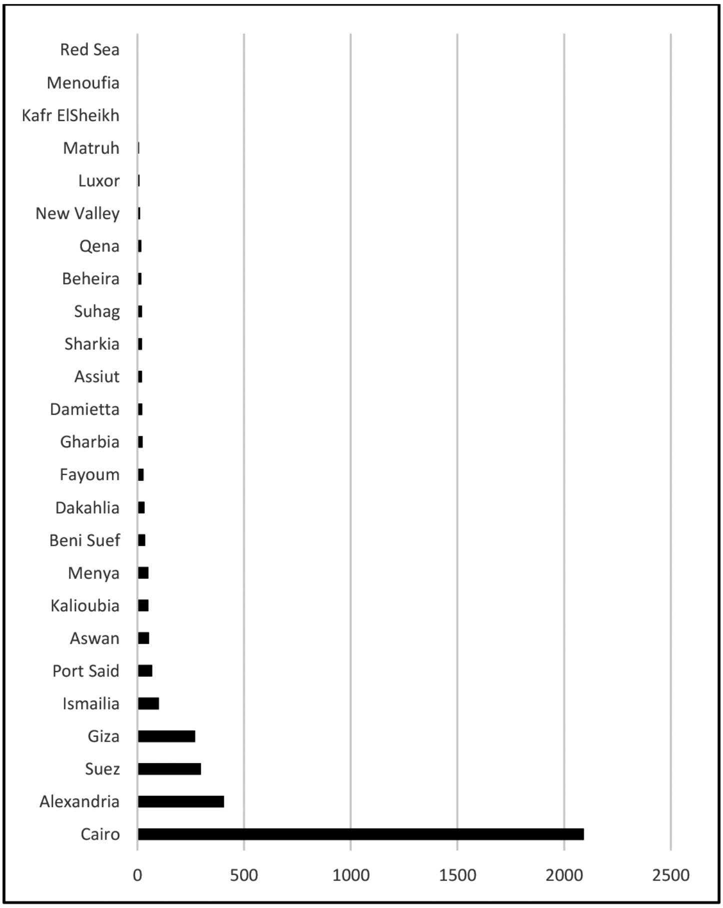

Figure 2: Total Fatalities during the period Jan 2011-August 2013 by governorate

There are several limitations in the study's identification strategy. *First,* the revolution had a negative impact on the economy. However, the adverse economic spillover effects were on the aggregate level; in fact, the *governorate*s most affected were those depending on tourism as a source of income such as Luxor, Aswan, and Red Sea. Yet, those touristic *governorate*s were also those with the minimum number of fatalities during the revolution. Accordingly, if there is any bias in the estimates, it should be downwards. Moreover, the regression controls for *governorate*-level unemployment rates in the year of birth to minimize any bias arising due to worse economic conditions. *Second,* the DHS datasets only report the date of birth and not the date of conception. As a result, to determine the trimester of exposure we count backwards from the date of birth which means that we must *defacto* assume that babies born in month t were conceived at month *t-9*. *Third,* the dataset used does not include any information on the history of women migration. It is assumed, thus, that the mother's location of residence is where the child was born. However, in Egypt, like many other developing countries, migration is usually from rural to urban *governorate*s. In other words, migration will be from the areas with lower levels of violence exposure to others with more intense violence episodes. Accordingly, the existence of migrant women in the dataset used who were pregnant in rural areas but report to be currently living in urban areas may lead to an underestimate of the impact of the shock on birth weight.

5. Data and Methodology:

To examine the impact of prenatal stress on birth weight, the Egyptian Revolution is used as an exogenous shock to the stress levels experienced by pregnant women. In this study, two datasets have been used. The first dataset is the Armed Conflict, Location and Event Data Project (ACLED) which captures all reported political events since 1997. ACLED is a database that is publicly available that collates political conflict and violence events in real-time based on media, news, and non-governmental organizations reports across Africa, South Asia, South East Asia, Middle East, Europe, and Latin America[1]. Events reported include type, location, and date of event, actors involved, number of resulting fatalities, and a brief description of the event. The data used in this paper include detailed information on each fatality since the first day of the revolution (Jan, 25th, 2011) until the break-up of the sit-in of the supporters of the former president Morsi in August 2013.

The second dataset used is the Demographic and Health Survey for Egypt (EDHS) in year 2014 from which child birth weight and other control variables are derived. The 2014 survey is the first and latest survey administered after the 2011 Egyptian Revolution. EDHS is a nationally representative survey conducted on both household and individual levels; however, its main focus is on women of reproductive age (15-49 years old). EDHS includes information on the socioeconomic status of respondents including education of members of households, assets owned (wealth index), and characteristics of household dwelling unit. It also includes a rich database of health indicators including: fertility, health status, family planning, HIV awareness, in addition to anthropometric measures such as: height and weight of adults and their children. For the purpose of this study, we look at the Birth Recode file published by EDHS in which observations are at the birth level. This file includes birth weight, date of birth, and location of residence of the child reported by the mother. Reported birth weights are for children who are 5 years old or younger at the time of the survey. Accordingly, births included in the survey whose birth weights are reported are born between May 2009 and June 2014 which implies that the sample includes births that were unexposed to political conflicts as fetus and others that were exposed for 1, 2, or 3 trimesters.

---

1. ACLED receives financial support from the Bureau of Conflict and Stabilization Operations (CSO) at the U.S. Department of State, the Dutch Ministry of Foreign Affairs, the Tableau Foundation, the International Organization for Migration (IOM), the University of Texas at Austin and the U.K. Department for International Development (DFID).

Given the availability of data on fatalities by month and *governorate*, we exploit such differences to identify the level of stress a pregnant mother is exposed to during each trimester by linking the date and location of fatality with the trimester of pregnancy. The number of fatalities by month and *governorate* are first identified. Afterwards, we identify the number of fatalities each mother has been exposed to during each month of pregnancy. Then we sum the number of fatalities in each trimester of pregnancy for each mother based on the month of child birth and their location of residence. Accordingly, exposure to prenatal stress has been identified by the child's birth date and governorate of residence. Births in Egypt, like most of the other developing countries, may not take place in a hospital or a clinic. In fact, in most of the rural areas' births take place at home. Consequently, birth weight is recalled by the mother rather than stated in official vital records. Out of the 15,842 births included in the DHS sample, 4,403 births were not weighed at birth and 1,879 births' weight were not recalled by the mother. Accordingly, the sample size for which data for birth weight was available was equal to 9560 births. 4 births were recorded as less than 1000 grams at birth and therefore we dropped them reducing the sample to 9556 births. Only singleton births are included in the analysis, so the aggregate sample is reduced to 9131 births which include births with and without siblings. Records not including parents' education, mother's age at birth, number of prenatal care visits and other controls were dropped from the sample reducing it to 9057 births born to 7066 mothers.

