THREE ESSAYS ON THE IMPACT OF POLITICAL AND ECONOMIC SHOCKS DURING CHILDHOOD ON HEALTH OUTCOMES: EVIDENCE FROM DEVELOPING COUNTRIES

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DEDICATION

I dedicate this dissertation to my husband and the love of my life, for his constant support, love, patience, and encouragement during the challenges of the Ph.D. program. I also dedicate it to my beautiful daughters, Nour and Laila, for tolerating the long hours I was busy on my computer. You are the source of happiness and joy in my life. I love you to the moon and back. Last, but not least, I dedicate it to my parents whose unconditional love is the reason I have become what I am today.

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Ronia Ahmed Hawash

THREE ESSAYS ON THE IMPACT OF POLITICAL AND ECONOMIC SHOCKS DURING CHILDHOOD ON HEALTH OUTCOMES: EVIDENCE FROM DEVELOPING COUNTRIES

The dissertation consists of three essays which attempt to capture causal relationships between shocks during childhood and before birth, and later health outcomes. Exogenous shocks such as the experiences of war and political upheaval are treated as natural experiments which minimize problems of endogeneity and selection that are present in most association studies. The first essay examines how exposure to civil war during childhood affects females' outcomes including age at first marriage, fertility, and second generation infant mortality using the Biafra war which took place in Nigeria between years 1967 and 1970. The study uses difference-in-difference analysis to show that females that witnessed war during early adolescence got married younger than their peers not exposed to the war, and were more likely to have higher fertility and second-generation infant mortality.

The second essay uses the same shock, the Biafra war, to test if males' and females' exposure to community-level violence results in higher risk of experiencing domestic violence in their marital relationships in the long-run. The study conducts difference-in-difference analysis on females and males separately to show that the males' exposure to the war at ages 13 and older is the main mechanism behind females being victims of domestic violence in the long-run.

The third essay examines the impact of acute prenatal stress on birth weight using the 2011 Egyptian revolution fatalities as an indicator for exposure to violence and stressful events. Results show that higher prenatal stress resulting from political conflict during the first and second trimesters of pregnancy has a significant negative impact on 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.

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Chapter 1

Introduction

Individuals' stock of health is a function of their genetic factors, health promoting activities and behaviors, use of medical care, and family and environmental characteristics. Accordingly, adult health has antecedents in childhood and even before birth. The aim of this dissertation is to test the impact of early exposure to political and economic shocks on later health outcomes.

The dissertation consists of three essays: The first essay examines how exposure to civil war during childhood affects females' outcomes including age at first marriage, fertility, and second generation infant mortality using the Biafra war which took place in Nigeria between years 1967 and 1970. The second essay uses the same shock to test if males' and females' exposure to community-level violence results in higher risk of experiencing domestic violence in their marital relationships in the long-run. The third essay examines the impact of in-utero shocks, specifically acute prenatal stress, on birth weight using the 2011 Egyptian revolution fatalities as an indicator for exposure to violence and stressful events.

Exogenous shocks such as the experiences of war and political upheaval are treated as natural experiments which minimize problems of endogeneity and selection that are present in most association studies. Using difference-in-difference and fixed effects econometric methods, the three essays show that shocks in early stages of life have significant long-term health impacts.

Chapter 2

The Aftermath of the Biafra War: Early Marriage, Fertility, Second Generation Infant Mortality

2.1 Introduction

Experiencing war creates substantial human misery, especially if those exposed were children. Since 1945, civil wars have killed almost 20 million people and have displaced at least 67 million others (Collier & Sambanis, 2005). Developing countries have a long and intense history of armed conflicts (Gleditsch, Wallensteen, Eriksson, Sollenberg, & Strand, 2002). Recent studies have sought to draw attention to the consequences of war for civilians particularly children and young women. Importantly, scholars and policy makers have emphasized that individuals exposed to civil wars as children do not only suffer in the short-run, but the effects of such shocks may be felt years or even decades later (Currie & Vogl, 2013). First, children who are exposed to war may experience nutritional and disease shocks with consequences for adult health. Second, young girls and women who are exposed to war may experience higher incidence of early marriage and sexual violence (Bunting, 2012). Finally, war and conflict may lead to displacement, destruction of schooling and health facilities with consequences for adult educational and health outcomes.

In this paper, we examine the long-term consequences of civil war, a relatively underexplored topic. The paper provides new evidence on the long-run consequences of civil war using data from the Nigerian Civil War, the first and most violent conflict in

independent Sub-Saharan Africa. Using socioeconomic data from the Nigerian Demographic and Health Surveys of 2003 and 2008, this study provides estimates of the long-run effect of exposure to civil conflict focusing on marriage, fertility, and second generation outcomes.

The Nigerian Civil War (1967-1970) was the first modern civil war in independent Sub-Saharan Africa. Between 1 million and 3 million died from starvation, disease and hostilities associated with the thirty-month civil war (Aall, 1970). To investigate the causal effects of exposure to war during childhood on adult socioeconomic outcomes, we exploit cohort and ethnicity variation in exposure to the conflict. The identification strategy draws on the difference in the outcome variables between the affected and unaffected cohorts in the treatment group which are the ethnicities exposed to the war, relative to the difference within the control group which is those belonging to an ethnicity not exposed to the war. We implement a difference-in-difference strategy in which the cohorts exposed are females experiencing the war during childhood, while the cohorts that are unexposed are those born after the end of the war. The key assumption is that in the absence of war the difference in trends of outcome variables between cohorts born after war would be similar for both the ethnicities exposed to war and those not exposed to war.

A growing body of work has shown that exposure to wars during childhood may cause lower heights in adulthood (Agüero & Delilokar, 2012; Akresh, Bhalotra, Leone, & Osili, 2012; Akresh, Verwimp, & Bundervoet, 2011; Bundervoet, Verwimp, & Akresh, 2009); and lower educational attainment (Akresh & de Walque, 2008; Alderman,

Hoddinot, & Kinsey, 2006). However, while there is established literature investigating the impact of shocks in utero and early childhood on long-term outcomes, very few studies have examined exposure to such shocks at older ages; namely, adolescence. Moreover, to our knowledge, the intergenerational effect of negative health shocks during childhood is largely unexamined within the literature (Currie & Vogl, 2013). This study expands the existing literature by examining the impact of exposure to civil war on first and second generation outcomes. From a public policy standpoint, it is important to identify the long-term impacts of shocks and to identify the age groups that are most vulnerable in order to give them more targeted assistance and support.

Our results show that girls exposed to the civil conflict during early childhood and early adolescence are the most scarred by the experience of civil war in comparison to the other age groups. In particular, girls that fell within the age group of 7 to 12 got married 1 year younger than their peers not exposed to the war and are 6% more likely to get married at an age below 17. Moreover, they tend to have 0.4 additional children. They also have a 4.5% higher probability of infant mortality. In addition, girls that fell within the age group of 0 to 3 got married 1.5 years younger than her peers not exposed to the war. Yet, they did not show any significantly higher fertility or infant mortality. Accordingly, relief efforts should put more focus into targeting these age groups in order to minimize the long-term welfare losses for the society resulting from such civil conflicts.

Section 2.2 of this paper gives a brief review on the previous studies examining the impact of civil conflict during childhood on long-run adult outcomes in developing

countries. Section 2.3 gives a short background on the Nigerian (Biafran) War. Section 2.4 shows the data and methodology used in the analysis. Section 2.5 and 2.6 presents the results and robustness checks. And finally, Section 2.7 concludes and presents the policy recommendations.

2.2 Background Literature

The relationship between an individual's health condition in childhood and his socioeconomic status in adulthood has been well-established in the literature. Previous studies have shown evidence of a positive association between an individual's height, an indicator of long-run health stock, and socioeconomic status (Currie, 2009; Steckel, 2008), productivity and wages (Haddad & Bouis, 1991; Thomas & Strauss, 1997), and cognitive skills (Case & Paxson, 2008). Due to the obvious endogeneity in health status, several studies attempted to examine causality using quasi-experimental designs exploiting unanticipated exogenous variations in weather, epidemiologic environment, disasters, or public policies. Exposure to civil war during childhood is one of these events that may result in long-term adverse effects through destruction of schools, hospitals, relatively limited food resources, and family dislocation. Since the children exposed to the Biafran war suffered mostly from severe starvation and civil violence, our review will focus only on the causal studies that examined the long-term impact of exposure to either wars or famines or both during childhood in developing countries[1].

[1] For a more detailed review on the impact of childhood shocks on adult outcomes in developing countries, see Currie, J., & Vogl, T. (2013). Early-Life Health and Adult Circumstance in Developing Countries. *Annu. Rev. Econ.*, *5*(1), 1-36.

Previous literature has shown that children exposed to wars suffer from *lower heights* during adulthood indicating relatively poorer long-term health status. Agüero and Deolalikar (2012) examined girls exposure to Rwandian genocide at ages 6 and above to show that those exposed to the war have decreased height-for-age z-scores in the long-run with the effect of the shock decreasing with age of exposure. Yet, even those exposed during late adolescence were also negatively affected in the long-run. Another study by Akresh *et al.* (2011) examined the impact of exposure to crop failure and political conflict in Rwanda at birth on height-for-age z-scores of children under the age of 5. Using difference-in-difference methods, their results show that exposure to armed conflict negatively affected heights of both boys and girls; whereas, exposure to crop failure affected only girls with more severe impact on those coming from poorer households. Furthermore, Akresh *et al.* (2012) examined the long-term impact of exposure to the Nigerian civil war (1967-1970) at different age stages on height. Comparing to females born after the war, their difference-in-difference results showed significant decrease in stature for all age groups from 0 to 16; however, the highest impact was that on the girls exposed to the war during the ages 13 to 16 indicating that the adolescence stage is not less critical than earlier ages in the growth process.

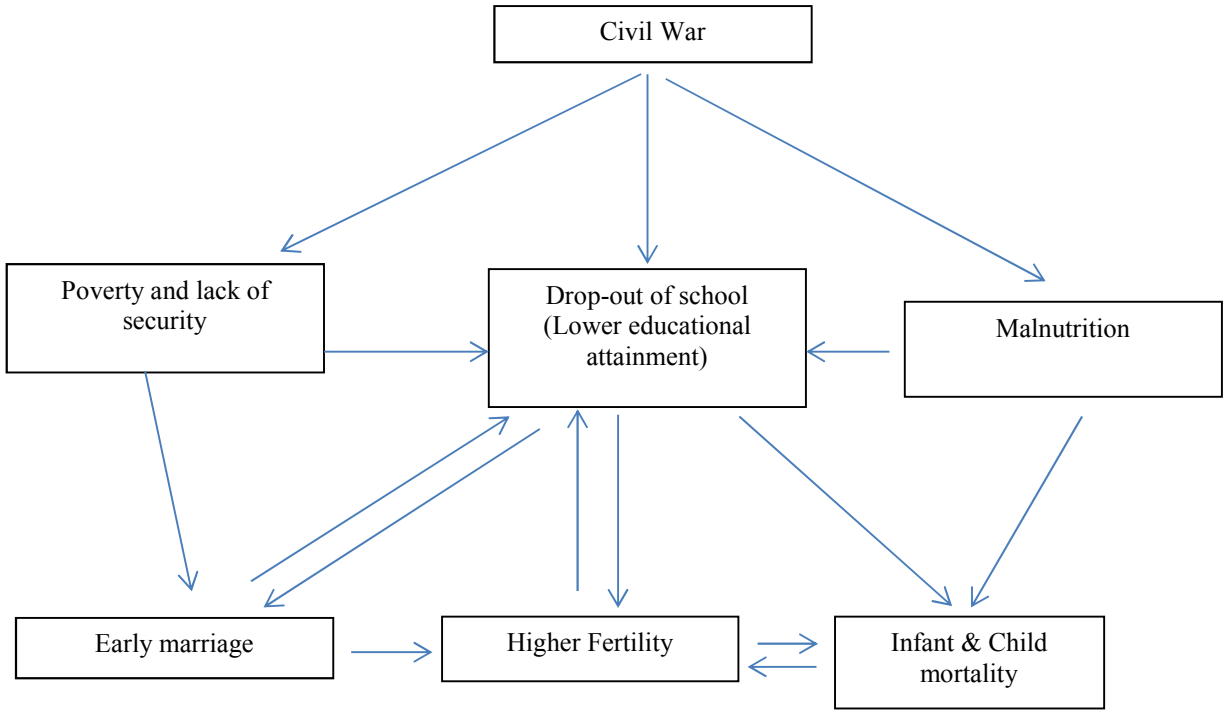
Other studies have shown that exposure to civil conflict during childhood results in lower educational attainment. Using a difference-in-difference analysis, Akresh and de Walque (2008) examine the impact of being exposed to the Rwandan genocide on years of schooling concluding that those exposed to the genocide during ages 6 to 15 ended up having fewer years of schooling compared to older cohorts who have completed schooling before the genocide. Furthermore, Leon (2012) examined the short-term and

long-term impact of exposure to Peruvian civil war before the age of 17 on educational attainment to conclude that children exposed to the civil conflict in utero, early childhood, and preschool were the ones that suffered from permanent education losses. On the other hand, those exposed to the war after they started their schooling cycle were able to recover and catch up to their peers not exposed to the war. Alderman *et al.* (2006) also highlighted the importance of the pre-school stage in nutrition by showing that Zimbabwean children who have been exposed to the 1980 civil war and experienced the drought shock suffered in the adolescence stage from lower heights and lesser years of education.

Exposure to *famines* during childhood has also proven to have a negative impact on long-term outcomes. For example, previous studies have shown that cohorts exposed to the China 1959-1961 famine while in utero and early childhood tend to have lower heights in the long-run (Chen & Zhou, 2007; Meng & Qian, 2009). Moreover, Almond, Edlund, and Li (2010) argued that female cohorts exposed to the China 1959-1961 famine while in utero are more likely to be illiterate, not working, and disabled. While the male cohorts exposed to the famine in utero were less likely to be married. Another study was that by Almond and Mazumder (2011) which exploited the fact that some pregnancies overlap with Ramadan, a month in which Muslims are fasting from sunrise to sunset. Their results showed that cohorts whose gestation period overlapped with Ramadan are more likely to be disabled and less likely to own a home of their own in the long-run.

In summary, most of the literature has mainly focused on the long-term impacts of shocks in utero and early childhood; yet, only a handful of recent studies have examined the impact of shocks at older ages. We believe that the adolescence stage is no less important than the early childhood stages. Moreover, to our knowledge none of the previous literature has examined the long-term impact of exposure to political conflict on early marriage, fertility, and second-generation infant mortality. As shown in Figure 2.1, there are several mechanisms by which exposure to political conflict during childhood may negatively affect our outcomes of interest. First, exposure to civil war during childhood may cause severe economic hardships resulting from family dislocation and death of head of household in the battlefield. This may be expected to force young girls into early marriages to escape poverty (Singh & Samara, 1996). Second, civil war results in destruction of schools making it more likely for females to drop out of the educational system early. Lower educational attainment may result in early marriages, higher fertility, and infant mortality. Third, experiencing civil war exposes children at critical ages to severe malnutrition which is expected to have long-run adverse effects on their health status during adulthood. Accordingly, the aim of this study is to examine the impact of exposure to war during childhood on early marriage, fertility, and second generation infant mortality; outcomes that have been under-examined in previous literature.