The births dataset in EDHS reports children who are 5 years or younger at the time of the survey (i.e. born between May 2009 and June 2014). For each mother included in the survey, data on each child born in the aforementioned period is reported including the gender, birth order, birth weight, etc. The number of births by each mother in the dataset ranges between 1 and 4 births. To control for time invariant mother and family characteristics, a more restricted sample is used in which *only mothers who had two or more births are included; whereas mothers who had only one birth are dropped from the sample*. This reduces the sample size from 9057 to 3850 births and reduces the number of mothers in the sample from 7069 to 1862 mothers. The restricted sample is an attempt to control for the genetic, social, and economic time-invariant characteristics of the family that may have a potential impact on birth weight.

The births included in the sample took place in 25 *governorate*s and were evenly distributed as shown in Table 2. Descriptive statistics of the exposure to fatalities by trimester, birth weight, and mother and child characteristics are shown in Table 3. Based on the date of the child's birth, some of the mothers were exposed to the violence shocks during pregnancy and others were not exposed. The intensity of exposure to violence differs by time of pregnancy and location. As shown in Table 3, across the whole sample (whether the mother is exposed or not), the average number of fatalities ranges between 13 and 14 per trimester. The average number of fatalities for mothers that had any exposure to violence range between 32 and 44 fatalities per trimester. The average birth weight in the sample is 2900 grams where 13% were reported to be born with less than 2500 grams and 10% were reported to be born at 2500 grams[2]. 47% of the births sample is females. Average number of years of education is 9.6 for mothers and 9.7 for fathers. Mothers' age at birth ranges from 13 to 47 years old with an average of 26 years old.

Table 1: Distribution of births and mothers

	No. of Births	No. of mothers
1 birth to each mother	5207	5207
2 births to each mother	3468	1734
3 births to each mother	372	124
4 births to each mother	16	4
Total	9057	7069

Table 2: Distribution of births across governorates

Governorates	No. of Births	Percent
Damietta	544	6.01
Sharkia	492	5.43
Cairo	489	5.4
Suez	481	5.31
Behera	478	5.28
Fayoum	432	4.77
Dakahlia	412	4.55
Giza	405	4.47
Assuit	402	4.44
Menoufia	396	4.37
Menya	367	4.05
Qena	367	4.05
Port Said	366	4.04
Kafr el-sheikh	366	4.04
Kalyubia	364	4.02
Gharbia	342	3.78
Ismailia	342	3.78
Beni Suef	328	3.62
Aswan	316	3.49
Suhag	311	3.43
Alexandria	304	3.36
Luxor	298	3.29
Matruh	222	2.45
Red Sea	144	1.59
New Valley	89	0.98
Total	9,057	100

[2] The definition of low birth weight by the World Health Organization (WHO) is being born at a weight of less than 2500 grams. https://www.who.int/nutrition/publications/globaltargets2025_policybrief_lbw/en/

Table 3: Descriptive Statistics of Full Sample (Weighted)

Variable	Obs.	Mean	Standard deviation	Min	Max
Birth weight (in grams)	9,057	2952.315	611.0291	1000	6000
Number of fatalities in first trimester across the whole sample	9,057	14.2	103.7747	0	1412
Number of fatalities in second trimester across the whole sample	9,057	13.6	103.6656	0	1384
Number of fatalities in third trimester across the whole sample	9,057	13.4	100.9615	0	1384
Number of fatalities in first trimester across the mothers exposed	2,292	44.3	167.268	1	1412
Number of fatalities in second trimester across the mothers exposed	2,401	37.8	162.181	1	1384
Number of fatalities in third trimester across the mothers exposed	2,883	32.2	145.1126	1	1384
Child Gender (Female=1)	9,057	0.4701	0.4991072	0	1
Birth Order	9,057	2.2945	1.326923	1	12
Mother's age at birth	9,057	26.5871	5.375233	13	47
Mother's years of education	9,057	9.6761	4.776616	0	19
Father's years of education	9,057	9.7760	4.818478	0	23
Mother's marital status (Married=1)	9,057	0.9860	0.1172858	0	1
Urban residence (Urban =1)	9,057	0.3568871	0.4790811	0	1
Had a minimum number of antenatal care visits (4 visits or more = 1)	9,057	0.8825024	0.3220123	0	1
Wealth Index	9,057	129.5468	120.631	100	5957
Unemployment rate in governorate	9,057	11.51539	3.69422	3.3	27.2

Two methodologies will be used in this study. The first methodology uses fixed effects regressions in which the number of fatalities per governorate per trimester over the period of January 2011 till August 2013 is used as a continuous indicator of prenatal stress. In other words, we are assuming that the higher the level of fatalities in the governorate in which the pregnant woman is living, the higher her stress levels are. Accordingly, the level of violence varies by location and the time of pregnancy and birth. We examine the causal relationship between prenatal stress and birth weight by estimating the model denoted in equation (1):

$$\beta_1 Frsttri_{ij} + \beta_2 Scndtri_{ij} + \beta_3 Thrdtri_{ij} + \gamma_1 X_{im} + \gamma_2 antenatal_i + \gamma_3 unemployment_{ij} + \delta_i + \alpha_i + \varphi_i + \pi_m + \varepsilon_{imj} \quad (1)$$

$Frsttri_{ij}$, $Scndtri_{ij}$, $Thrdtri_{ij}$ denote indicators for prenatal stress in the first, second and third trimesters respectively. As previously mentioned, this will be the number of fatalities in the *governorate* of residence during each trimester of pregnancy. *X* is a vector of parental and child characteristics that are expected to have an impact on birth weight including household wealth index, mother and father years of education, gender and birth order of child, age of mother at the time of birth, marital status of mother, and region of residence (urban or rural). A dummy indicating whether the pregnant woman had at least 4 antenatal care visits before delivery as recommended by the World Health Organization[3] is denoted by $antenatal_i$. The unemployment rate in the governorate of residence in the year of the child's birth denoted by $unemployment_{ij}$ is also included to control for the economic conditions at the governorate of residence in the year of birth. The subscripts *i* index the child, *m* to the mother and *j* to the area of residence.

To minimize any potential omitted variable bias, we include *governorate* and year of birth fixed effects to control for time-invariant unobservables varying by *governorate* and unobservable seasonal patterns of birth weight. For these estimations to be unbiased, we are assuming that shocks are homogenously perceived among all births within the same *governorate* and that there are no other confounding variables that vary at the *governorate*-quarter levels that also affect birth weights of offspring. In an additional specification, we include mother fixed effects to control for unobserved heterogeneity with respect to genetic endowments and other household-level time-invariant characteristics. This will be a more restricted regression that will be conducted on a smaller sample including siblings and controlling for time-invariant mother characteristics. It is assumed that mother unobservable characteristics that affect birth outcomes do not change over time.

The second methodology uses a difference-in-difference analysis in which we focus only on the two major violence shocks that took place during the period of analysis. The two major shocks are the first 18 days of the revolution in January 2011 and the break-up of the sit-in of the Muslim Brotherhood supporters in August 2013. As shown in Figures 3 and 4, there was a geographical variation in the level of intensity of violence during both shocks. The governorate characterized by being the most violent was Cairo in which "Tahrir Square" was located. On the other hand, there were governorates that were not exposed to any violence and no fatalities in any of both shocks. Accordingly, we use Cairo as the treatment group; i.e., the governorate exposed to the shock. And we use the governorates that have not experienced any fatalities in the violence shocks as the control group; i.e. the governorates not exposed to the shock[4]. Governorates who had some fatalities were dropped from the difference-in-difference analysis not to bias the results. In difference-in-difference analysis, it is assumed that with the absence of the shock the trend in the outcome variable will be the same for both the treated and the control groups. Therefore, we are assuming that the violence shock that took place was the only source of variation in prenatal stress between the treated and the control groups.

The date of birth of the child determines whether the fetus has been exposed to any of the violence shocks or not and whether the exposure was in the first, second, or third trimester. Since the shocks durations were very short (less than 18 days in the first shock and 2 days in the second shock), the exposure was very acute and intense. Based on date

---

3. http://www.who.int/gho/maternal_health/reproductive_health/antenatal_care_text/en/

4. Control governorates for the first shock are: Assiut, Aswan, Beheira, Damietta, Gharbia, Kafr El-Sheikh, Luxor, Matruh, Menoufia, New Valley, Qena, Sharkia, and Suhag. Control governorates for the second shock are Dakahlia, Luxor, Matruh, Menoufia, New Valley, Qena, Suhag, and Red Sea.

of birth, we determine if the shock took place in the first, second, or third trimester. The difference-in-difference approach exploits the difference in the trends of the birth weights across the treatment group (Cairo) and the control governorates (with no fatalities during the shock period). For both shocks, the before-period refers to the births born before the shock and the after-period refers to those born after the shock and exposed as fetus. The timeline for the before and after periods for both shocks are represented in Figure 5.

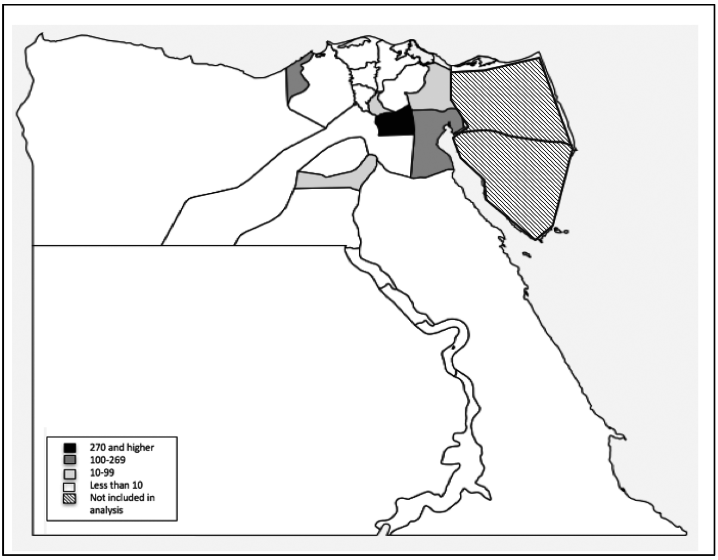

Figure 3: Geographical Distribution of fatalities during Shock 1 (January 2011)

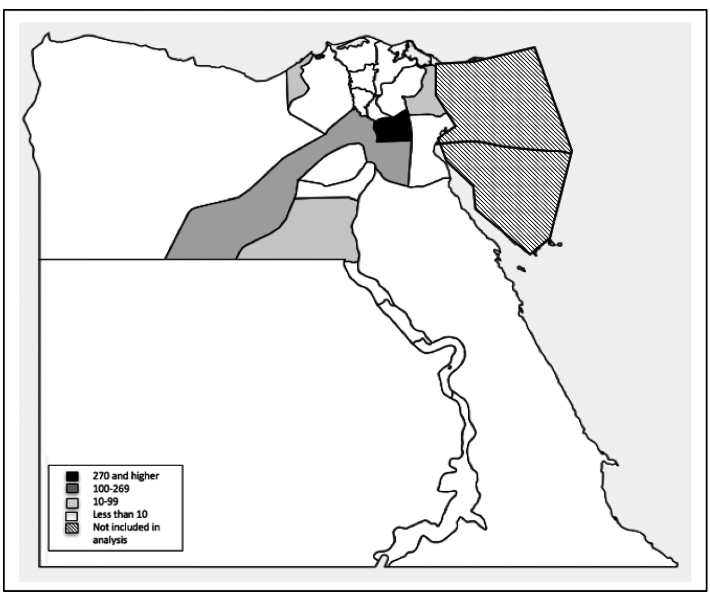

Figure 4: Geographical Distribution of fatalities during Shock 2 (August 2013)