Figure 2.1: Potential Mechanisms

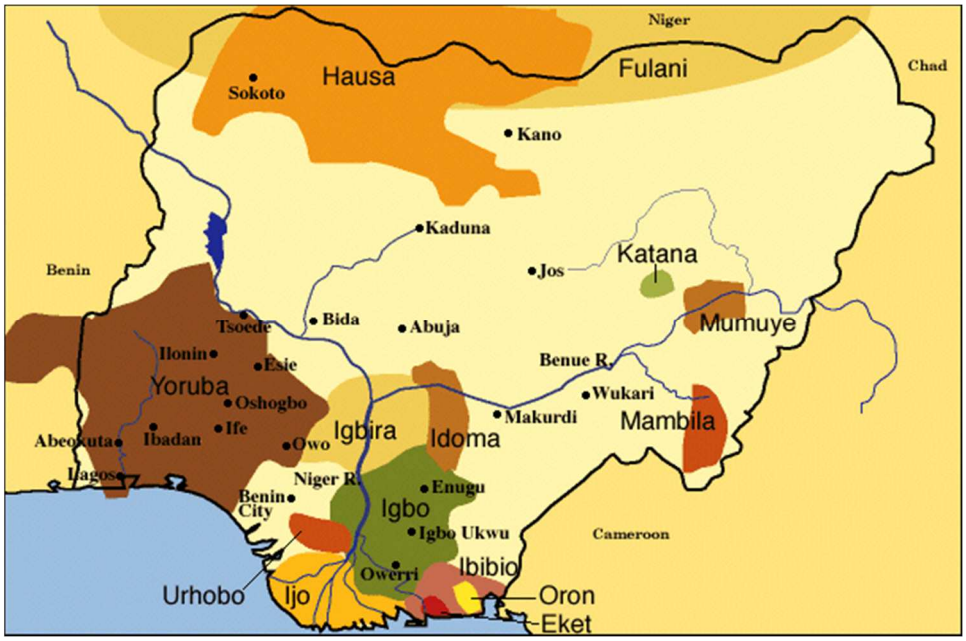


2.3 The Nigerian Civil War (1967-1970)

Nigeria is the most populous country in Africa with a fifth of the continent's entire population and is characterized by ethno-linguistic diversity in religious affiliation and socioeconomic development. Even though Nigeria gained independence from the British colonialism in 1960 as one unified country, important ethnic, religion, and social considerations shaped the post-independence period. As shown in Figure 2.2, Nigeria was divided into three semiautonomous regions: The Northern region dominated by the Muslim Hausa-Fulani ethnic group; the Western region dominated by the Yoruba ethnic group; and the Eastern region dominated by the Igbo (Ibo) ethnic group (Diamond, 1983).

After Nigeria's independence, there were heightened ethnic tensions between Northerners in the key civil posts with alliances from the Western region and the Igbos. The causes of the Nigerian civil war were complex. However, growing inter-ethnic and religious conflicts resulted in a massacre of thousands of Igbos living in the North and induced the migration of 1 million Easterners from the Northern region back to their homeland in the East. In May 1967, the former military governor of the Eastern region Lt. Col. Ojukwu with the support of the Eastern Region Consultative assembly declared the region's independence under the name of the Republic of Biafra. The Nigerian government considered this as an illegal secession and in June 1967, the government of Nigeria announced war on the state of Biafra in attempt to unify the country once again. The war lasted for 31 months and ended in January 1970 with the surrender of Biafra to the Nigerian federal troops (Zinn, 2005).

Figure 2.2: Map of Nigeria by Ethnicity



Source: Art and Life in Africa Project, University of Iowa. Retrieved February 14, 2014, from http://www.uiowa.edu/~africart/toc/countries/Nigeria.html

Nigeria's geo-political regions: the East, West, and the North, reflected differences in economic resources. The Eastern region was very low in animal protein supplies and it mainly relied on imports from other regions. After the outbreak of the war in 1967, the East suffered from a severe food deficit. Food shortages, destruction of stores, and overpopulation in the region after Igbo migration from the North all resulted in extreme carbohydrate and protein deficiency resulting in high child mortality (Aall, 1970). Moreover, a weaker immune system of the malnourished population resulted in other health hazards such as the spread of anemia, tuberculosis, measles, and yellow fever that were commonly seen during the war (Miller, 1970). We study the impact of health

shocks and severe socioeconomic conditions on long-run first and second generation outcomes including early marriage, fertility, and second generation infant mortality.

2.4 Data and Methodology

The study uses data from the Nigerian Demographic and Health Survey. The Demographic and Health Survey (DHS) is a nationally representative, cross-sectional, household survey in which women at child bearing age are interviewed. The DHS survey provides comprehensive information on demographic and health characteristics of respondents including birth histories, fertility preferences, family planning, educational attainment, health and nutritional status of mother and child, childhood mortality, among other characteristics. We use the DHS surveys conducted in Nigeria for years 2003 and 2008. The sample used in the study will include those exposed to the war in utero and during childhood (age range 0 to 16); that is, birth cohorts 1954 till November 1970. We define the control group as those born after the war ended including birth cohorts from December 1970 till December 1974. We select a narrow window for the control group to minimize the probability of any unobserved confounding events that would bias the results. The sample size from both surveys combined and including those born between years 1954 and 1974 equals to 13,228 females.

Ethnicities of respondents can be divided into 4 groups: (1) Igbo, which is the main ethnicity *exposed* to the war (14.4%); (2) Other minority ethnicities *exposed* to the war (8.3%); (3) Yoruba, a major ethnicity *not exposed* to the war (14.7%); (4) Hausa-Fulani, a major ethnicity *not exposed* to the war, more populous and less developed in comparison to the Igbos and Yorubas (22.6%); (5) Other minorities not exposed to the

war (40%). Accordingly, the ethnicities included in the treatment group will be those exposed to the war; i.e. those in categories (1) and (2). On the other hand, the control group will include all other ethnicities not exposed to the war.

The study exploits variation in ethnicities and cohorts to identify its treated group. The Nigerian Civil War was fought almost entirely in the eastern region. The most affected ethnicity by the Biafran war is the "Igbo" in addition to "other minorities" who fled to the South Eastern region (Biafra) during the war[2]. Accordingly, the variable of interest showing the impact of war on the "*treated group"* is an interaction term (war_{mce}) between *cohorts exposed to the war * ethnicity exposed to war.*

The strength of the study is that it adopts a quasi-experimental design exploiting the exogenous variation in the social, economic, and health environments of the individuals during their childhood. Because exposure to the war was exogenous to the respondents, it tends to be uncorrelated with the observed and unobserved characteristics affecting the outcomes of interest. The study uses the difference-in-difference methods to identify the differential impact of the Biafran war on the children exposed relative to those unexposed. We identify women exposed to the war, i.e. the "treated group", by cohort and ethnicity. Cohorts included in the treated group are those exposed to the war either in utero, childhood, or adolescence. As previously mentioned, the sample includes the birth cohorts falling between 1954 and 1974. The oldest cohort in the sample i.e. those born in 1954 have been exposed to the war as adolescents falling in the age range

[2] Other minority ethnicities include: Adoni, Adun, Annang, Efik, Ekoi, Ibibio, Ijaw (Izon), Isekiri, Isoko, Ogoni (ogori), Urhobo.

of 13 to 16. On the other hand, those born between November 1971 (specifically nine months after the end of the war) and December 1974 have not experienced the war at all.

We use difference-in-difference methods to identify the impact of the war on the people of Biafra. The key assumption in such models is that the treatment and control groups follow the same trend in the absence of treatment. Yet, to minimize any bias in our estimates we include cohort and ethnicity fixed effects to control for time-invariant unobserved characteristics of ethnicities and cohorts included in the study. In addition, we will control for the current economic status of the individuals by including a wealth index as one of the explanatory variables. The wealth index *(wealth)* is computed using principal component analysis of assets and utilities owned by each household including: electricity, radio, television, fridge, bike, motorbike, and car ownership.

The outcome variables of interest are: (1) Age at first marriage. The survey asks the question: "How old were you when you first started living with your first husband?" The question does not explicitly inquire whether the marriage was voluntary or forced. (2) Fertility: The survey asks the respondent "How many children have you ever had?" (3) Infant Mortality and Child Mortality in which the respondent is asked about the living status of each child born by the mother. And if it died, respondents are asked about the age of death. It is worth noting that infant and under age 5 child mortality are one of the most important indicators for maternal and child health.

Table 2.1 includes the descriptive statistics for the combined sample of both the treated and the control groups. The average age of first marriage in the sample is 18 years old and 39% of the sample had at least one child dying at less than 1 year old, while

almost 50% had at least one child dying at less than 5 years old. The average fertility measured as the number of children ever born is equal to 6.

Table 2.1: Descriptive statistics for the entire sample- Weighted

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent Variables					
Fertility (No. of Children ever born)	13228	5.937	2.922	0	18
Age at first Marriage	13228	18.11	5.355	6	46
Marriage at an age below 18	13228	0.55	0.497	0	1
Infant Mortality	13228	0.712	1.166	0	11
Respondent has at least one child dying less than 12 months	13228	0.387	0.487	0	1
Respondent has at least one child dying less than 5 years old	13228	0.499	0.500	0	1
Independent Variables					
Ethnicity Exposed to the War	13228	0.244	0.429	0	1
Female Years of Education	13228	4.61	5.302	0	22
Wealth index	13228	0.081	1.642	-1.99	3.82

The sample is divided into *5 groups* based on the age in which the child was exposed to the war: (i) during the fetal year, (ii) ages 0 to 3, (iii) ages 4 to 6, (iv) ages 7 to 12, (v) ages 13 to 16.

Therefore, the main regression equation will be:

$$
\begin{aligned}
Outcome_{imcesr} &= \beta_0 war0_{mce} + \beta_1 war1_{mce} \\
&+ \beta_2 war2_{mce} + \beta_3 war3_{mce} + \beta_4 war4_{mce} + \delta_0 mexpany0_{mc} \\
&+ \delta_1 mexpany1_{mc} + \delta_2 mexpany2_{mc} + \delta_3 mexpany3_{mc} \\
&+ \delta_4 mexpany4_{mc} + \gamma wealth_{imcesr} + \theta_e + \alpha_c + \tau_r + u_{imces}
\end{aligned}
$$

The subscripts *i, m, c, e,* and *r* index an individual woman *i*, of birth month *m*, born in year *c*, of ethnicity *e*, and outcome is measured in survey *r*. The variables of interest are $war0_{mce}$, $war1_{mce}$, $war2_{mce}$, $war3_{mce}$, $war4_{mce}$ which are interaction terms between war exposed ethnicity and war exposed cohorts for age groups: in utero, 0 to 3, 4 to 6, 7 to 12, and 13 to 16 respectively. The coefficient on this variable reflects the difference between the impact of the war on the ethnicities directly exposed to the war and those who lived during the same period but were not exposed to the war (i.e. the difference-in-difference coefficient). The variables $mexpany0_{mc}$, $mexpany1_{mc}$, $mexpany2_{mc}$, $mexpany3_{mc}$, $mexpany4_{mc}$ are the uninteracted terms for war exposed cohorts which show the change in the outcome variable that occurred whether or not the individual belongs to the ethnicity directly exposed to the war for age groups: in utero, 0 to 3, 4 to 6, 7 to 12, and 13 to 16 respectively. Therefore, the total impact of the war on the ethnicities directly exposed to the war equals $\beta_a + \delta_a$ where a = 1,2,3,4; whereas, the impact on those not directly exposed to the war is only δ_a. While β_a is the difference-in-difference coefficient in which these two coefficients are allowed to change according to the age at which the child was exposed to the war. All regressions control for the respondent's

household current wealth. The age distribution of respondents in both surveys is shown in Table 2.2.

Table 2.2: Age distribution of respondents by survey

	Age range of exposure to war	Age range at the time of survey	No. of respondents exposed in age range
DHS 2003	In utero	32-35	516
	0-3	33-39	816
	4-6	36-41	809
	7-12	39-47	1109
	13-16	45-49	456
DHS 2008	Age range of exposure to war	Age range at the time of survey	No. of respondents exposed in age range
	In utero	37-41	2737
	0-3	38-44	3267
	4-6	41-47	2603
	7-12	44-49	2956

With the severe economic conditions of war, scarce resources, starvation, political violence, and poverty, it is expected that cohorts and ethnicities directly exposed to the war will have adverse health and socioeconomic outcomes than their peers who were not exposed. This differential impact would be reflected in the sign, magnitude and significance of β_a. Allowing for variation in the coefficients across the 5 age groups will allow us to show whether the impact may differ according to the age of the child during the war. Our main assumption is that in the absence of war the difference in trends of outcome variables between cohorts would be similar for both ethnicities exposed to war and not exposed to war.

2.5 Results

Civil wars are expected to have long-term adverse effects on children exposed to war. This is mainly due to the severe conditions facing children during wars including malnutrition, drop-out of school, economic hardships, family displacement, loss of head of household, lack of security, and exposure to violence. In our empirical analysis, we examine the impact of exposure to war on early marriage, fertility, and second generation mortality. Tables 2.3 and 2.4 present the results of the regressions. We are primarily interested in the estimated coefficient on the interaction term between ethnicity exposed and birth cohorts exposed at each age group.

Results in Table 2.3 show that the girls exposed to the war during the age of 7 to 12 marry earlier than their peers not exposed to the war by 1.4 years and are 9% more likely to get married at an age below 18 and have 0.4 more children. Another age group negatively affected by the war is that exposed between ages 0 and 3. Females falling in this age group got married 1 year younger than those not exposed to the war and are 7% more likely to get married below the age of 18. Yet, they do not have higher fertility than those unexposed.

Table 2.3: Age at First Marriage and Fertility

	(1) Age at first Marriage	(2) Marriage below age 18	(3) Fertility
Any exposure utero*War ethnicity	0.176	0.018	0.204
	(0.279)	(0.022)	(0.154)
Any exposure at ages 0-3*War ethnicity	-1.123***	0.068***	-0.017
	(0.286)	(0.020)	(0.172)
Any exposure at ages 4-6*War ethnicity	0.522**	-0.007	-0.074
	(0.234)	(0.020)	(0.140)
Any exposure at ages 7-12*War ethnicity	-1.398***	0.088***	0.392***
	(0.289)	(0.024)	(0.135)
Any exposure at ages 13-16*War ethnicity	0.012	0.043	0.511*
	(0.469)	(0.039)	(0.296)
Any exposure in utero	0.074	-0.033	-0.131
	(0.266)	(0.028)	(0.168)
Any exposure at ages 0-3	0.337	-0.055*	0.122
	(0.363)	(0.032)	(0.200)
Any exposure at ages 4-6	-0.391	0.023	0.251
	(0.572)	(0.053)	(0.275)
Any exposure at ages 7-12	-0.806	0.088	0.325
	(0.614)	(0.068)	(0.377)
Any exposure at ages 13-16	0.762	0.011	0.682**
	(0.965)	(0.052)	(0.333)
Wealth index	0.495***	-0.040***	-0.219***
	(0.041)	(0.003)	(0.021)
N	13228	13228	13228

Notes: Each column is a separate regression. Standard errors in parenthesis and clustered at the year of birth and ethnicity level. Regressions include survey year dummy and year, state, ethnicity dummies. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Worse marriage and fertility outcomes in older age groups exposed to the war could be explained by the fact that the age of menarche in Sub-Saharan Africa ranges from age 10 to 14 (Sommer, 2011). Uneducated poor families consider girls after puberty as ready for marriage. Accordingly, families suffering from poverty, displacement, or the death of the head of their household in the battle field may be resorting to force their girls into early marriage as a means of escaping poverty and seeking security. Another

mechanism behind early marriage may be that those girls have dropped out of school early. Since the war lasted for almost 3 years, by the end of the war, children exposed at the age of 7 or older would be too old to go back to school. Hence, they may not have any incentive to delay marriage.

Table 2.4 presents results for the impact of exposure to war on infant and child mortality showing that the only age group suffering from higher second generation infant mortality are females exposed to the war between ages 7 and 12. The results show that females exposed to war in this age range are 5% more likely to have an infant dying at less than 12 months and 7.3% more likely to have child dying at an age of less than 5 years. There are several potential mechanisms to explain the higher infant and child mortality at this age group including early marriage, severe malnutrition at the age of puberty onset, lower educational attainment, higher fertility, factors that collectively have an adverse impact on maternal and child health. It is worth noting that this age group includes females that experience puberty onset and their second growth sprout during the time of the war. Severe malnutrition during that phase may have had an adverse effect on the health of the mother and in turn the health of the child.