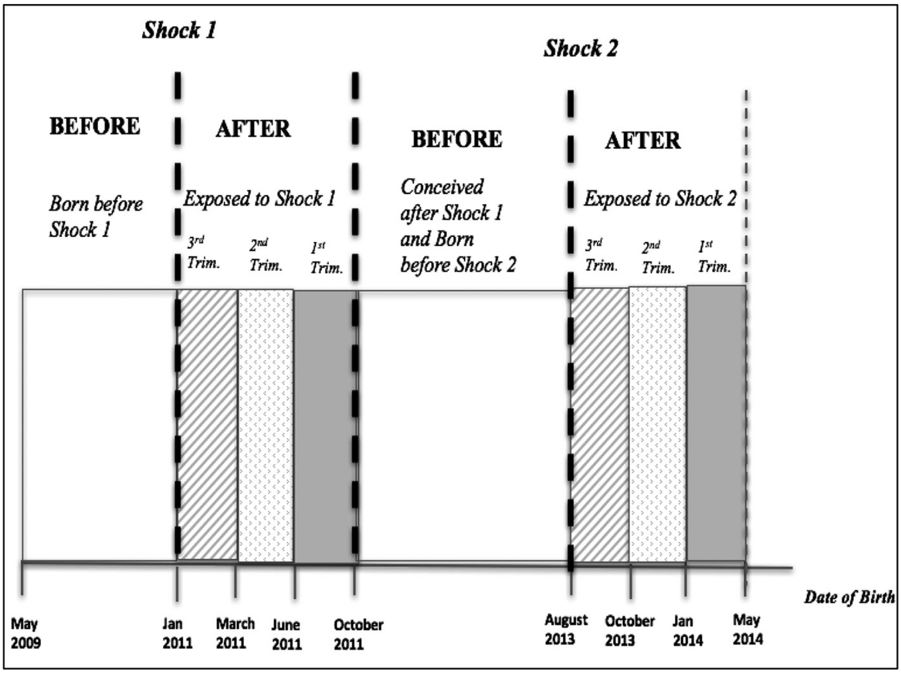

Figure 5: Timeline of Exposure to Shocks 1 and 2

In the difference-in-difference analysis, two regressions on two sub-samples will be conducted. The first regression will analyze the impact of shock 1 (January 2011) using the sub-sample of births between May 2009 and October 2011. In this regression, births between May 2009 and December 2010 are born *before* the shock (i.e. unexposed to the shock); whereas, those born between January 2011 and October 2011 were either exposed in the first, second, or third trimester. The number of observations in the first sub-sample is 2319 births. Descriptive statistics for this sub-sample is shown in Table 4.

Table 4: Descriptive Statistics of Sub-Sample used in Difference-in-Difference Analysis of Shock 1 (January 2011) 5

Variable	Obs.	Mean	Standard deviation	Min	Max
Birth weight (in grams)	2,319	2989.1860	599.5575	1000	6000
Births in treatment group (Cairo==1)	2,319	0.1376	0.3445	0	1
Child Gender (Female=1)	2,319	0.4708	0.4991	0	1
Birth Order	2,319	2.2374	1.3267	1	11
Mother's age at birth	2,319	26.3587	5.3533	13	46
Mother's years of education	2,319	9.6028	4.8283	0	19
Father's years of education	2,319	9.7645	4.8429	0	19
Mother's marital status (Married=1)	2,319	0.9815	0.1347	0	1

[5]. Descriptive Statistics of Births in treatment and control governorates born between May 2009 & October 2011.

Variable	Obs.	Mean	Standard deviation	Min	Max
Urban residence (Urban=1)	2,319	0.3293	0.4699	0	1
Had a minimum number of antenatal care visits (4 visits or more=1)	2,319	0.8784	0.3269	0	1
Wealth Index	2,319	117.0446	31.1043	100	646
Unemployment rate in governorate	2,319	10.1592	3.6645	4.1	25.8

On the other hand, the second regression will analyze the impact of shock 2 (August 2013) using the sub-sample of births between November 2011 and May 2014. In this regression, births between November 2011 and June 2013 are born before the shock (i.e. unexposed to the shock); whereas, those born between August 2013 and May 2014 were either exposed in the first, second, or third trimester. The number of observations in the second sub-sample is 1495 births. Descriptive statistics for this sub-sample is shown in Table 5. Note that the number of observations is highly reduced than that of the fixed effects regression because we include only Cairo as a treatment group and governorates with no fatalities as the control group. All governorates that had any fatalities were not included in the difference-in-difference analysis.

Table 5: Descriptive Statistics of Sub-Sample used in Difference-in-Difference Analysis of Shock 2 (August 2013)[6]

Variable	Obs.	Mean	Standard deviation	Min	Max
Birth weight (in grams)	1,495	2930.6390	572.4591	1000	5000
Births in treatment group (Cairo==1)	1,495	0.2763	0.4471497	0	1
Child Gender (Female=1)	1,495	0.4955	0.4999797	0	1
Birth Order	1,495	2.2742	1.292367	1	10
Mother's age at birth	1,495	27.0941	5.272734	15	47
Mother's years of education	1,495	10.3344	4.455537	0	19
Father's years of education	1,495	10.2398	4.595669	0	22
Mother's marital status	1,495	0.9882	0.1082031	0	1
Urban residence	1,495	0.4508	0.4975775	0	1
Had a minimum number of antenatal care visits (4 or more)	1,495	0.8878	0.3155823	0	1
Wealth Index	1,495	134.4253	118.2017	100	4397
Unemployment rate in governorate	1,495	13.1097	3.230213	7.7	21

Two separate regressions were conducted for each of the two shocks on two different subsamples using equation (2) shown below:

$$\text{BirthWeight}_i = \beta_1\text{Frsttri\_Dum}_{ij}*\text{CAIRO} + \beta_2\text{Scndtri\_Dum}_{ij}*\text{CAIRO} + \beta_3\text{Thrdtri\_Dum}_{ij}*\text{CAIRO} + \beta_4\text{Frsttri\_Dum}_{ij} + \beta_5\text{Scndtri\_Dum}_{ij} + \beta_6\text{Thrdtri\_Dum}_{ij} + \beta_2\text{CAIRO}\ \gamma_1 X_{im} + \gamma_2\text{antenatal}_i + \gamma_3\text{unemployment}_{ij} + \delta_i + \alpha_i + \varphi_i + \varepsilon_{imj} \quad (2)$$

6. Descriptive Statistics of Births in treatment and control governorates born between November 2011 & May 2014.

$Frsttri\_Dum_{ij}$, $Scndtri\_dum_{ij}$, $Thrdtri\_Dum_{ij}$ are dummy variables that take the value of 1 if the child has been exposed to the shock in the first, second or third trimesters respectively, and takes the value of zero otherwise. *CAIRO* is a dummy variable that takes the value of 1 if the governorate of residence is Cairo (treated group) and takes the value of zero if the birth was in one of the control governorates that did not have any fatalities during violence shock. The variables of interest in this equation are the interaction variables between the dummy variables of the exposure and Cairo; i.e. $Frsttri)\_Dum_{ij}*CAIRO$, $Scndtri\_Dum_{ij}*CAIRO$, $Thrdtri\_Dum_{ij}*CAIRO$.