Table 2.4: Second Generation Infant and Child Mortality

	(1)	(2)
	At least one infant dying less than 12 months	At least one child dying under the age of 5
Any exposure utero*War ethnicity	0.016	0.038
	(0.029)	(0.025)
Any exposure at ages 0-3*War ethnicity	-0.037	-0.025
	(0.029)	(0.026)
Any exposure at ages 4-6*War ethnicity	-0.006	-0.004
	(0.027)	(0.029)
Any exposure at ages 7-12*War ethnicity	0.049*	0.073**
	(0.025)	(0.028)
Any exposure at ages 13-16*War ethnicity	-0.078	-0.041
	(0.052)	(0.052)
Any exposure in utero	-0.047	-0.035
	(0.033)	(0.028)
Any exposure at ages 0-3	0.031	0.049*
	(0.036)	(0.027)
Any exposure at ages 4-6	-0.063*	-0.056*
	(0.036)	(0.030)
Any exposure at ages 7-12	-0.016	-0.034
	(0.075)	(0.057)
Any exposure at ages 13-16	0.121**	0.163**
	(0.052)	(0.068)
Wealth index	-0.036***	-0.047***
	(0.002)	(0.003)
N	13228	13228

Notes: Each column is a separate regression. Standard errors in parenthesis and clustered at the year of birth and ethnicity level. Regressions include survey year dummy and year, state, ethnicity dummies.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2.6 Robustness Checks

2.6.1 Using a different comparison group

As a robustness check, the same difference-in-difference model will be conducted but in which the control group is different. This model uses the Yoruba ethnicity as the comparison group not exposed to the war. Results are presented in Tables 2.5 and 2.6

which turn out to be very similar to those of the original model indicating the that the age groups most vulnerable to worst long-term adult outcomes are those who have been exposed to the war during the ages 0 to 3 who tend to marry earlier than their peers unexposed to the war and 7 to 12 who marry early, have higher fertility, and higher second generation mortality. This suggests that the results of the original model are robust to changing the comparison group.

Table 2.5: Age at First Marriage and Fertility using a different comparison group

	(1) Age at first Marriage	(2) Marriage below Age 18	(3) Fertility
Any exposure utero*War ethnicity	0.784**	-0.030	0.068
	(0.308)	(0.019)	(0.166)
Any exposure at ages 0-3*War ethnicity	-1.469***	0.084***	0.240
	(0.289)	(0.017)	(0.165)
Any exposure at ages 4-6*War ethnicity	0.796***	-0.023	0.071
	(0.246)	(0.019)	(0.136)
Any exposure at ages 7-12*War ethnicity	-0.831***	0.062**	0.408***
	(0.299)	(0.024)	(0.139)
Any exposure at ages 13-16*War ethnicity	-0.939*	0.123*	0.185
	(0.529)	(0.070)	(0.368)
Any exposure utero	-0.545	0.021 (0.024)	-0.060
	(0.460)		(0.195)
Any exposure at ages 0-3	1.084***	-0.071**	-0.100
	(0.392)	(0.031)	(0.282)
Any exposure at ages 4-6	-1.595**	0.013 (0.078)	0.159
	(0.720)		(0.337)
Any exposure at ages 7-12	0.050	-0.034	-0.332
	(0.705)	(0.111)	(0.531)
Any exposure at ages 13-16	2.909***	-0.141	1.092
	(0.830)	(0.108)	(0.803)
Wealth index	0.705***	-0.040***	-0.306***
	(0.047)	(0.004)	(0.021)
N	4948	4948	5158

Note: Each column is a separate regression. Standard errors in parenthesis and clustered at the year and ethnicity level. Regressions include survey year dummy and year, state, ethnicity dummies. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.6: Second Generation Infant and Child Mortality using a different comparison group

	(1) At least one infant dying less than 12 months	(2) At least one child dying under the age of 5
Any exposure utero*War ethnicity	-0.016 (0.030)	-0.018 (0.029)
Any exposure at ages 0-3*War ethnicity	-0.020 (0.027)	-0.021 (0.033)
Any exposure at ages 4-6*War ethnicity	0.017 (0.030)	0.012 (0.034)
Any exposure at ages 7-12*War ethnicity	0.045* (0.025)	0.049* (0.029)
Any exposure at ages 13-16*War ethnicity	-0.100 (0.086)	-0.136 (0.097)
Any exposure utero	-0.043 (0.040)	0.017 (0.037)
Any exposure at ages 0-3	0.014 (0.062)	0.023 (0.057)
Any exposure at ages 4-6	-0.100 (0.078)	-0.065 (0.069)
Any exposure at ages 7-12	0.042 (0.114)	0.028 (0.116)
Any exposure at ages 13-16	0.132 (0.085)	0.141 (0.093)
Wealth index	-0.039*** (0.004)	-0.049*** (0.004)
N	5158	5158

Note: Each column is a separate regression. Standard errors in parenthesis and clustered at the year and ethnicity level. Regressions include survey year dummy and year, state, ethnicity dummies.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2.6.2 Using regions as an identification strategy for the treatment group

Another check for the robustness of the results is by using regions instead of ethnicities for identifying the treatment group exposed to the war. Respondents living in states located in the *South East* were considered as *the treatment group* while those living in other unexposed regions were considered as *the control group*. Results of the robustness check are presented in Tables 2.7 and 2.8 confirm our previous results showing lower ages of marriage for the age groups 0-3 and 7-12. Moreover, they reassert higher fertility and second generation mortality for the age group 7-12. This shows that the results of the original model are robust to changing the identification strategy from variation in ethnicity to variation in region.

Table 2.7: Age at First Marriage and Fertility using regions as an identification strategy

	(1) Age at first Marriage	(2) Marriage below Age 18	(3) Fertility
Any exposure in utero*War region	0.208	0.018	0.070
	(0.316)	(0.021)	(0.188)
Any exposure at ages 0-3*War region	-1.262***	0.068***	0.257
	(0.330)	(0.019)	(0.188)
Any exposure at ages 4-6*War region	0.398	-0.017	-0.055
	(0.263)	(0.021)	(0.151)
Any exposure at ages 7-12*War region	-1.458***	0.062**	0.422***
	(0.317)	(0.024)	(0.145)
Any exposure at ages 13-16*War region	-0.750	0.079	0.872***
	(0.512)	(0.054)	(0.215)
Any exposure utero	0.066	-0.042**	-0.072
	(0.274)	(0.020)	(0.162)
Any exposure at ages 0-3	0.310	-0.012	0.098
	(0.348)	(0.026)	(0.202)
Any exposure at ages 4-6	-0.355	0.035	0.215
	(0.561)	(0.045)	(0.268)
Any exposure at ages 7-12	-0.830	0.106	0.433
	(0.570)	(0.066)	(0.356)
Any exposure at ages 13-16	1.048	0.036	0.589
	(1.085)	(0.071)	(0.361)
Wealth index	0.499***	-0.040***	-0.233***
	(0.041)	(0.003)	(0.021)
N	13237	13237	13496

Note: Each column is a separate regression. Standard errors in parenthesis and clustered at the year and ethnicity level. Regressions include survey year dummy and year, state, ethnicity dummies.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.8: Second Generation Infant and Child Mortality using regions as an identification strategy

	(1) At least one infant dying less than 12 months	(2) At least one child dying under the age of 5
Any exposure in utero*War region	-0.019 (0.029)	0.006 (0.029)
Any exposure at ages 0-3*War region	-0.022 (0.027)	-0.017 (0.030)
Any exposure at ages 4-6*War region	0.001 (0.026)	0.008 (0.029)
Any exposure at ages 7-12*War region	0.057** (0.024)	0.067** (0.028)
Any exposure at ages 13-16*War region	-0.071 (0.055)	-0.047 (0.059)
Any exposure in utero	-0.039 (0.029)	-0.035 (0.028)
Any exposure at ages 0-3	0.020 (0.036)	0.037 (0.031)
Any exposure at ages 4-6	-0.067** (0.033)	-0.059* (0.031)
Any exposure at ages 7-12	-0.005 (0.071)	-0.009 (0.056)
Any exposure at ages 13-16	0.093 (0.077)	0.093 (0.065)
Wealth Index	-0.035*** (0.003)	-0.047*** (0.003)
N	13496	13496

Note: Each column is a separate regression. Standard errors in parenthesis and clustered at the year and ethnicity level. Regressions include survey year dummy and year, state, ethnicity dummies. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2.6.3 Education as a potential mechanism

Several studies have asserted that there is a well-established relationship between education and age at first marriage (Van Den Berg & Gupta, 2015) as well as education and fertility (Osili & Long, 2008). Regressions in Tables 2.9 and 2.10 control for females' years of education while examining the impact of the war on marriage, fertility, and infant mortality. The results for all regressions show that there is some decrease in the magnitude of the coefficients of interest age groups 0 to 3 and 7 to 12; yet, they remain to be significantly different from zero. This suggests that the education may have only a partial effect on the adverse outcomes of both groups; yet, other factors including socioeconomic status, malnutrition, and poor maternal health may have had an impact on the worse long-term outcomes of children exposed to the war during early childhood and early adolescence.

Table 2.9: Age at First Marriage and Fertility after controlling for education

	(1) Age at first Marriage	(2) Marriage below Age 18	(3) Fertility
Any exposure utero*War ethnicity	0.084	0.026	0.239
	(0.258)	(0.021)	(0.153)
Any exposure at ages 0-3*War ethnicity	-1.011***	0.059***	-0.060
	(0.258)	(0.019)	(0.164)
Any exposure at ages 4-6*War ethnicity	0.378*	0.004	-0.019
	(0.222)	(0.019)	(0.137)
Any exposure at ages 7-12*War ethnicity	-1.088***	0.064***	0.274**
	(0.267)	(0.023)	(0.132)
Any exposure at ages 13-16*War ethnicity	-0.040	0.047	0.530*
	(0.488)	(0.043)	(0.271)
wealth index	0.081**	-0.008**	-0.063***
	(0.036)	(0.003)	(0.019)
Years of Female Schooling	0.294***	-0.023***	-0.111***
	(0.016)	(0.001)	(0.007)
N	13228	13228	13228

Note: Each column is a separate regression. Standard errors in parenthesis and clustered at the year and ethnicity level. Regressions include uninteracted exposure to war, survey year dummy and year, state, ethnicity dummies. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2.10: Second Generation Infant and Child Mortality after controlling for education

	(1) No. of infants dying less than 12 months	(2) At least one infant dying less than 12 months	(3) At least one child dying under the age of 5
Any exposure utero*War ethnicity	0.075	0.020	0.043
	(0.063)	(0.027)	(0.026)
Any exposure at ages 0-3*War ethnicity	-0.125**	-0.038	-0.032
	(0.057)	(0.027)	(0.027)
Any exposure at ages 4-6*War ethnicity	0.042	0.012	0.022
	(0.050)	(0.027)	(0.030)
Any exposure at ages 7-12*War ethnicity	0.019	0.051**	0.058**
	(0.050)	(0.025)	(0.028)
Any exposure at ages 13-16*War ethnicity	-0.073	-0.088*	-0.060
	(0.104)	(0.045)	(0.046)
Wealth index	-0.060***	-0.022***	-0.028***
	(0.007)	(0.003)	(0.003)
Female years of education	-0.024***	-0.010***	-0.013***
	(0.002)	(0.001)	(0.001)
N	13485	13485	13485

Note: Each column is a separate regression. Standard errors in parenthesis and clustered at the year and ethnicity level. Regressions include survey year dummy and year, state, ethnicity dummies. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2.7 Conclusion

Exposure to war during childhood has severe adverse impacts in the long-run. Our study shows that early adolescence tends to be one of the most sensitive age groups to shocks and this is reflected in worse health and social outcomes in the long-run. Our results indicate that, even after controlling for lower education, the age group 7 to 12 suffers from worse outcomes including early marriage, higher fertility, and higher

probability of infant and child mortality. Public health intervention and relief efforts focus mostly on children younger than 5 years, as it is a critical developmental stage. Public health also gives more attention to those aged 15 to 24 years, as they tend to be the most exposed to HIV infection and unplanned pregnancy. Yet, the children falling in the age range in between; that is, from 5 to 15 tend to be overlooked by public health policy (Sommer, 2011).

The early adolescence stage is that of puberty onset, which makes girls relatively more vulnerable to family pressures of restricted mobility and forced early marriages. Such restrictions may imply early drop-out of school and result in dangerously early pregnancies, higher fertility, and higher risks of infant mortality. During political conflict, such pressures become even stronger due to lack of safety and tougher economic conditions which families suffer from during wars. Moreover, during puberty onset, girls are most likely to be in need of protein and iron rich supplements which during wars are severely rare. Not meeting nutritional needs at such a critical stage of growth may have a negative impact on girls' energy levels and academic performance which in turn makes them more likely to drop out of school and may also result in worse maternal and child health. Therefore, the take away message is that early adolescence in females is extremely critical and sensitive to political and health shocks. Accordingly, more attention should be given to the forgotten early adolescence age group. Future research would be directed towards exploring the potential mechanisms by which exposure to political conflict during childhood results in worse adult outcomes.

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Chapter 3

Exposure to Shocks during Childhood and its Impact on Domestic Violence

3.1 Introduction

Intimate partner violence is defined by the World Health Organization as "any behavior by an intimate partner or ex-partner that causes physical, sexual or psychological harm, including physical aggression, sexual coercion, psychological abuse and controlling behaviors" (World Health Organization [WHO], 2014). It is estimated that 35 percent of women worldwide have experienced gender-based violence at least once in their lifetime either in the form of intimate partner violence or non-partner sexual violence (WHO, 2014). However, there are vast differences in the prevalence rates of domestic violence worldwide. Developing countries, especially Africa, have the highest rates of intimate partner violence in ever-partnered women reaching 65 percent in Central Sub-Saharan Africa. Also, domestic violence prevalence rates in other low and middle-income countries are as high as 42 percent in South Asia and 41 percent in Andean Latin America. High-incomed countries have relatively lower prevalence rates yet still considerably high, namely, 19 percent in Western Europe, and 21 percent in North America (WHO, 2013). Not until the 1980s has domestic violence gained attention by public policy as a pressing concern and a significant threat to women's health and well-being (Ellsberg & Heise, 2013).

Recent studies have shown that women that are exposed to domestic violence tend to suffer from higher levels of emotional distress, poor physical and reproductive health, and higher risk of HIV infection (Coker *et al.*, 2002; Ellsberg, Jansen, Heise, Watts, Garcia-Moreno, 2008; Li *et al.*, 2014; Watkins *et al.*, 2014). A growing literature also examines the intergenerational consequences of exposure to domestic violence. In particular, children who are exposed to domestic violence have adverse behavioral and academic outcomes with persistence in adolescence (Hungerford, Wait, Fritz, & Clements, 2012; Wolf, Crooks, Lee, McIntyre-Smith, & Jaff, 2003). Schiff *et al.* (2014) have shown that exposure to violence during childhood is associated with depression, anxiety and substance use during adolescence. Moreover, children witnessing parental violence at home are more likely to be victims or perpetrators of intimate partner violence as adults creating a cycle of violence (Cappell & Heiner, 1990; Simons, Johnson, Beaman, & Conger, 1993; Stith *et al.*, 2000). Accordingly, there has been increasing interest in identifying the risk factors behind higher domestic violence since its impact not only affects the generations exposed but is transmitted to future generations as well.