6. Results

Overall results suggest that exposure to stress due to political tension or upheaval has a significant impact on the offspring's birth weight. More specifically, estimates of the various specifications and models consistently argue that the early stages of pregnancy, namely first and second trimesters, are the most sensitive to prenatal stress. This coincides with other studies which argue that the third trimester is more sensitive to malnutrition and food intakes; whereas, stress tends to be more critical for early stages of pregnancy (Almond, Hoynes, Schanzenbach, 2011; Bozzoli & Quintana-Domeque, 2014; Stein & Lumey, 2015). Fixed effects regressions testing the effect of exposure to political conflict on birth weight are presented in Table 6. The fixed effects regression uses the number of fatalities per trimester in the *governorate* of the mother's residence as the main indicator of prenatal stress. Panels (1) and (2) control for unobservable characteristics of the household including year of birth and governorate fixed effects. Panel (3) restricts the sample to siblings and mother fixed effects are included to control for unobservables on the household level. In all specifications, standard errors are clustered by *governorate* and included in parenthesis. Panels (2) and (3) are our preferred specifications.

Table 6: Fixed Effects Regressions of Birth Weight using no. of fatalities in governorate of residence by trimester

	(1) Birth Weight	(2) Birth Weight	(3) Birth Weight
No. of fatalities during first trimester	-0.117***	-0.139***	0.041
	(0.020)	(0.020)	(0.040)
No. of fatalities during second trimester	-0.090***	-0.097***	-0.153***
	(0.029)	(0.032)	(0.038)
No. of fatalities during third trimester	0.026	0.014	0.072
	(0.016)	(0.010)	(0.051)
Wealth Index	0.010	0.010	
	(0.029)	(0.029)	
Age of mother at birth	3.997**	3.423*	-6.872
	(1.865)	(1.849)	(15.688)
Child gender (Female=1)	-38.401***	-38.543***	-68.367***
	(11.799)	(11.839)	(19.348)
Birth order	5.011	7.532	-70.026*
	(7.594)	(7.313)	(36.057)

	(1) **Birth Weight**	(2) **Birth Weight**	(3) **Birth Weight**
Mother years of education	6.796** (2.482)	6.933** (2.529)	
Father years of education	2.345 (1.691)	2.193 (1.540)	
Married	69.884 (58.077)	68.765 (58.004)	
Urban	35.707* (18.130)	22.749 (17.344)	
Had a minimum of 4 visits for antenatal care (WHO)	43.509* (22.140)	44.737* (22.969)	69.397 (45.957)
Delivered in hospital/clinic	-65.258 (40.978)	-66.138 (42.042)	-66.891 (55.653)
Unemployment rate in Governorate in year of birth	-2.071 (1.963)	-9.722*** (2.306)	-1.749 (3.979)
Year of Birth Fixed Effects	Yes	Yes	Yes
Governorate Fixed Effects	No	Yes	Yes
Mother Fixed Effects	No	No	Yes
N	9057	9057	3850

Standard errors in parenthesis are clustered at governorate level.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results shown in Table 6 indicate that all estimators of interest reflecting prenatal stress in the first and second trimesters are negative and significant indicating an inverse relationship between the degree of prenatal stress and birth weight in the early stages of pregnancy. Across the different panels it may be realized that the estimates of interest change in magnitude indicating the importance of controlling for unobservables. In Panel (1), results suggest that an additional fatality in the *governorate* of residence during the first and second trimesters decrease the birth weight by 0.117 grams and 0.09 grams respectively. As we multiply this estimate by the average number of fatalities by trimester among the exposed mothers, we find that exposure to political violence in the first and second trimesters reduced the birth weight by 5 and 3.3 grams, respectively[7]. In other words, exposure to a violence shock in at least once in the first and second trimesters reduces birth weight by 8.3 grams (0.3 percent of the average birth weight). These estimates are similar to those of Camacho (2008) which argue that babies exposed to landmine explosions while in utero are 8.7 grams less at birth than their siblings who were unexposed to any explosions.

After including *governorate* fixed effects in Panel (2), the magnitude of the coefficients slightly increase to show that an additional fatality in the *governorate* of the mother's residence reduces birth weight by 0.139 grams in the first trimester and 0.097 grams in the second trimester. As we multiply by the average number of fatalities among the exposed mothers, results suggest that exposure to political violence during the first trimester reduces birth weight by 5.5 grams, while exposure in the second trimester reduces birth weight by 3 grams. Figure 6 shows the predicted average values of weight at birth for different values

7. As shown in Table 3, the average number of fatalities for exposed mothers is 44 fatalities in the first trimester and 38 in the second trimester.

of fatalities to which mothers were exposed during the first and second trimester based on the estimates of Panel (2).

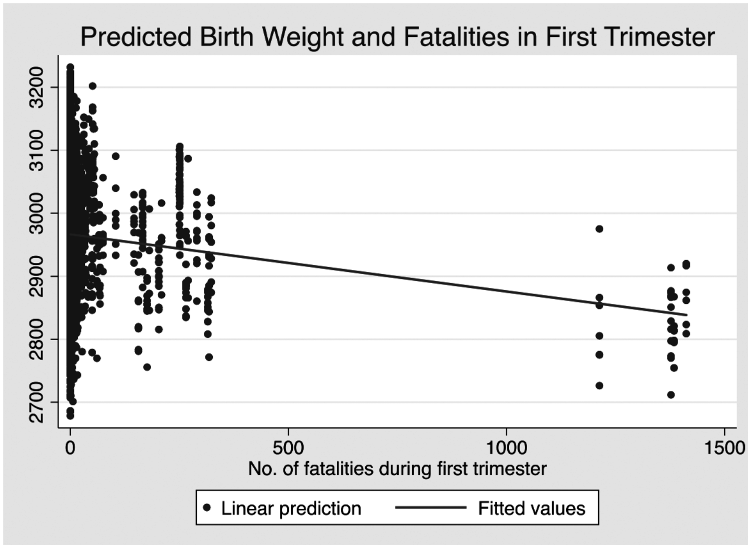

Figure 6: Predicted birth weight for different levels of fatalities in first and second trimesters

As we include mother fixed effects, the negative coefficients on the first and second trimester remain; yet, the significance of the first trimester disappears. This may be explained by the fact that restricting the sample to siblings significantly reduces variation in the sample. In addition, including only live births exposes the sample to selection problems especially in the first trimester in which most of the miscarriages take place. This explains the large reduction in the magnitude of the first trimester coefficient and the significant increase in the magnitude of the standard errors. Estimates using the siblings sample indicate that each fatality in the mother's governorate of residence during the first and second trimesters reduces birth weight by 0.041 and 0.153 grams respectively. As we multiply by the average number of fatalities per trimester of the mothers exposed, the siblings sample shows a reduction of 7 grams in birth weight as exposure takes place in the second trimester[8].

The second set of results show a difference-in-difference analysis in which Cairo is used as the treatment group and other governorates with no fatalities are used as the control group. Table 7 shows the results for the first violence shock in January 2011 and Table 8 shows the results for the second violence shock in August 2013. Panels (1) - (4) show different combinations of fixed effects. Our preferred specification is that presented in Panel (4) in which both governorate and year of birth fixed effects are included in the regression. The difference-in-difference results show stronger impacts than the fixed effects results indicating that fetus exposed to violence during the first, second, and third trimesters have significantly lower weights than those not exposed to violence. Results in Table 8 show that fetus exposed to the violence shock in January 2011 in the first, second, and third trimesters were born respectively 97, 194, and 174 grams less than those not exposed to the January 2011 violence shock. That is, the average birth weight of a fetus exposed to a violence shock is reduced by 3.3%, 7%, and 6% if exposed in the first, second, and third trimester respectively. Results in Table 9 confirm the fact that the early stages of pregnancy, specifically the first and second trimesters have the highest negative impact on the fetus birth weight. Results show that fetus exposed to the violence shock in August 2013 during the first trimester are born 224 grams lower than those not exposed; whereas, those exposed to the violence shock in their second trimester are born 99 grams lower than those not exposed altogether.

Table 7: Difference-in-Difference Regressions using Cairo as a treatment group for Shock 1 (January 2011)

	(1) Birth Weight	(2) Birth Weight	(3) Birth Weight	(4) Birth Weight
First trimester in utero during Shock 1* Cairo residence	-84.865^{**}	-78.827^{*}	-101.227^{***}	-96.662^{**}
	(31.418)	(38.700)	(33.277)	(38.831)
Second trimester in utero during Shock 1* Cairo residence	-187.604^{***}	-172.799^{***}	-206.136^{***}	-193.669^{***}
	(27.491)	(29.150)	(32.133)	(31.994)
Third trimester in utero during Shock 1* Cairo residence	-154.289^{***}	-152.545^{***}	-174.496^{***}	-174.457^{***}
	(42.258)	(38.698)	(42.802)	(38.520)
Wealth Index	−0.199	−0.317	−0.203	−0.313
	(0.531)	(0.552)	(0.539)	(0.561)

8. Birth order in panel (3) is showing a negative impact on birth weight at 10% significance level which contradicts with previous studies that have shown that higher birth orders are of higher birth weights (Seidman et al., 1988). This may be justified by the fact that births in the siblings' sample are reported to be born in the last 5 years before the survey (between May 2009 and June 2014) implying that mothers in the sample that had 3 or 4 births had significantly low birth intervals between their successive children. Studies have shown that small birth intervals are associated with lower birth weights (e.g. Conde-Agudelo, A. et al., 2006). This rationalizes why higher birth orders were associated with lower birth weights in the siblings' sample.

	(1) Birth Weight	(2) Birth Weight	(3) Birth Weight	(4) Birth Weight
Age of mother at birth	4.610 (3.720)	3.917 (3.898)	4.532 (3.715)	3.891 (3.895)
Child gender (Female=1)	–42.229 (24.750)	–42.385 (24.142)	–42.510* (23.959)	–42.457* (23.423)
Birth order	7.058 (12.793)	7.801 (12.712)	8.316 (12.959)	8.994 (12.918)
Mother years of education	5.366* (3.035)	6.270* (3.063)	5.075 (2.984)	6.033* (3.001)
Father years of education	2.977 (2.733)	2.065 (2.441)	3.153 (2.834)	2.167 (2.501)
Married	125.493 (96.193)	115.493 (96.882)	119.052 (94.788)	108.936 (95.399)
Urban	36.183 (29.014)	46.209 (33.750)	34.866 (28.256)	44.152 (33.015)
Had a minimum of 4 visits for antenatal care (WHO)	39.390 (59.386)	31.736 (63.161)	43.046 (59.116)	35.669 (62.828)
Delivered in hospital/clinic	–33.665 (66.324)	–47.130 (70.548)	–30.952 (67.840)	–44.270 (72.084)
First trimester in utero during Shock 1	–52.979 (37.214)	–38.937 (36.329)	–39.579 (44.256)	–27.416 (45.121)
Second trimester in utero during Shock 1	–33.360 (37.226)	–27.521 (38.970)	–51.566 (46.973)	–53.894 (45.952)
Third trimester in utero during Shock 1	–8.987 (40.221)	9.794 (42.246)	–73.200 (52.554)	–55.111 (52.978)
Cairo Resident	37.360 (26.066)	237.064*** (19.840)	47.823 (27.449)	241.375*** (23.251)
Governorate Fixed Effects	No	Yes	No	Yes
Year of Birth Fixed Effects	No	No	Yes	Yes
N	2319	2319	2319	2319

Standard errors in parenthesis are clustered at governorate level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Difference-in-Difference Regressions using Cairo as a treatment group for Shock 2 (August 2013)