To date, most of the existing research on causes of domestic violence has focused on individual-level variables including income, education and parental conflict that are expected to influence the offspring's quality of marriage. Yet, much less is known about the impact of exposure to community-level violence such as civil war during childhood on long-term domestic violence. Accordingly, the aim of this study is to identify the impact of exposure to civil war during childhood on long-term experiences of domestic violence as adults. We use the Biafra war that took place in Nigeria between years 1967 and 1970 as an exogenous shock to identify how exposure to civil war during childhood

may have an impact on exposed children's domestic violence attitudes as adults. By studying the long-term effects of exposure to war, this paper contributes to an emerging literature tracing the long-lasting scars of political conflict. Previous studies have shown that children experiencing civil war have poorer health and lower educational attainment as adults (Agüero & Deolalikar, 2012; Akresh, Bhalotra, Leone, & Osili, 2012; Akresh & de Walque, 2008; Alderman, Hoddinot, & Kinsey, 2006; Bundervoet, Verwimp, & Akresh, 2009). To our knowledge, this study is one of very few recent studies testing the impact of exposure to civil conflict during childhood on experiencing domestic violence as adults.

Less than a handful of studies investigated the long-term impacts of exposure to civil war on domestic violence (Gallegos & Guitierrez, 2011; Grimard & Laszlo, 2014; Justino, Leone, & Salardi, 2015; La Mattina, 2014). Few studies have shown that women exposed to civil war are more likely to be victims of domestic violence in their marital relationships because they are more likely to accept and justify violence from partners (Gallegos & Gutierrez, 2011) or due to changes in gender composition (La Mattina, 2014). Other studies have shown negative or no impact of exposure to war during childhood on long-run female experience of domestic violence (Grimard & Laszlo, 2014; Justino *et al.*, 2015).

Among the few papers that examine the long-run impact of exposure to civil war during childhood, to our knowledge, we are the first to test the impact of husband's exposure to war as the main mechanism for higher experience of domestic violence in the long-run.

An important strength of this paper is the use of a nationally representative population-based sample which allows heterogeneity and identification of sub-groups to investigate a causal relationship between exposure to political violence during childhood and higher domestic violence as adults for both male and female children. Using the Biafra war as an exogenous shock and difference-in-difference analysis, our model is able to examine the hypothesis of whether the experience of political violence in males and females during childhood and adolescence causes more domestic violence as adults. Also, this paper identifies the mechanisms through which exposure to war may have resulted in higher domestic violence in the long-run.

The study shows that the effects of the experience of violence during childhood are persistent. Specifically, females exposed to political violence during school age (ages 7 to 12) have stronger long-term effects on higher risks of domestic violence in comparison to those unexposed to the war or exposed at younger ages (in utero until age 5). This may be justified by the fact that older children have more mature cognitive abilities to recall such violent experiences in comparison to those exposed at younger ages. Our results also show that husbands exposed to the war as adolescents and young adults (ages 13 to 21) are more likely to be violent perpetrators against their wives and to justify violence in different incidents in comparison to those unexposed to the war. Having a higher impact on older males are expected, as they are more likely to have experienced the war as soldiers or victims of violence, sexual assault and rape which makes them more psychologically affected by the war experience in the long-run.

An interesting mechanism behind the causal relationship between exposure to war and higher domestic violence is that the war negatively affected the quality of marriage

for older males by increasing the educational and earnings gap in couples. Wives of older male cohorts tend to have higher schooling than their husbands resulting in higher domestic violence towards the superior wife. It is worth noting that higher education for wives are independently inversely associated with domestic violence in household bargaining power models; however, recent studies have shown that in male-dominant societies, females with superior powers than their husbands become more susceptible to domestic violence in their marital relationships (Ackerson, Kawachi, Barbeau, & Subramanian, 2008; Burazeri *et al.*, 2005; Flake, 2005). Additionally, results have shown that older males exposed to the war have more lifetime sexual partners than those unexposed to the war, possibly due to the high death tolls of males in battlefields and their relative scarcity in the aftermath of wars thereby increasing available female partners. We assume a lower sex ratio of men to women results in a larger number of lifetime sex partners for males which is expected to reduce the bargaining power of wives and increase the risks of intimate partner violence.

3.2 Violence during the Civil Conflict in Nigeria (1967-1970)

The Nigerian (Biafran) civil war took place between years 1967 and 1970 to be one of the most violent civil wars in the history of Africa. The Nigerian civil war was triggered by the interethnic and religious conflicts that became extremely tense as the former military governor of the Eastern region Lt. Col. Ojukwu with the support of the Eastern Region Consultative assembly declared the region's independence under the name of the Republic of Biafra in 1967. The Nigerian government considered this as an illegal secession and announced war on the state of Biafra in attempt to unify the country

once again. The war lasted for 31 months and ended in January 1970 with the surrender of Biafra to the Nigerian federal troops (Zinn, 2005). The war was characterized by being relatively short but very intense. The human toll was estimated to be between 1 and 3 million deaths (Smith, 2005). Deaths were either due to mass killings in the battlefield or families and children dying of famine and hunger.

Wars not only cause death and disease but they are also a perfect setting for harassment, intimidation, rape, and forced pregnancies which have long been used as instruments of war. Accordingly, such horrifying experiences are expected to have their own long-term impact on the behaviors of those who endure them during childhood. The war took place in the South-Eastern region of Nigeria which was mainly dominated by the Igbo ethnicity along with other minorities who suffered from the brutality of the war and the massacres that preceded the war. Experiencing the trauma of war as a child or teenager is expected to have long-term impact.

Experiences of the war differed by the gender of the child. Boys at certain age groups were exposed to the military experience as child soldiers. Initially, the Biafran army recruited boys aged 18 and older to participate in the armed forces of the war. However, due to shortage of arms, later during the war boys as young as the age of 15 were conscripted to participate in the Biafra army (Uchendo, 2007). On the other hand, girls were victims of sexual harassment from Federal and Biafran soldiers and sustained living through prostitution and cohabitation with soldiers (Uchendo, 2007). Our hypothesis is that children who are exposed to harsh experiences of violence during wars

are more likely to experience domestic violence as adults as either victims or perpetrators.

3.3 Background Literature

3.3.1 Theoretical Perspectives on Intimate Partner Violence

Johnson (1995) classifies intimate partner violence as either intimate terrorism or situational couple violence. The classification of domestic violence depends on the underlying motivation of the perpetrator. *Intimate terrorism* is when the violent partner continuously exerts control tactics that are mostly nonviolent such as intimidation, isolation, emotional and economic abuse, coercion, and threats to gain power and control over his intimate partner. In case the victim does not comply, they may resort to physical violence. In most of the cases, the perpetrator in this type of violence is the male (Dobash, 2003; Graham-Kevan & Archer, 2003; Zlotnick, Johnson, & Kohn, 2006). The second type of domestic violence is *Situational Violence* which is motivated by conflict between partners and not by the desire to overpower the partner (Johnson & Leone, 2005). This type of violence may escalate into physical aggression and is perpetrated by both men and women. However, such situations occur less frequently than intimate terrorism violence which is a more chronic pattern of emotional intimidation. Yet, situational violence may be aggravated by economic hardships (Kelly & Johnson, 2008). In other words, adverse macroeconomic conditions have proven in previous studies to have a significant negative impact on the quality of marriage and to result in higher prevalence of intimate partner violence. This has been established in the "Family Stress Model" which illustrates that economic strains lead to higher marital conflict and more

tolerance by the wife towards emotional and physical abuse by the husband (Schneider, Harknett, & McLanahan, 2014).

Wars are one of those situations in which there are intense economic and psychological strains that are expected to result in higher prevalence of situational violence among families who lived through the war. Accordingly, children witnessing violence during wars may be adversely affected in the long-run. Our hypothesis is that witnessing the violence of war during childhood is expected to have an impact on their behaviors towards their wives as adults, either in the form of having a more controlling and overpowering behavior in the household; i.e. higher intimate terrorism; or by being engaged in situational violence when marital conflict arises. There is a growing consensus that past backgrounds and experiences of husband and wife have a significant influence on shaping behaviors of couples in a relationship. Theories in psychology provide several explanations for the relationship between past experiences and future behavior. The "social learning theory" developed by Bandura (1977) suggests that new patterns of behavior can be acquired through direct experience or by observing the behavior of others. In other words, if children witness a significant amount of violence during childhood, they could ultimately become violent persons themselves. Furthermore, the "learned helplessness theory" argues that individuals facing adverse unavoidable and inescapable events suffer from motivational, cognitive, and emotional effects that make them believe that their responses and the shocks are unrelated. As a result, they develop negative beliefs in their abilities and react passively to similar situations in the future (Maier & Seligman, 1976). Accordingly, the theory predicts that females that have faced violence as children in their family of origin are more likely to be accepting to be victims

of violence as adults and to believe that any effort to face such situations is futile (Peterson & Seligman, 1983). In other words, psychology theory predicts that individuals with higher exposure to violence early in their lives are more likely to be victims or perpetrators of violence in their own relationships in the long-run.

3.3.2 Previous Empirical Work on Domestic Violence Risk Factors

In most African cultures, domestic violence is considered to be an exclusive right given to husbands (Oyediran & Isiugo-Abanihe, 2005). Incidence of intimate partner violence in households is determined by the couple's current characteristics and past background experiences (Capaldi, Knoble, Shortt, & Kim, 2012; Hindin, Kishor, & Ansara, 2008). One of the most significant determinants of domestic violence is the educational status of both partners. Most of the literature on domestic violence has shown that higher educational attainment by husband and wife independently reduces the risk of domestic violence within the household. However, the higher the difference in educational attainment between both partners, the higher the probability of domestic violence (Abrahams, Jewkes, Laubscher, & Hoffman, 2006; Ackerson *et al.*, 2008; Flake, 2005). Moreover, females marrying at younger ages are more likely to experience domestic violence relative to those marrying at older ages (Hindin *et al.*, 2008; Rodriguez, Sheldon, Bauer, & Perez-Stable, 2001; Kim & Gray, 2008). Other factors associated with higher intimate partner violence are low household income (O'donnell, Smith, & Madison, 2002) and unemployment of husband (Brownridge & Halli, 2002; Caetano, Vaeth, Ramisetty-Mikler, 2008; Ellison, Trinitapoli, Anderson, & Johnson, 2007).

Wives are not the only victims of intimate partner violence, but their offspring also suffer from adverse mental and health effects in the short and long-run. Children residing in homes experiencing domestic violence suffer from relatively more emotional and behavioral problems in comparison to others raised in non-violent families, as they tend to be more aggressive, socially incompetent, anxious, and depressed (Hungerford *et al.*, 2012; Wolfe *et al.*, 2003). Some of these adverse effects are long-term and continue into young adulthood. Schiff *et al.* (2014) argue that witnessing intimate partner violence during childhood is associated with depression, anxiety and substance use during young adulthood. In addition, these children tend to have lower cognitive abilities and academic performance (Hungerford *et al.*, 2012; Huth-Bocks, Levendosky, & Semel, 2001; Kitzmann, Gaylord, Holt, & Kenny, 2003). Moreover, Carrell and Hoekstra (2010) show that children exposed to parental violence cause adverse effects on their peers' academic achievements. This is because they negatively affect learning in the classroom either through their disruptive behavior or their low academic performance, which slows down the learning of their peers. Accordingly, negative spill-over effects of domestic violence are intergenerational which emphasizes its importance as a public health priority.

Several empirical studies supported this argument showing that females who witness parental physical conflict and experience abuse in childhood are more likely to be victims of violence in their dating and marital relationships than those who did not (Aldarondo & Sugarman, 1996; Maker, Kammelmeier, & Peterson, 1998; Renner & Slack, 2006). The same applies for males exposed to violence during childhood who are more likely to become perpetrators in their relationships with their partners (Roberts, Gilman, Fitzmaurice, Decker, Koenen, 2010). Moreover, Linder and Collins (2005) show

a significant positive correlation between childhood physical abuse, parent-child boundary violations and later perpetration and victimization in their romantic relationships as adults. Ehrensaft, Cohen, and Johnson (2006) argue that the association between childhood family violence and higher risk of partner violence in adulthood is partially mediated by personality disorders in early adulthood.

Most of the previous work on the relationship between exposure to violence during childhood and later experience of domestic violence are association studies which deal with household-level parental violence. Yet, much less is known about the impact of exposure to community-level violence such as civil wars on later experiences of domestic violence in marital relationships as adults. War is a traumatic event in which children experience overwhelming powerlessness and terror. Children exposed to wars witness significant levels of violence including homicide, mass destruction, sexual assault, rape, and torture. Moreover, during wars females not only face threats of physical and sexual abuse from their enemies but domestic violence also increases as men take out their frustrations on women (Colson, 1995). Accordingly, we hypothesize that children exposed to war are more likely to be perpetrators or victims in their marital relationships as adults.

Very few studies examined the impact of long-term impacts of exposure to civil war on domestic violence. Gallegos and Gutierrez (2011) show that females exposed to the civil conflict in Peru during childhood and teenage years had higher probability of being exposed to domestic violence in their marriages as adults. Their study showed that the main mechanism behind this association was that females exposed to war during childhood are more likely to accept violence in comparison to females that were not

exposed to the war during childhood. La Mattina (2014) reached similar results arguing that women who married after the 1994 Rwandan genocide were exposed to higher violence than women married before the war. The study showed that the higher incidence of violence is due to changes in the marriage market sex ratios. On the other hand, Justino *et al.* (2015) examine the impact of Timor-Leste conflict exposure on women's empowerment to show that females exposed to the war in the age range of 6 to 24 are more likely to make decisions alone within the household, justify refusing sex, and less likely to be victims of domestic violence. In other words, the conflict empowered the women exposed to the conflict. However, none of the previous studies have examined the role of the husband's exposure to civil war on higher risk of domestic violence towards the wife. We argue that the husband's exposure to civil war is one of the main mechanisms behind the females' higher experience of domestic violence in the long-run. To our knowledge, our study is the first to investigate the role of male children's exposure to civil war on the higher probability of being perpetrators of domestic violence in their long-run marital relationships.

3.4 Data and Methodology

The study uses data from the Nigerian Demographic and Health Surveys (NDHS) for years 2008 and 2013. A nationally representative sample of households is randomly selected and interviewed using a household questionnaire that identifies the household members and the dwelling basic characteristics. Females in the household aged 15 to 49 at the date of the survey are eligible to participate in the female survey by responding to a women's questionnaire that is collecting comprehensive data on demographic, social,

economic, and health information on mother and child. In some countries, DHS also interviews males which are a subsample of the sample used to select the females. Male interviews are a shorter version of the females' interviews conducted using the males' questionnaire. If the men selected and interviewed are husbands of the female respondents, data on both males and females are compiled in the couples' dataset.

One eligible woman from each household is randomly selected to participate in the domestic violence survey. Due to the sensitivity of the issue, interviews on domestic violence proceeded only when maximum privacy had been secured (DHS, 2008, 2013). The survey reports 12 domestic violence indicators that may be experienced by the wife. However, for a simpler interpretation, we group them into 3 types of domestic violence: *Emotional Violence* indicates that the female has been insulted, humiliated or threatened with harm by husband. *Physical Violence* indicates that female has been pushed or shook, slapped, punched, arm twisted, hair pulled, kicked or dragged, strangled, or threatened with knife or weapon. *Sexual Violence* indicates that wife has been forced into unwanted sex or unwanted sexual acts.

The dependent variables are: (1) The wife has ever been a victim of *Psychological Violence*; (2) the wife has ever been a victim of *Physical* violence; (3) the wife has ever been a victim of *Sexual Violence;* (4) a binary indicator showing if the wife has been exposed to *any* of the 3 types of domestic violence.

We examine if females and/or males' exposure to war during childhood may increase the possibility of experiencing domestic violence in the long-run. Analysis is conducted on *females* and *males'* exposure to war separately to examine how exposure to

civil war during childhood would impact genders differently in the long-run. We start our analysis by investigating the impact of females' exposure using the *female individual dataset*. Given that the DHS interviews females aged between 15 and 49, the oldest female cohort in the study was born in 1958 which allows us to include females who have experienced the war as children and early adolescents. (i.e. the oldest cohort was age 9 when the war started and age 12 when it ended). Our sample size consists of 10,536 female respondents. We use information on month and year of birth to construct the duration of exposure to the war in two age ranges. Given that the oldest female cohort included in the surveys used was born in 1958, we divide the sample into two groups: (1) Females exposed before school age, namely in-utero until age 6[3]. (2) Females exposed during school age, which is age 7 till age 12. Unfortunately, older cohorts of females that were respondents in previous Nigerian DHS surveys were not interviewed for the domestic violence module. Accordingly, we could not include females exposed to the war at older age ranges. Information on month and year of birth for each respondent is used to identify the duration of exposure to war by months. The control group is identified as cohorts born after the end of the war by nine months until December 1974. A narrow window for the control group is selected to control for potential confounding events that may arise with a larger window size.

Males exposed to the war during childhood are also expected to be affected in the long-run. As previously mentioned, boys exposed to the war at the age of 15 and above have been conscripted to participate in the Biafra army (Uchendo, 2007). Moreover, older

[3] We tried using narrower group age ranges; namely in utero, 0-3, 4-6. The three groups gave similar results in terms of significance and magnitude. Accordingly, for simplicity of analysis, we compiled them all in one group age range: in-utero till age 6.

boys were more susceptible to be involved as perpetrators or victims of violence, sexual harassment, and socioeconomic hardship. Accordingly, it would be useful to examine how such an experience may affect their long-run behavior towards their wives as adults 40 to 50 years later. To test this hypothesis, we are using the couples' dataset which includes data on both the husband and wife. We use the couples' dataset to examine how a husband's exposure to the war during childhood may have an impact on higher domestic violence experienced by the wife and to test for other indicators of quality of marriage in the couple. It is worth noting that the Males' cohorts in the couple dataset are relatively older. The oldest male cohort used in the analysis was born in 1949 so we reach an age group who were adolescents and young adults at the time of the war. (i.e. the oldest cohort was age 18 when the war started and age 21 when it ended). The sample size including information on both husband and wife is reduced to 6,157 respondents in which males' birth cohorts range between 1949 and 1974. Since the males' cohorts are relatively older, this enables us to capture two extra age groups which are 13-16 and 17-21; that is, adolescence and young adulthood. Tables 3.1 and Table 3.2 show the descriptive statistics of prevalence of domestic violence and exposure variables for the Males and Females samples. The descriptive statistics show that the samples are very comparable in terms of outcome and exposure variables. 20 percent of the females in the sample were exposed to emotional violence, 15 percent were exposed to physical violence, and almost 4 percent were exposed to sexual violence. Overall, 26 percent of females were exposed to at least one type of violence from their partners.

Exposure to war during childhood may change people's perceptions about violence making it closer to a social norm. Therefore, a mechanism by which exposure to

war may be associated to higher domestic violence is an individual's higher justification of violence. The DHS asks both males and females whether they justify violence towards the wife in certain situations such as going out without permission, neglecting children, arguing with husband, refusing to have sex with husband, and burning food. Table 3.1 shows that 40 percent of females justify violence in one or more of these situations. On the other hand, Table 3.2 shows that 25 percent of males justify violence in one or more of these situations; however, the high standard deviation indicates that there is a wide variation in males' tendency to justify violence.

Exposure to war may also affect the quality of marriage between husband and wife by increasing the age and education gap between partners. Moreover, wars may lead to higher fatalities and incarcerations of males approaching the age of marriage which may result in relative scarcity in males and lower bargaining power for the wife. These aforementioned characteristics may have a negative impact on the quality of marriage, which in turn may result in higher domestic violence between partners. We test for the potential mechanisms for the causal relationship between exposure to war and long-run experiences of domestic violence.

Table 3.1: Descriptive Statistics for dependent and exposure variables for FEMALE Sample (Cohorts: 1958-1974)- Weighted

	Mean	St. Dev.	Min	Max
Dependent Variables:				
Emotional Violence	0.204	0.403	0	1
Physical Violence	0.157	0.364	0	1
Sexual Violence	0.034	0.180	0	1
Any type of violence from husband to wife	0.270	0.444	0	1
Female Exposure Variables:				
Ethnicity exposed to the war	0.136	0.343	0	1
No. of months of exposure to war in age group 0-6	24.014	9.501	1	31
No. of months of exposure to war in age group 7-12	19.190	11.272	1	31
Female Justifies Violence if she:				
Goes out without permission	0.302	0.459	0	1
Neglects Children	0.286	0.452	0	1
Argues with husband	0.254	0.435	0	1
Refuses to have sex with husband	0.234	0.423	0	3
Burns food	0.154	0.361	0	1
Female justifies violence if any of the above situations take place	0.398	0.489	0	1

Table 3.2: Descriptive Statistics for dependent and exposure variables for MALE Sample (Cohorts: 1949-1974) - Weighted

	Mean	St. Dev.	Min	Max
Dependent Variables:				
Emotional Violence	0.205	0.404	0	1
Physical Violence	0.147	0.354	0	1
Sexual Violence	0.037	0.188	0	1
Any type of violence from husband to wife	0.264	0.441	0	1
Male Exposure Variables:				
Ethnicity exposed to the war	0.160	0.366	0	1
No. of months of exposure to war in age group 0-6	24.653	9.094	1	31
No. of months of exposure to war in age group 7-12	19.494	10.938	1	31
No. of months of exposure to war in age group 13-16	18.490	9.667	1	31
No. of months of exposure to war in age group 17-21	20.798	11.124	1	31
Male Justifies Violence if wife:				
Goes out without permission	0.161	0.368	0	1
Neglects Children	0.150	0.357	0	1
Argues with husband	0.138	0.345	0	1
Refuses to have sex with husband	0.119	0.324	0	3
Burns food	0.08	0.273	0	1
Male justifies violence if any of the above situations take place	0.250	0.433	0	1

Table 3.3: Couples' Quality of Marriage Descriptive Statistics -Weighted

	Mean	Standard Deviation	Min	Max
Wife Age	32.835	6.941	15	49
Husband Age	43.107	5.612	33	59
Age difference (Husband age minus Wife age)	10.213	6.083	-14	41
Wife years of education	4.970	5.417	0	19
Husband years of education	6.406	5.882	0	21
Husband's years of education minus wife's years of education	1.435	4.251	-15	17
Female has higher education than Male	0.134	0.340	0	1
Wife age at first marriage	18.060	4.875	6	44
Husband age at first marriage	26.217	6.182	10	51
Husband's number of lifetime sex partners	4.231	6.823	1	90

Table 3.3 shows the descriptive statistics for the quality of marriage indicators. These indicators will be used to identify the mechanisms by which exposure to war may affect the levels of domestic violence in the couple. On average, husband's years of education are 1.5 years higher than his wife. Only 13% of females have education levels higher than their husbands. The average age at first marriage for females is 18 years old; whereas, the average age at first marriage for husband is 26 years old. The average age difference between husband and wife is 10 years difference. However, in extreme cases

wives are 14 years older than husband or husbands are 40 years older than wives. The husband has on average 4 lifetime female sex partners.

In this study, we examine whether exposure to political conflict during childhood causes higher intimate partner violence during adulthood. We follow the same identification strategy conducted by Akresh *et al.* (2012) in their study examining the impact of exposure to the Biafra war on height during adulthood. The difference-in-difference technique that we use measures the pre-post difference in average outcome in the treatment group minus the pre-post difference in the average outcome in the control group allowing us to capture the true effect of the treatment which is exposure to the war. The procedure is based on the assumption of having a "parallel trend" for the treatment and control groups over time. In the study, we test the hypothesis of interest by exploiting ethnicity and cohort variations in the extent to which the civil war affects childhood exposure to violence. The main estimated equation is:

$$\boldsymbol{IPV_{imcers} = \beta_a war_{mce} + \delta_a m_{mc} + \alpha_c + \theta_e + \lambda_s + wealth_{imcers} + religion_i + u_{imcers}}$$

IPV will indicate different types of intimate partner violence in each panel. The subscripts *i, m, c, e, s* index an individual woman *i* of birth month *m* and birth year *c* of ethnicity *e* who is surveyed in year *s*. We use a difference-in-difference identification strategy in which the main variable of interest, $\boldsymbol{war_{mce}}$ is specified as the interaction term in which we use a dummy indicating whether the respondent had *ANY exposure* to the war at each age group and interact it by another dummy showing if the ethnicity of

the respondent was exposed to the war. So, the variable of interest will be the interaction term *(war-exposed ethnicity$_e$*ANY months of war exposure)$_{mc}$*. As an additional identification strategy, we use the months of exposure to the war at a certain age group multiplied by the ethnicity exposed to the war as the variable of interest, *(war-exposed ethnicity$_e$*Months of war exposure)$_{mc}$*. The regression includes fixed effects for ethnicity($\boldsymbol{\theta_e}$), year of birth ($\boldsymbol{\alpha_c}$), a dummy for survey year ($\boldsymbol{\lambda_s}$) and uninteracted months of war exposure ($\boldsymbol{m_{mc}}$). In all of our regressions we control for religion of respondent, and the economic status of the household using the wealth index provided in the dataset. Moreover, year of birth and ethnicity fixed effects are included in all regressions to account for time invariant unobservable characteristics.

We allow the coefficients of exposure variables ($\boldsymbol{\beta_a}, \boldsymbol{\delta_a}$) to vary by age range of exposure. This is because being exposed to the war for certain duration may be relatively more damaging at one age range in comparison to another. The coefficients $\boldsymbol{\beta_a}$ indicate the causal effects of the war on higher domestic violence under the standard assumptions of difference-in-difference models. On the other hand, $\boldsymbol{\delta_a}$ capture any impact on the "untreated" ethnicities for being alive at the time of the war. The standard errors are clustered at the ethnicity levels. The second set of regressions attempt to identify the potential mechanisms by which exposure to war during childhood affects long-term domestic violence experiences. Accordingly, we test the impact of exposure to war during childhood on justification of violence by males and females and other indicators for the quality of marriage between the couple in the long-run.

3.5 Results

Regressions showing the impact of exposure to civil war during childhood on long-run domestic violence have been conducted for *females and males separately*. Table 3.4 presents the results of females' estimations. Females' results indicate that the effects of experiencing civil war during childhood are persistent. Specifically, females exposed to political violence during school age have stronger long-term effects on higher risks of domestic violence in comparison to those unexposed to the war or exposed at younger ages (in utero till age 6). The coefficients on the treatment variable ($\boldsymbol{war_{mce}}$) are statistically significant for the age band 7 to 12 showing that a female exposed to the war in this age range is 10% and 14% more likely to be experiencing emotional and physical violence as an adult, respectively. Panel (5) shows that female's incidence of exposure to war in the age range of 7 to 12 increases the likelihood of experiencing any type of domestic violence by 13% which is 47% of the sample mean. Another specification shown in Table 3.6 uses the months of exposure at each age group as the explanatory variable of interest. Results show that each month of exposure to the war during the age range 7 to 12 increases the likelihood of experiencing any type of domestic violence by 0.005. Since the average number of months of exposure at this age range is equal to 19 months, the likelihood of experiencing any type of domestic violence is on average 9.5% higher than unexposed females of the same cohort which represents 35% of the average likelihood of exposure to domestic violence in the whole sample. Older females being more sensitive to the war shock may be justified by the fact that older children have more mature cognitive abilities to recall such violent experiences in comparison to those

exposed at younger ages. Moreover, those exposed to political conflict at older ages are more susceptible to have been direct victims of violence, sexual assault and rape which makes them relatively psychologically more affected by the experience in the long-run.

Results showing the impact of males' exposure to civil war on their wives probability of reporting the experience of domestic violence are shown in Tables 3.5 and 3.7. Since the male respondents belong to older cohorts, we are able to capture two extra age ranges which are 13 to 16, and 17 to 21. In this sample, the males' years of birth fall between 1949 and 1974; however, there are no restrictions on the wives years of birth. In other words, wives may or may not have experienced the war. Estimation results in Table 3.5 show that relatively stronger effects are found for males exposed to the war at older ages. Particularly, females whose husbands have experienced the war at ages 13 and above are more likely to be victims of domestic violence. For males exposed to the war at ages between 13 and 16, wives are 10% more likely to report emotional violence, 8% more likely to report sexual violence and 14% more likely to report any type of violence relative to women whose husbands have not been exposed to the war at this age range which is 53% of the sample mean. Effects of exposure are strongest for males experiencing the war between the ages 17 and 21. Wives of males experiencing the war at late teenage years and young adulthood are more likely to report higher physical violence by 19% and higher sexual violence by 10% in comparison to others whose husbands have not been exposed to the war. Furthermore, they are more likely to report being victims of any type of violence by 16% higher than others whose husbands have not been exposed

to the war, which represents 60% of the average number of women reporting any type of violence in the sample.

One of the main mechanisms behind this relationship is social norms and males and females beliefs about justification of intimate partner violence. Past backgrounds and experiences of husband and wife have a significant influence on shaping behaviors of couples in a relationship. Theories in psychology such as the "social learning theory" developed by Bandura (1977) suggest that new patterns of behavior can be acquired through direct experience or by observing the behavior of others. In other words, if children witness a significant amount of violence during childhood, they could ultimately become violent persons themselves by justifying higher violence as a social norm.

Table 3.4: Incidence of Exposure to War during childhood in FEMALES and long-run Domestic Violence

	(1) Any type of Violence	(2) Any type of Violence	(3) Emotional Violence	(4) Physical Violence	(5) Sexual violence
Female exposed to war at age 0-6*War ethnicity	-0.019 (0.019)	-0.018 (0.019)	-0.011 (0.025)	-0.013 (0.016)	0.003 (0.016)
Female exposed to war at age 7-12*War ethnicity	0.123*** (0.044)	0.127*** (0.045)	0.100** (0.048)	0.142*** (0.054)	0.000 (0.021)
Religion	Yes	Yes	Yes	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year of Birth Fixed Effects	Yes	Yes	Yes	Yes	Yes
Wealth	No	Yes	Yes	Yes	Yes
N	10536	10536	10536	10536	10536

Table 3.5: Incidence of Exposure to War during childhood in MALES and long-run Domestic Violence

	(1) Any type of Violence	(2) Any type of Violence	(3) Emotional Violence	(4) Physical Violence	(5) Sexual violence
Male exposed to war at age 0-6*War ethnicity	0.010 (0.026)	0.011 (0.026)	0.023 (0.020)	0.021 (0.025)	-0.014 (0.016)
Male exposed to war at age 7-12*War ethnicity	-0.044* (0.025)	-0.044* (0.026)	-0.031 (0.029)	-0.019 (0.026)	0.006 (0.015)
Male exposed to war at age 13-16*War ethnicity	0.139*** (0.046)	0.139*** (0.045)	0.101** (0.050)	0.049 (0.042)	0.076*** (0.026)
Male exposed to war at age 17-21*War ethnicity	0.158*** (0.050)	0.158*** (0.051)	0.032 (0.049)	0.189*** (0.044)	0.095** (0.038)
Religion	Yes	Yes	Yes	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year of Birth Fixed Effects	Yes	Yes	Yes	Yes	Yes
Wealth	No	Yes	Yes	Yes	Yes
N	6157	6157	6157	6157	6157

Table 3.6: Months of Exposure to War during childhood in FEMALES and long-run Domestic Violence

	(1) Any type of Violence	(2) Any type of Violence	(3) Emotional Violence	(4) Physical Violence	(5) Sexual violence
Female months of exposure at ages 0-6*War ethnicity	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.000)
Female months of exposure at ages 7-12*War ethnicity	0.005** (0.002)	0.005** (0.002)	0.003 (0.003)	0.005* (0.003)	0.000 (0.001)
Religion	Yes	Yes	Yes	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year of Birth Effects	Yes	Yes	Yes	Yes	Yes
Wealth	No	Yes	Yes	Yes	Yes
N	10536	10536	10536	10536	10536

Table 3.7: Months of exposure to War during childhood in MALES and long-run Domestic Violence:

	(1) Any type of Violence	(2) Any type of Violence	(3) Emotional Violence	(4) Physical Violence	(5) Sexual violence
Months of Male exposure to war at age 0-6*War ethnicity	0.001 (0.001)	0.001 (0.001)	0.001* (0.001)	0.000 (0.001)	-0.000 (0.001)
Months of Male exposure to war at age 7-12*War ethnicity	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.002)	-0.000 (0.002)	0.001 (0.001)
Months of Male exposure to war at age 13-16*War ethnicity	0.004 (0.003)	0.004 (0.003)	0.002 (0.003)	0.003 (0.002)	0.003*** (0.001)
Months of Male exposure to war at age 17-21*War ethnicity	0.006*** (0.002)	0.006*** (0.002)	0.002 (0.002)	0.008*** (0.002)	0.003*** (0.001)
Religion	Yes	Yes	Yes	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year of Birth Fixed Effects	Yes	Yes	Yes	Yes	Yes
Wealth	No	Yes	Yes	Yes	Yes
N	6157	6157	6157	6157	6157

The DHS asks males and females whether they justify using violence in certain incidents such as: going out without husband's permission, neglecting children, arguing with husband, refusing to have sex with husband, or burning food. We examine the impact of males' and females' exposure to civil war on their justification of violence in different situations. Results for FEMALES are shown in Table 3.8 which does not show any significant impact of exposure to war in the two age groups on justification of violence. This means that even though descriptive statistics for justification of violence by females show that 40 percent of females justify violence, exposure to the war does not seem to be the reason behind their justification of violence.