	(1) Birth Weight	(2) Birth Weight	(3) Birth Weight	(4) Birth Weight
First trimester in utero during Shock 2* Cairo residence	-258.291*** (32.553)	-241.332*** (18.133)	-247.380*** (35.156)	-223.713*** (17.377)
Second trimester in utero during Shock 2* Cairo residence	-102.870*** (28.162)	-101.197*** (28.182)	-101.974** (31.962)	-98.660** (32.725)
Third trimester in utero during Shock 2* Cairo residence	-4.648 (60.500)	-10.204 (59.581)	-4.764 (59.643)	-11.048 (58.312)
Wealth Index	-0.013 (0.056)	-0.015 (0.054)	-0.010 (0.051)	-0.010 (0.049)
Age of mother at birth	1.584 (4.106)	1.657 (4.324)	2.067 (4.182)	2.153 (4.381)
Child gender (Female=1)	-47.890 (36.784)	-47.343 (36.642)	-50.699 (37.445)	-50.643 (37.251)

	(1) Birth Weight	(2) Birth Weight	(3) Birth Weight	(4) Birth Weight
Birth order	15.144 (13.748)	15.428 (14.414)	13.042 (14.111)	13.379 (14.703)
Mother years of education	7.286 (4.027)	6.817 (3.948)	7.023 (3.944)	6.558 (3.916)
Father years of education	-3.686 (4.765)	-3.437 (4.699)	-3.749 (4.847)	-3.466 (4.795)
Married	197.607* (104.692)	169.194 (96.648)	187.833 (113.588)	159.708 (105.590)
Urban	52.817 (28.594)	74.798* (36.845)	47.883 (28.963)	68.677* (34.708)
Had a minimum of 4 visits for antenatal care	33.800 (37.426)	37.264 (36.879)	32.006 (36.043)	34.810 (35.981)
Delivered in hospital/clinic	5.576 (82.674)	20.056 (82.463)	3.510 (82.561)	16.634 (81.176)
First trimester in utero during Shock 2	114.880** (34.443)	119.955*** (21.563)	116.639* (50.781)	119.518** (36.785)
Second trimester in utero during Shock 2	-26.894 (23.466)	-21.031 (25.024)	-51.037 (43.765)	-49.739 (47.465)
Third trimester in utero during Shock 2	25.895 (58.862)	26.880 (56.609)	91.616* (47.341)	95.036* (46.294)
Cairo Resident	142.166*** (31.803)	-10.503 (61.691)	141.466*** (34.478)	-45.461 (64.265)
Governorate Fixed Effects	No	Yes	No	Yes
Year of Birth Fixed Effects	No	No	Yes	Yes
N	1495	1495	1495	1495

Standard errors in parenthesis are clustered at governorate level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: The Impact of Violence Exposure on Antenatal Visits

	(1) No. of Antenatal Visits	(2) Antenatal Visits (Dummy Variable=1 if 4 visits or more)
No. of fatalities during first trimester	0.000 (0.001)	–0.000 (0.000)
No. of fatalities during second trimester	0.000 (0.001)	–0.000 (0.000)
No. of fatalities during third trimester	0.001 (0.001)	–0.000 (0.000)
Wealth Index	0.001 (0.001)	–0.000 (0.000)
Age of mother at birth	0.065*** (0.015)	0.003*** (0.001)
Child gender (Female=1)	–0.077 (0.114)	–0.010 (0.007)
Birth order	–0.640*** (0.062)	–0.032*** (0.004)
Mother years of education	0.128*** (0.016)	0.008*** (0.001)

	(1) No. of Antenatal Visits	(2) Antenatal Visits (Dummy Variable=1 if 4 visits or more)
Father years of education	0.065***	0.003***
	(0.015)	(0.001)
Married	0.040	–0.011
	(0.515)	(0.027)
urban	0.488***	0.010
	(0.155)	(0.008)
Unemployment rate in Governorate in year of birth	0.002	0.001
	(0.029)	(0.002)
N	9057	9057

Standard errors in parenthesis are clustered at governorate level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To examine the fact that access to health care has not been affected by the shock, we conduct a regression in which the access to prenatal care is the dependent variable and the number of fatalities the mother is exposed to in each trimester of pregnancy is the explanatory variable. Results are shown in Table 10. In Panel (1), the dependent variable is the actual number of prenatal visits; while in Panel (2), the dependent variable is a dummy variable indicating if the mother had 4 antenatal visits, which is the minimum requirement by the WHO. The reason behind conducting this regression is to ensure that the lower birth weights of offspring to mothers exposed to the revolution violence shocks in their first and second trimesters is not a result of inadequate access to health care rather than prenatal stress. Estimations show that there is no significant impact of the violence episodes on the access to health care since the number of antenatal visits have not been affected by the indicators we have used to proxy the intensity of the violence shocks.

7. Conclusion

The 2011 Egyptian Revolution and its aftermath created a significant amount of political conflict and violence between the regime allies and protestors which resulted in a considerable toll of fatalities. These fatalities range from deaths due to the security vacuum, armed attacks from authorities or thugs, brute force by authorities in prisons, or curfew violations. It is worth noting that these fatalities have been experienced all over the country but with different levels of intensity which allows us to resemble a quasi-experimental setting design to test the impact of acute exogenous stress shocks experienced by pregnant women on birth weights. A significant negative relationship is found between prenatal stress during the early stages of pregnancy and birth weights, which coincides with other medical and causal studies testing the same hypothesis. Yet, as we compare the study estimates to other studies testing the same hypothesis, it may be important to differentiate between the different sources of stress and whether the higher levels of prenatal stress were acute or chronic. This is because each identification strategy has its own limitations which may affect the results of the study. In this study, stress arises from political conflict or upheaval and is characterized as being acute since it lasts for a short period of time. Identifying the most significant determinants of birth weight is important for economic literature which has shown a significant association between birth weight and long-term health and socioeconomic outcomes.