On the other hand, Table 3.9 shows how MALE exposure to the war may have affected their own justification of violence towards their wives. Results show that males who have been exposed to the war in the age group of 13 to 16 appear to have 5% higher justification of violence if their wives go out without permission or argue with husband. Males exposed to the war at the age group of 13 to 16 are 7% more likely to justify any type of violence against the wife, which is 27% of the males' sample mean of justification of any type of violence. The effects are even stronger for older cohorts who have been exposed in the age group of 17 to 21. Results indicate that males exposed to the war in teenage years and early adulthood justify violence against their wives in all the situations proposed in the survey and that they are 10% more likely to justify violence in any of these situations relative to males who have not been exposed to the war which is 40% of the sample mean. This is more likely to happen since the older males have been exposed to the war as child soldiers and have suffered more harsh social and economic

hardships compared to the younger cohorts. This confirms the fact that as the violence on the community-level increases, it becomes a more social norm to justify violence.

Since the results in Tables 3.8 and 3.9 have indicated that exposure to war has not increased females' justification of violence; whereas, it had a significant impact on males' justification of violence; we may expect that males' exposure to war may be the main mediating factor behind the higher reporting of domestic violence by females in both samples. To test this hypothesis, we use the couples' data to test how both females' and males' exposure to the war affects domestic violence in couples. Results are displayed in Table 3.10.

Table 3.8: Impact of exposure to war on FEMALES' long-run justification of Domestic Violence

	(1) Going out without permission	(2) Neglects children	(3) Argues with husband	(4) Refuses to have sex with husband	(5) Burns food	(6) Any Violence Justified
Female exposed to war at age 0-6*War ethnicity	-0.009 (0.028)	-0.003 (0.023)	0.011 (0.020)	0.022 (0.019)	0.014 (0.013)	-0.011 (0.035)
Female exposed to war at age 7-12*War ethnicity	-0.015 (0.040)	-0.023 (0.041)	-0.042 (0.049)	0.009 (0.029)	0.008 (0.027)	-0.009 (0.050)
Religion	Yes	Yes	Yes	Yes	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year of Birth Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Wealth	Yes	Yes	Yes	Yes	Yes	Yes
N	10536	10536	10536	10536	10536	10536

Table 3.9: Impact of exposure to war on MALES' long-run justification of Domestic Violence

	(1) Goes out without permission	(2) Wife neglects children	(3) Wife argues with husband	(4) Wife refuses sex with husband	(5) Wife burns food	(6) Any Violence Justified
Male exposed to war at age 0-6*War ethnicity	-0.001 (0.027)	-0.012 (0.035)	-0.003 (0.019)	-0.009 (0.019)	-0.014 (0.011)	-0.002 (0.034)
Male exposed to war at age 7-12*War ethnicity	-0.010 (0.022)	0.028 (0.025)	0.021 (0.028)	-0.004 (0.015)	0.002 (0.018)	-0.009 (0.024)
Male exposed to war at age 13-16*War ethnicity	0.052*** (0.019)	0.012 (0.025)	0.047* (0.026)	-0.027 (0.028)	0.008 (0.030)	0.068** (0.027)
Male exposed to war at age 17-21*War ethnicity	0.089** (0.038)	0.162*** (0.050)	0.074* (0.039)	0.085*** (0.025)	0.068** * (0.024)	0.105** (0.042)
Religion	Yes	Yes	Yes	Yes	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year of Birth Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Wealth	Yes	Yes	Yes	Yes	Yes	Yes
N	6157	6157	6157	6157	6157	6157

Table 3.10: Domestic Violence using FEMALE and MALE incidence of exposure at different age groups

	(1) Any Domestic Violence	(4) Any Domestic Violence	(1) Emotional Violence	(2) Physical violence	(3) Sexual violence
Female exposed to war at age 0-6*War ethnicity	-0.088**	-0.084**	-0.056**	-0.117***	0.003
	(0.031)	(0.032)	(0.024)	(0.025)	(0.013)
Female exposed to war at age 7-12*War ethnicity	-0.059	-0.059	-0.012	0.042**	-0.043
	(0.058)	(0.059)	(0.054)	(0.016)	(0.037)
Male exposed to war at age 0-6*War ethnicity	0.015	0.015	0.026	0.029	-0.014
	(0.025)	(0.025)	(0.019)	(0.025)	(0.015)
Male exposed to war at age 7-12*War ethnicity	-0.019	-0.020	-0.017	0.008	0.007
	(0.025)	(0.025)	(0.026)	(0.027)	(0.015)
Male exposed to war at age 13-16*War ethnicity	0.180***	0.178***	0.121***	0.077*	0.085***
	(0.031)	(0.030)	(0.038)	(0.041)	(0.031)
Male exposed to war at age 17-21*War ethnicity	0.204***	0.202***	0.058	0.232***	0.099***
	(0.050)	(0.052)	(0.045)	(0.049)	(0.035)
Religion	Yes	Yes	Yes	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year of Birth Fixed Effects	Yes	Yes	Yes	Yes	Yes
Wealth	No	Yes	Yes	Yes	Yes
N	6157	6157	6157	6157	6157

Results in Table 3.10 show that after including both the exposure of Males and Females to the war in the set of explanatory variables, the significance of the females' exposure disappears and the results are much weaker than those before we include the Males' exposure variables. The only coefficient that remains significant is that of Physical violence for females in the age group of 7 to `12. However, the magnitude of the coefficient becomes significantly smaller than that in Table 3.4 showing a reduction of 10% in the probability of being exposed to physical domestic violence. On the other hand, results for Males remain to be significant and stronger for the older cohorts exposed to the war at the age ranges of 13-16 and 17-21 indicating that Males' exposure may be the main mediating factor behind the higher experience of females to domestic violence. In other words, the Males' exposure to the war is more sensitive and has a stronger impact on females being victims of domestic violence than females' exposure.

Another potential mechanism behind the positive significant relationship between exposure to war and higher domestic violence is the war's impact on the couple's quality of marriage, and the females' relative bargaining power. Accordingly, we examine the impact of exposure to war on the difference in education and age between husband and wife; age at first marriage for husband and wife; wife having higher education than male; female earning more than male; and the males having a higher number of lifetime sex partners as a proxy for scarcity of males after the war.

Couples in which males were exposed to the war in the older ages tend to have a lower quality of marriage. Table 3.11 shows that wives tend to have higher education

than the husband in couples where the males were exposed to the war at the age older than 13. Males exposed to the war at ages 13 to 16 are 13% more likely to have education less than their wives in comparison to males in the same age group who have not been exposed to the war. Also, males exposed to the war at ages 17 to 21 are 12% more likely to have education less than their wives. Previous studies have shown that women with higher status than their husbands have a higher risk of abuse by their husband (Ackerson *et al.*, 2008; Burazeri *et al.*, 2005; Flake, 2005). This is especially true in developing countries in which the man's sense of masculinity and patriarchal power structure are challenged if they sense lacking domination over their wives. This in turn becomes reflected in higher intimate partner violence towards the superior wife.

Table 3.11: Education Gap as a Mechanism for Domestic Violence

	(1) Husband's years of Schooling	(2) Wife's years of Schooling	(3) Difference in Years of schooling (Absolute Value)	(4) Wife has higher Education than Husband
Female exposed to war at age 0-6*War ethnicity	0.799**	0.568**	-0.405	-0.090**
	(0.362)	(0.262)	(0.267)	(0.037)
Female exposed to war at age 7-12*War ethnicity	-0.147	-0.594*	0.912	0.066
	(0.433)	(0.304)	(0.790)	(0.056)
Male exposed to war at age 0-6*War ethnicity	-0.307	-0.147	0.073	0.010
	(0.311)	(0.235)	(0.170)	(0.031)
Male exposed to war at age 7-12*War ethnicity	0.752*	0.012	0.439	-0.075**
	(0.398)	(0.205)	(0.341)	(0.033)
Male exposed to war at age 13-16*War ethnicity	-0.198	0.464	0.765	0.128**
	(0.381)	(0.416)	(0.739)	(0.056)
Male exposed to war at age 17-21*War ethnicity	0.535	0.618**	2.670***	0.124***
	(0.516)	(0.274)	(0.570)	(0.034)
Religion	Yes	Yes	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes	Yes	Yes
Year of Birth Fixed Effects	Yes	Yes	Yes	Yes
Wealth	Yes	Yes	Yes	Yes
N	6157	6157	6157	6157

Males exposed to the war also tend to get married at an older age than their peers not exposed to the war. Results in Table 3.12 indicate that males exposed to the war in the age range of 17 to 21 have 3.5 more lifetime sex partners than those not exposed to the war, which is 82% of the sample mean. If we assume the higher number of male's lifetime sex partners is an indicator of a lower male-to-female sex ratio, then we may deduce that this results in a lower bargaining power for females which in turn results in higher domestic violence. This result confirms a previous study showing that females married after the Rwandan genocide experienced higher rates of domestic violence mainly due to the lower male-to-female sex ratios (La Mattina, 2014).

Our study concludes that older age groups are more sensitive to the scars of the war in comparison to younger cohorts. Males' exposure to the war may be the main mechanism behind the higher long-run domestic violence experienced by females exposed to the war during childhood. The war negatively affected the males exposed at ages 13 an above by letting them have higher justification of violence towards their wives and a lower quality of marriage.

Table 3.12: Quality of Marriage as a Mechanism for Domestic Violence

	(1) Wife's age at first marriage	(2) Husband's age at first marriage	(3) Difference in age between husband and Wife (Absolute Value)	(4) Husband's number of lifetime sex partners
Female exposed to war at age 0-6*War ethnicity	1.209**	-0.043	0.154	-0.738
	(0.488)	(0.569)	(0.264)	(0.459)
Female exposed to war at age 7-12*War ethnicity	0.621	-1.178	-0.090	-1.401*
	(0.986)	(0.805)	(0.405)	(0.753)
Male exposed to war at age 0-6*War ethnicity	0.264	0.535	-0.016	0.912
	(0.291)	(0.358)	(0.104)	(0.816)
Male exposed to war at age 7-12*War ethnicity	-0.560	0.673	-0.068	0.019
	(0.370)	(1.067)	(0.096)	(0.432)
Male exposed to war at age 13-16*War ethnicity	-0.061	2.749***	-0.004	-0.168
	(1.007)	(0.726)	(0.175)	(0.618)
Male exposed to war at age 17-21*War ethnicity	0.120	3.398***	0.086	3.518**
	(0.469)	(0.931)	(0.204)	(1.560)
Religion	Yes	Yes	Yes	Yes
Ethnicity Fixed Effects	Yes	Yes	Yes	Yes
Year of Birth Fixed Effects	Yes	Yes	Yes	Yes
Wealth	Yes	Yes	Yes	Yes
N	6157	6157	6157	6157

3.6 Conclusion

Domestic violence has gained recent attention by public policy as a pressing concern and a significant threat to women's health and well-being. Victims of domestic violence have higher levels of emotional distress, poor physical and reproductive health, and higher risk of HIV infection. The adverse effects of domestic violence are intergenerational, as they negatively impact offspring's behavioral and academic outcomes and their marital relationships as adults. Our study aims at examining the long-term impact of exposure to civil wars during childhood on wives' long-term experiences of domestic violence. Our difference-in-difference estimations on males and females indicate that female cohorts exposed to the war at ages 7 and above are at higher risk of being victims of domestic violence in the long-run. Moreover, male cohorts exposed to the war at ages 13 and above are more likely to become perpetrators of domestic violence in their long-run marital relationships. The main mechanisms for this causal relationship is that exposure to war increases the males' long-run justification of violence towards their wives and reduces the quality of marriage by creating an educational gap between partners. Another mechanism is that exposure to war increases the bargaining power of husbands exposed at the age range of 17 to 21, since results show that they have a significantly higher number of lifetime sexual partners in comparison to those unexposed to the war. We assume that this is due to a lower male-to-female sex ratio since this is the age range in which males are conscripted to the army and are the primary victims and casualties of war.

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Chapter 4

Prenatal Stress and Birth Weight: Evidence from the Egyptian Revolution

4.1 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 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, Wadhwa, Dunkel-Schetter, Chicz-DeMet, & Sandman, 2001). 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, 2011; 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 also 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 2011 Egyptian Revolution 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 health outcomes[4]. 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 two proxies for prenatal stress. The first indicator is the number of fatalities that ranges from deaths due to the security vacuum,

[4] The only other study investigating the micro-level impacts of the Egyptian revolution is Mallakh *et al.* (2015) which tested the impact of the Egyptian revolution on the gender wage gap in the Egyptian labor market. The study used the number of fatalities as an indicator for the intensity of the political shock concluding that the revolution reduced the gender gap within the poorest households. This is because the political shock increased males' income volatility which induced a higher participation by females belonging to the poorest households as a risk coping strategy.

armed attacks from authorities or thugs, brute force by authorities in prisons, or curfew violations. 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.

Most of the fatalities and violence turbulence were located in Tahrir Square which was the focal point where the revolution first sparked and where most of the conflict and turmoil was present. Accordingly, as a second indicator for prenatal stress the study uses the distance from Tahrir Square *if a violence episode took place* assuming that the closer the pregnant woman's *governorate*[5] of residence is from Tahrir Square during the violence shock the more she has experienced the stress of the violence episodes.

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.

[5] "*Governorate*" in Egypt is equivalent to "County" in the United States.

4.2 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" (Chebib & Sohail, 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 among *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 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 points in their pregnancies at times with more or less violence as a natural experiment to examine the causal relationship between prenatal stress and birth weight.

4.3 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. A disadvantage with using natural disasters as a violence indicator or proxy for exposure to stress is that mothers may be affected by other direct effects of these disasters including injury, crowded shelters, inadequate safe food and clean water. Moreover, some of these regions may be known to be more susceptible to hurricanes, volcanos, etc. Accordingly, mothers may anticipate these disasters and adjust their behaviors to cope with emergencies or may choose to migrate to other regions which are less dangerous. This could lead to some selection problems. Currie and Rossin-Slater (2013) attempt to correct for some of those potential problems by using 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, he concludes that exposure to stress during early pregnancy, particularly the first and second trimesters, result in a lower average birth weight. His 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. On the other hand, Mansour and Rees (2012) use al-Alaqsa Intifada to examine how pregnant women's exposure to armed conflict affects birth weight. The study uses the Palestine Demographic and Health Survey for year 2004. 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. However, wars as indicators for stress have their own problems since they usually last for relatively long times; besides, those exposed to the stress of war are also exposed to family displacements, malnutrition, difficulty in transportation, and inadequate prenatal care.

Another interesting 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, 2011, 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.

4.4 Identification Strategy

Violence episodes during the Egyptian Revolution tend to be random, unanticipated, sporadic, and very short. Figure 4.1 displays the daily distribution of

fatalities during the period from January 25th, 2011 till September 30th, 2013. It appears from the graph that the spikes in fatalities tend to last for less than a week. With the exception of the first 18 days of the revolution, periods between violence episodes were characterized by being completely 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. Another incident was on February 1st, 2012 when 74 spectators of a soccer match were killed in the Port Said stadium by their rival fans after their team's victory (BBC, 2012). The most violent episode 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. This indicates that those violence episodes were not expected and the level of variation in the intensity of violence differs from one incident to another. 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 of prenatal stress. In other words, the first identification strategy assumes that the higher the number of fatalities in the *governorate* of residence, the higher the stress levels of the pregnant woman.

As we observe the overall level of violence on the country-level by month which includes both fatalities and injuries displayed in Figure 4.2, we may see that there is no clear pattern for the incidence of violence. This confirms the study's assumption of

randomness of the shock to prenatal stress. Figure 4.3 shows that *governorate*s have shown substantial variation in the number of fatalities over the period of study; however, that the majority of fatalities were concentrated in Cairo, more specifically Tahrir Square. Accordingly, we may expect that residents of governorates closer to Cairo during the violence episode may be more affected by stress than the others residing in governorates that are located farther away. Accordingly, the second identification strategy assumes that the closer the pregnant woman's *governorate* of residence is from Tahrir Square during violence episodes, the higher her levels of stress.

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 Sharm ElSheikh (South Sinai). Yet, those touristic *governorate*s were those with the minimum number of fatalities during the revolution. Accordingly, if there is any bias in the estimates, it should be downwards. The regression also controls for *governorate*-level unemployment rates in the year of birth to minimize any bias arising due to worse economic conditions. Second, the dataset used only reports 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. Accordingly, it is assumed 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.

Figure 4.1: Daily distribution of the total number of fatalities over the period from January 2011 to September 2013

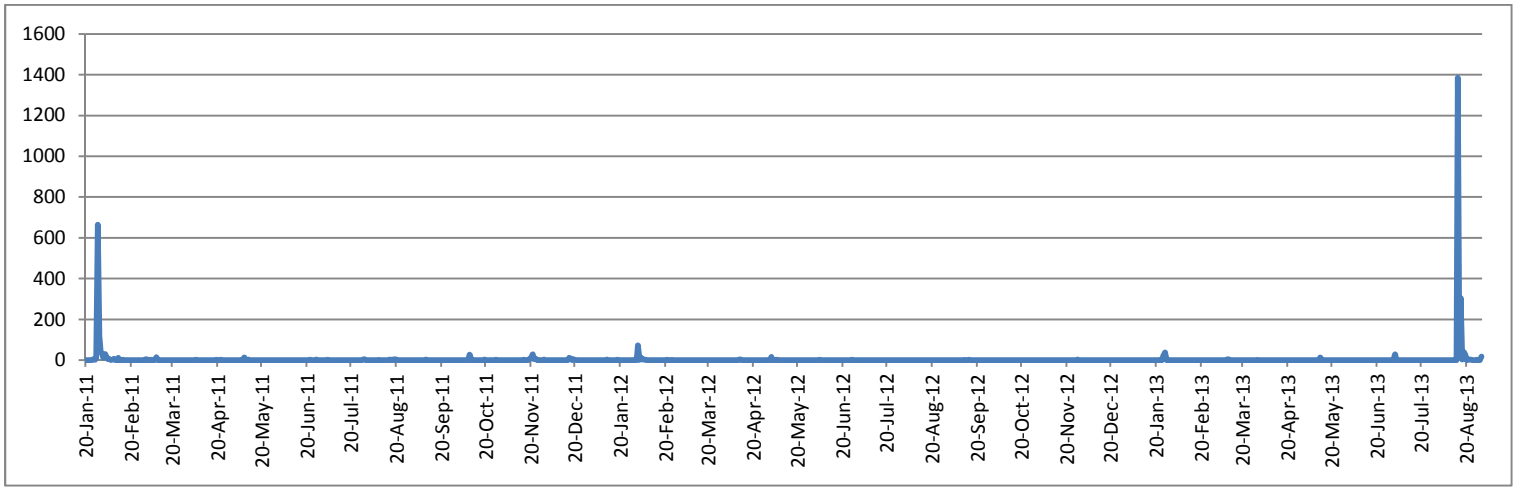


Figure 4.2: Monthly distribution of violence (fatalities and injuries) over the period from January 2011 to September 2013

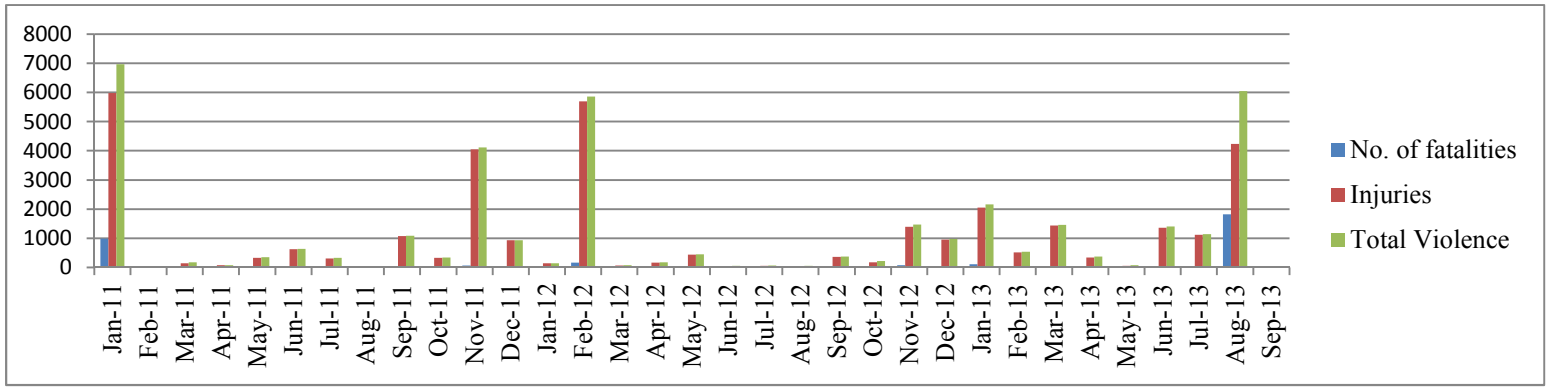
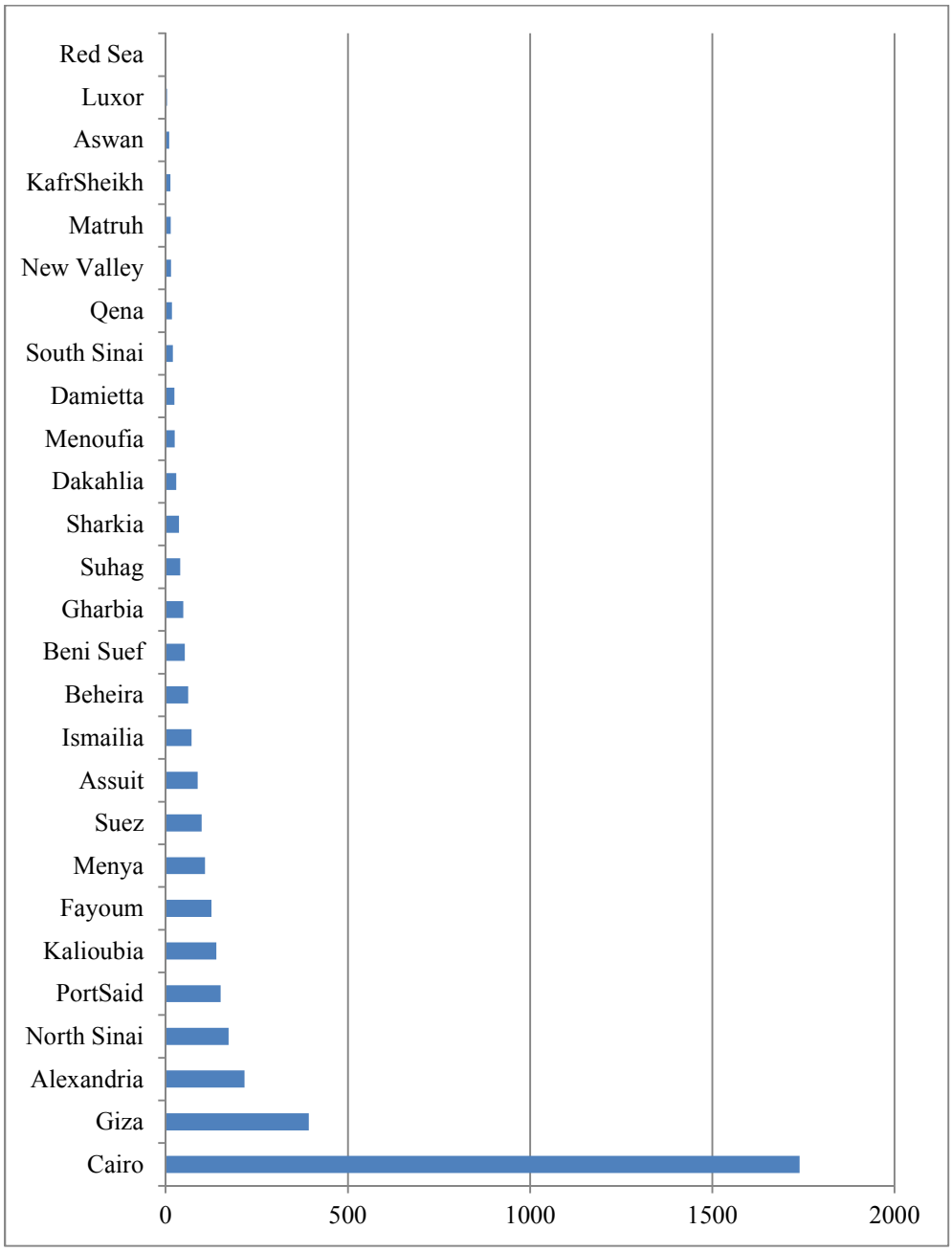


Figure 4.3: Distribution of total fatalities over the period from January 2011 to September 2013 by governorate



4.5 Data and Methods

To examine the impact of prenatal stress on birth weight, the Egyptian Revolution is used as an exogenous shock to the stress levels faced by pregnant women. In this study, two datasets have been used. The first dataset is the Statistical Database of the Egyptian Revolution from which the violence indicators are derived which are used as a proxy for prenatal stress exposure. This database was administered by the Egyptian Center for Economic and Social Rights and includes the names, age and marital status of fatalities in addition to the location, date and cause of death for each fatality. Data 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. Incidences of fatality are collected on daily basis and their sources are included for documentation. 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 individuals such as 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. Accordingly, births included in the survey and whose birth weights are reported are born between May 2009 and June 2014 which implies that the sample includes births that were unexposed to the revolution as fetus and others that were exposed for 1, 2, or 3 trimesters.

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 place of birth. 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 15,827 births included in the DHS sample, 4398 births were not weighed at birth and 1877 births' weight were not recalled by the mother. Accordingly, the sample size for which data for birth weight was available was equal to 9552 births. 4 births were recorded as less than 1000 grams at birth and therefore we dropped them reducing the sample to 9548 births. Only singleton births are included in the analysis, so the aggregate sample is reduced to 9123 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 9050 births born to 7063 mothers. On the other hand, if we include only births with siblings the sample size for births will be reduced to 3842 births born to 1855 mothers. The distribution of births and mothers are shown in Table 4.1. The births included in the sample took place in 25 *governorate*s and were evenly distributed as shown in Table 4.2.

Table 4.1: Distribution of births and mothers

	No. of Births	No. of mothers
1 birth to each mother	5208	5208
2 births to each mother	3454	1727
3 births to each mother	372	124
4 births to each mother	16	4
Total	9050	7063

Two models with two different indicators are conducted for prenatal stress as treatment variables of interest. The *first* model uses the number of fatalities per *governorate* per trimester as the explanatory variable to proxy 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 following model:

$$\mathrm{BirthWeight_i} = \beta_1 \mathrm{Frsttri_{ij}} + \beta_2 \mathrm{Scndtri_{ij}} + \beta_3 \mathrm{Thrdtri_{ij}} + \gamma_1 \mathrm{X_{im}} + \gamma_2 \mathrm{antenatal_i} + \gamma_3 \mathrm{unemployment_{ij}} + \delta_j + \alpha_i + \varphi_i + \pi_m + \varepsilon_{imj}$$

Using the aforementioned model, several specifications are assumed. $\mathrm{Frsttri_{ij}}$, $\mathrm{Scndtri_{ij}}$, $\mathrm{Thrdtri_{ij}}$ 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. *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[6] is denoted by $\boldsymbol{antenatal_i}$. The unemployment rate in the governorate of residence in the year of the child's birth denoted by $\boldsymbol{unemployment_{ij}}$ is also included to control for the economic conditions. 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*, month 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. Accordingly, it is assumed that mother unobservable characteristics that affect birth outcomes do not change over time.

[6] http://www.who.int/gho/maternal_health/reproductive_health/antenatal_care_text/en/

Table 4.2: Distribution of births among governorates

Governorate	No. of Births	Percent
Damietta	544	6.01
Sharkia	492	5.44
Cairo	486	5.37
Suez	480	5.3
Behera	478	5.28
Fayoum	432	4.77
Dakahlia	412	4.55
Giza	404	4.46
Assuit	403	4.45
Menoufia	396	4.38
Menya	367	4.06
Qena	367	4.06
Port Said	366	4.04
Kafr El-Sheikh	365	4.03
Kalyubia	363	4.01
Gharbia	342	3.78
Ismailia	342	3.78
Beni Suef	328	3.62
Aswan	316	3.49
Souhag	311	3.44
Alexandria	304	3.36
Luxor	298	3.29
Matroh	221	2.44
Red Sea	144	1.59
New Valley	89	0.98
Total	9,050	100

The *second* model uses proximity to Tahrir Square as the main variable of interest. Here we are assuming the closer the woman resides to Tahrir Square *during a violence episode*, the more stressed she will be.

$$Y_i = \beta_1 \text{distshock\_frsttri}_{ij} + \beta_2 \text{distshock\_scndtri}_{ij} + \beta_3 \text{distshock\_thrdtri}_{ij} + \gamma_1 X_{im}$$
$$+ \gamma_2 \text{antenatal}_i + \gamma_3 \text{unemployment}_{ij} + \gamma_4 \text{shock\_frsttri}_{ij}$$
$$+ \gamma_5 \text{shock\_scndtri}_{ij} + \gamma_6 \text{shock\_thrdtri}_{ij} + \gamma_7 \text{Proximity to Tahrir sq.}_i$$
$$+ \alpha_i + \varphi_i + \pi_m + \varepsilon_{imj}$$

We first identify dummy variables indicating whether there was a violence shock or not during each trimester of pregnancy (shock_frsttri, shock_scndtri, shock_thrdtri). The dummy variables take the value of 1 if the number of fatalities all over the country exceeded the average number of country-level fatalities. Afterwards, we multiply the incidence of violence shock in each trimester by the reciprocal of the distance to Tahrir Square. The magnitude of the variable will then reflect the proximity to Tahrir Square at the time of the violence episode. The variables of interest denoted as distshock_frsttri, distshock_scndtri, and distshock_thrdtri are calculated as the Incidence of a violence shock in each trimester multiplied by proximity to Tahrir Square (i.e. Incidence of Violence shock/distance from Tahrir Square). Accordingly, the closer the residence is from Tahrir Square during a violence episode, the higher the magnitude of the variable of interest ranging from 0 to 1. 0 indicates that no violence took place during the trimester of pregnancy and the magnitude of the variable increases as we get closer to Tahrir Square during a violence episode. A value of 1 indicates that a violence episode took place and the pregnant woman was living in Cairo. Distances between *governorate* of residence and Tahrir Square were derived using Google maps. Since proximity to Tahrir

Square is collinear to *governorate* fixed effects, we eliminate the latter variable from the regression equation[7]. Descriptive statistics for the variables are shown in Table 4.3.