References

Almond, D. (2006). Is the 1918 Influenza Pandemic Over? Long-Term Effects of *In Utero* Influenza Exposure in the Post-1940 U.S. Population. *Journal of Political Economy*, *114*(4), 672–712. https://doi.org/10.1086/507154

Almond, D., Chay, K. Y., & Lee, D. S. (2005, August). The costs of low birth weight. *Quarterly Journal of Economics*. https://doi.org/10.1162/003355305774268228

Almond, D., Hoynes, H. W., & Schanzenbach, D. W. (2011). Inside the war on poverty: The impact of food stamps on birth outcomes. *Review of Economics and Statistics*, *93*(2), 387–403. https://doi.org/10.1162/REST_a_00089

Bozzoli, C., & Quintana-Domeque, C. (2014). The weight of the crisis: Evidence from newborns in Argentina. *Review of Economics and Statistics*, *96*(3), 550–562. https://doi.org/10.1162/REST_a_00398

Camacho, A. (2008). Stress and birth weight: Evidence from terrorist attacks. In *American Economic Review* (Vol. 98, pp. 511–515). https://doi.org/10.1257/aer.98.2.511

Catalano, R., & Hartig, T. (2001). Communal bereavement and the incidence of very low birthweight in Sweden. *Journal of Health and Social Behavior*, *42*(4), 333–41. https://doi.org/10.2307/30

Chen, Y., & Zhou, L. A. (2007). The long-term health and economic consequences of the 1959-1961 famine in China. *Journal of Health Economics*, *26*(4), 659–681. https://doi.org/10.1016/j.jhealeco.2006.12.006

Conde-Agudelo, A., Rosas-Bermúdez, A., & Kafury-Goeta, A. C. (2006). Birth spacing and risk of adverse perinatal outcomes: A meta-analysis. *Journal of the American Medical Association*, *295*(15), 1809–1823. https://doi.org/10.1001/jama.295.15.1809

Currie, J. (2011). Inequality at birth: Some causes and consequences. In *American Economic Review* (Vol. 101, pp. 1–22). https://doi.org/10.1257/aer.101.3.1

Currie, J., & Rossin-Slater, M. (2013). Weathering the storm: Hurricanes and birth outcomes. *Journal of Health Economics*, *32*(3), 487–503. https://doi.org/10.1016/j.jhealeco.2013.01.004

Dunkel Schetter, C. (2010). Psychological Science on Pregnancy: Stress Processes, Biopsychosocial Models, and Emerging Research Issues. *SSRN*. https://doi.org/10.1146/annurev.psych.031809.130727

Glynn, L. M., Wadhwa, P. D., Dunkel-Schetter, C., Chicz-DeMet, A., & Sandman, C. A. (2001). When stress happens matters: Effects of earthquake timing on stress responsivity in pregnancy. *American Journal of Obstetrics and Gynecology*, *184*(4), 637–642. https://doi.org/10.1067/mob.2001.111066

Human Rights Watch (2014, August 12). Egypt: Raba'a killings likely crimes against humanity. No justice a year later for series of deadly mass attacks on protestors. Retrieved from: https://www.hrw.org/news/2014/08/12/egypt-raba-killings-likely-crimes-against-humanity

Khosrokhavar, F. (2014). Violence in the Arab Revolutions: The Paradigmatic Case of Egypt. *International and Multidisciplinary Journal of Social Sciences*, *3*(1), 1-35.

Kinninmont, J. (2012). "Bread, Dignity and Social Justice": The Political Economy of Egypt's Transition. *Chatham House Briefing Paper*.

Kirkpatrick, D. (2011, January 28th). Mubarak orders crackdown, with revolt sweeping Egypt. *The New York Times*. Retrieved from http://www.nytimes.com/2011/01/29/world/middleeast/29unrest.html?pagewanted=all&_r=0

Kirkpatrick, D. (2011, January 29th). Egyptians defiant as military does little to quash protests. *The New York Times*. Retrieved from http://www.nytimes.com/2011/01/30/world/middleeast/30-egypt.html?pagewanted=all&_r=0

Lauderdale, D. S. (2006). Birth Outcomes for Arabic-Named Women in California Before and After September 11. *Demography*, *43*(1), 185–201. https://doi.org/10.1353/dem.2006.0008

Mansour, H., & Rees, D. I. (2012). Armed conflict and birth weight: Evidence from the al-Aqsa Intifada. *Journal of Development Economics*, *99*(1), 190–199. https://doi.org/10.1016/j.jdeveco.2011.12.005

Minatullah Sohail, R., & Chebib, N. (2011). The Reasons Social Media Contributed to 2011 Egyptian Revolution. *International Journal of Business Research and Management*, *2*(3), 139–162. https://doi.org/10.1016/0191-8869(95)00076-I

Mulder, E. J. H., Robles De Medina, P. G., Huizink, A. C., Van Den Bergh, B. R. H., Buitelaar, J. K., & Visser, G. H. A. (2002, December). Prenatal maternal stress: Effects on pregnancy and the (unborn) child. *Early Human Development*. https://doi.org/10.1016/S0378-3782(02)00075-0

Rodenbeck, M. (2010). *Holding its breath: a special report on Egypt*. Economist Newspaper.

Roseboom, T. J., van der Meulen, J. H., Osmond, C., Barker, D. J., Ravelli, A. C., Schroeder-Tanka, J. M., ... & Bleker, O. P. (2000). Coronary heart disease after prenatal exposure to the Dutch famine, 1944-45. *Heart*, *84*(6), 595–598. https://doi.org/10.1136/heart.84.6.595

Seidman, D. S., Ever-Hadani, P., Stevenson, D. K., Slater, P. E., Harlap, S., & Gale, R. (1988). Birth order and birth weight reexamined. *Obstetrics and Gynecology*, *72*(2), 158–62. http://www.ncbi.nlm.nih.gov/pubmed/3260664

Stein, A. D., & Lumey, L. H. (2015). The Relationship between Maternal and Offspring Birth Weights after Prenatal Famine Exposure: The Dutch Famine Birth Cohort Study. *Human Biology*, *72*(4), 641–654.

The Guardian (2011). Egypt's revolution turns ugly as Mubarak fights back. February, 2nd, 2011. Retrieved May 9th 2016 from http://www.theguardian.com/world/2011/feb/02/egypt-revolution-turns-ugly

Torche, F. (2011). The Effect of Maternal Stress on Birth Outcomes: Exploiting a Natural Experiment. *Demography*, *48*(4), 1473–1491. https://doi.org/10.1007/s13524-011-0054-z

Wadhwa, P. D., Sandman, C. A., Porto, M., Dunkel-Schetter, C., & Garite, T. J. (1993). The association between prenatal stress and infant birth weight and gestational age at birth: A prospective investigation. *American Journal of Obstetrics and Gynecology*, *169*(4), 858–865. https://doi.org/10.1016/0002-9378(93)90016-C