Table 4.3: Descriptive Statistics of Aggregate Sample - Weighted

Variable	Obs	Mean	St. Deviation	Min	Max
Birth Weight (in grams)	9050	2952	611.18	1000	6000
Low Birth weight (BW<2500gm)	9050	0.129	0.336	0	1
Governorate-level no. of fatalities in first trimester	9050	8.245	58.447	0	1105
Governorate-level no. of fatalities in second trimester	9050	10.350	73.106	0	1105
Governorate-level no. of fatalities in third trimester	9050	13.409	82.459	0	1105
Child gender (Female=1)	9050	0.47	0.499	0	1
Child birth order	9050	2.294	1.327	1	12
Mother's age at birth	9050	26.582	5.376	13	47
Mother's years of education	9050	9.674	4.777	0	19
Father's year of education	9050	9.774	4.819	0	23
Mother's Marital Status (married=1)	9050	0.986	0.117	0	1
Urban residence	9050	0.356	0.479	0	1
Rural residence	9050	0.644	0.479	0	1
Antenatal Visit (more than or equal to 4 visits = 1)	9050	0.882	0.322	0	1
Wealth Index	9050	131.07	124.654	100	5957
Distance from Tahrir Square (in kilometers)	9050	236	218.2	1	848
Unemployment rate in *governorate* (in percentage)	9050	12.3	4.7	3.3	27.2

[7] Derivations for the marginal effects of proximity to Tahrir square during violence shocks are included in Appendix.

4.6 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, 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, 2000). Results of regressions testing the effect of exposure to political conflict on birth weight are presented in Tables 4.4 and 4.5. Table 4.5 uses the number of fatalities per trimester in the *governorate* of the mother's residence as the main indicator of prenatal stress. Table 4.5 uses the distance from Tahrir Square *during violence episodes* as a proxy for the degree of exposure to prenatal stress.

In Tables 4.4 and 4.5, panel (1) does not control for any unobservable characteristics of the household by simply conducting a linear regression testing the association between the intensity of violence episodes and birth weight of offspring. Panels (2) to (5) attempt to control for various unobservables by including *governorate*, year, and month of birth fixed effects. Panel (6) 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. Panel (5) which includes all sets of fixed effects and Panel (6) which is restricted to the siblings sample are our preferred specifications.

Results shown in Table 4.4 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. Moreover, by comparing the results in Panel (1) to those in Panel (6), it may be realized that the estimates of interest significantly decrease 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 0.188 grams and 0.136 grams respectively. As we multiply this estimate by the average number of fatalities in *governorate* by trimester among the exposed mothers[8], we find that exposure to political violence in the first and second trimesters reduced the birth weight by 4 and 3.6 grams, respectively (0.13 percent of the average birth weight). So, children born in a *governorate* with at least one violence shock in the first and second trimester of pregnancy weigh on average 7.6 grams less than those born without any violence shocks.

After including *governorate*, month and year fixed effects in panel (5), the magnitude of the coefficients slightly decrease to show that an additional fatality in the *governorate* of the mother's residence reduces birth weight by 0.17 grams in the first trimester and 0.11 grams in the second trimester. As we multiply by the average number of fatalities, results suggest that exposure to political violence during the first trimester reduces birth weight by 3.6 grams, while exposure in the second trimester reduces birth weight by 3 grams (0.12 percent of average birth weight). In other words, after controlling

[8] The average number of fatalities by *governorate* in each trimester for mothers exposed are showed in the footnote of Table 4.4.

for time invariant unobservables on the *governorate* level and seasonal patterns in birth weight, we can find that children born in a *governorate* with at least one violence shock in the first and second trimester of pregnancy weigh on average 6.6 grams less than those born without any violence shocks. Yet, the impact is expected to be bigger if we look at one of the *governorate*s with high intensity of violence such as Cairo where the average number of fatalities per trimester was 185 fatalities. A fetus born in Cairo and whose mother was exposed to at least one violence shock in the first and second trimester of pregnancy weighs on average 52 grams less than a child born in Cairo and not exposed to any violence shocks as fetus (1.8% reduction in the average weight at birth). This result is similar to Torche (2011) which argues that mothers exposed to the Tarapaka earthquake and experienced high intensity of stress in the first trimester gave birth to babies 51 grams lower in weight than those unexposed.

As we include mother fixed effects, the negative coefficients on the first and second trimester remain; yet, the significance of the first trimester goes away. 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 0.08 and 0.11 grams respectively. As we multiply by the average number of fatalities, the siblings sample shows a reduction of 1.7 grams and 3 grams in birth weight as exposure takes place in the first and second

trimester respectively (0.2 percent of average birth weight). The estimates from the siblings sample are smaller than the full sample estimates, yet still significantly different from zero in the second trimester. Accordingly, mothers who were exposed to at least one violence shock in the first and second trimesters weigh 4.7 grams less than their siblings who were not exposed to any maternal stress due to political violence while in utero. These estimates are slightly lower than Camacho (2008) results 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.

Yet, by looking at high violence intensity *governorate*s such as Cairo, we may find that a fetus born in Cairo and whose mother was exposed to at least one violence shock in the first and second trimester of pregnancy weighs on average 36 grams less than his sibling born in Cairo yet was not exposed to any violence shocks as fetus (1.2% reduction in the average weight at birth).

Table 4.4: Birth Weight and Prenatal Stress using fatalities at governorate level

	Outcome: Birth weight in grams					
	(1)	(2)	(3)	(4)	(5)	(6)
No. of fatalities during first trimester in gov.	-0.178***	-0.186***	-0.180***	-0.185***	-0.171***	-0.082
	(0.033)	(0.021)	(0.034)	(0.031)	(0.031)	(0.113)
No. of fatalities during second trimester in gov.	-0.128***	-0.134***	-0.123***	-0.122***	-0.112**	-0.111***
	(0.031)	(0.041)	(0.030)	(0.029)	(0.048)	(0.037)
No. of fatalities during third trimester in gov.	0.010	0.009	0.001	0.044	0.029	0.023
	(0.026)	(0.032)	(0.025)	(0.033)	(0.040)	(0.070)
Unemployment rate in *Governorate* in year of birth	-2.180	-9.387***	-2.258	0.222	-2.060	-2.843
	(1.966)	(2.210)	(2.033)	(1.356)	(3.001)	(3.977)
Wealth Index	0.009	0.008	0.009	0.031	0.025	
	(0.028)	(0.028)	(0.030)	(0.026)	(0.027)	
Age of mother at birth	3.815**	3.301*	3.761*	3.962**	3.487*	-1.856
	(1.842)	(1.818)	(1.858)	(1.878)	(1.855)	(17.189)
Child gender (Female=1)	-37.203***	-37.244***	-37.365***	-36.648***	-36.846***	-67.347***
	(11.669)	(11.724)	(11.616)	(11.563)	(11.682)	(19.514)
Birth order	6.467	8.717	6.569	7.039	8.630	-62.202*
	(7.738)	(7.440)	(7.642)	(7.760)	(7.324)	(34.969)
Mother years of education	6.356**	6.563**	6.418**	6.408**	6.797***	
	(2.314)	(2.382)	(2.322)	(2.312)	(2.382)	
Father years of education	2.398	2.205	2.378	2.442	2.169	
	(1.702)	(1.548)	(1.693)	(1.687)	(1.524)	
Married	74.246	73.184	71.778	83.397	76.546	
	(57.297)	(57.158)	(58.103)	(57.081)	(56.870)	
Urban	33.412*	20.746	33.591*	23.364	18.160	
	(18.029)	(18.006)	(18.138)	(18.337)	(17.950)	
Had a minimum of 4 visits for antenatal care (WHO)	37.409*	39.258*	38.839*	37.645*	41.917*	65.748
	(21.703)	(22.495)	(22.140)	(21.817)	(23.029)	(44.632)
Governorate Fixed Effects	No	Yes	No	No	Yes	
Month of birth Fixed Effects	No	No	Yes	No	Yes	Yes
Year of birth Fixed Effects	No	No	No	Yes	Yes	Yes
Mother Fixed Effects	No	No	No	No	No	Yes
N	9050	9050	9050	9050	9050	3842

Notes: Each column is a separate regression. All robust standard errors in parenthesis are clustered at *governorate* level. The mean [standard deviation] of number of fatalities at the *governorate* level (for the exposed mothers) in the first, second, and third trimesters is 21[91.6], 26[114.21], 29[119.38], respectively.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4.5 uses the distance from Tahrir Square during a violence shock as an indicator for prenatal stress. The regression also includes dummies for any incidence of a violence shock during each trimester[9] and controls for the *governorate* of residence proximity to Tahrir Square. Estimates indicate that there is a significant negative relationship between prenatal stress and birth weight. Yet, the significance of exposure to stress during the third trimester disappears as we restrict the sample to siblings.

The partial derivatives of birth weight with respect to distance from Tahrir Square at the time of the violence episode equal to $-\frac{\textbf{β at trimester x}}{\textbf{distance\^2}}$ [10]. The highest magnitude for the impact appears in panel (5) which restricts the sample to siblings. Given that the mean distance of *governorate*s from Tahrir Square is equal to 236 km. Accordingly, if we compute the partial derivatives at the mean distance from Tahrir Square using panel (5) estimates we may deduce that if the violence episode took place in the first trimester, the birth weight decreases by 0.0025 grams as the mother's residence is an additional 1 kilometer closer to Tahrir Square. The same applies to shocks in the second trimester in which the birth weight decreases by 0.0022 as the mother lives 1 kilometer closer to Tahrir Square. For example, a child born in Cairo and exposed to at least one violence shock in his first and second trimesters in utero will have a birth weight 4 grams lower than a child exposed to the same two shocks but was living in Aswan (which is 848 km far from Tahrir Square).

[9] Violence shock means more than average number of total fatalities that took place during the trimester of pregnancy for the whole period under study.
[10] Derivations for the partial derivatives are shown in the Appendix.

Table 4.5: Birth Weight and Prenatal Stress using distance from Tahrir Square

	Outcome: Birth weight in grams				
	(1)	(2)	(3)	(4)	(5)
Incidence of Violence shock in first tri*Proximity to Tahrir Sq.	-48.688**	-48.936**	-49.453**	-49.313**	-137.744***
	(20.809)	(21.420)	(21.220)	(21.513)	(32.526)
Incidence of Violence shock in second tri*Proximity to Tahrir Sq.	-160.305***	-161.572***	-163.707***	-162.555***	-118.017***
	(23.252)	(22.000)	(21.725)	(20.396)	(31.529)
Incidence of Violence in third tri*Proximity to Tahrir Sq.	-62.505***	-62.427***	-62.262***	-61.993***	46.638
	(17.768)	(17.769)	(17.501)	(17.518)	(35.913)
Unemployment rate in *Governorate* in year of birth	-2.046	-2.061	0.185	0.181	-2.728
	(2.026)	(2.079)	(1.404)	(1.428)	(3.911)
Wealth Index	0.011	0.012	0.030	0.033	
	(0.027)	(0.028)	(0.025)	(0.026)	
Age of mother at birth	3.806*	3.766*	3.976**	3.929**	-3.174
	(1.870)	(1.876)	(1.898)	(1.894)	(20.649)
Child gender (Female=1)	-37.684***	-37.839***	-37.039***	-37.360***	-66.646***
	(11.591)	(11.557)	(11.517)	(11.568)	(19.333)
Birth order	6.503	6.657	6.803	7.081	-62.737*
	(7.790)	(7.694)	(7.794)	(7.645)	(34.857)
Mother years of education	6.318**	6.389**	6.355**	6.431**	
	(2.317)	(2.322)	(2.316)	(2.328)	
Father years of education	2.449	2.429	2.462	2.452	
	(1.684)	(1.677)	(1.674)	(1.666)	
Married	72.555	70.238	81.635	79.567	
	(57.538)	(58.229)	(57.793)	(58.031)	
Urban	29.871	29.646	21.895	21.668	
	(18.095)	(18.211)	(18.461)	(18.548)	
Proximity to Tahrir Square (=1/distance from Tahrir Sq. in km)	35.383*	35.702*	30.171*	30.218	
	(19.103)	(19.540)	(17.456)	(17.838)	
Had a minimum of 4 visits for antenatal care (WHO)	37.658*	38.774*	38.072*	39.434*	66.547
	(21.759)	(22.155)	(21.939)	(22.237)	(45.038)
Incidence of violence episode in 1st trimester	-25.744	-31.369	-16.655	-6.954	6.664
	(18.682)	(19.042)	(23.151)	(28.613)	(36.170)
Incidence of violence episode in 2nd trimester	-21.631	-13.947	-15.564	-2.212	0.432
	(20.939)	(21.057)	(25.528)	(28.086)	(42.943)
Incidence of violence episode in 3rd trimester	9.638	1.138	27.858	23.348	-26.312
	(16.496)	(15.322)	(21.938)	(21.452)	(43.193)
Month of birth Fixed Effects	No	Yes	No	Yes	Yes
Year of birth Fixed Effects	No	No	Yes	Yes	Yes
Mother Fixed Effects	No	No	No	No	Yes
N	9050	9050	9050	9050	3842

Notes: Each column is a separate regression. All robust standard errors in parenthesis are clustered on the governorate level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

As we compute the marginal impact of exposure to the shock in each *governorate* by differentiating with respect to the incidence of a shock, we will find that a first trimester shock impacts birth weight by $\boldsymbol{\beta_1} * \frac{\mathbf{1}}{\boldsymbol{distance\ from\ Tahrir}} + \boldsymbol{\gamma_4}$ whereas exposure in the second trimester impacts birth weight by $\boldsymbol{\beta_2} * \frac{\mathbf{1}}{\boldsymbol{distance\ from\ Tahrir}} + \boldsymbol{\gamma_5}$[11]. Accordingly, exposure to the same shock has a smaller impact as the distance from Tahrir square increases. Using the estimates of the siblings sample in panel (5); we may find that exposure to a shock in the first trimester to a child born in Cairo, characterized by high intensity of violence, results in a reduction of birth weight by 131 grams in comparison to a sibling born in Cairo but has not been exposed to any violence shocks. Moreover, if the child born in Cairo was exposed to a shock in the second trimester, his birth weight will decrease by 118 grams in comparison to his sibling born in Cairo but was not exposed to any violence shocks as fetus[12].

Estimates of the impact of prenatal stress on birth weight in the study may seem different in terms of magnitude in comparison to other studies that tested the same hypothesis. Our explanation is the difference in the identification strategy used in this study compared to previous ones. Fatalities during the Egyptian Revolution mainly measures stress and is uncorrelated to other effects that may contaminate the relationship between both variables such as financial problems, malnutrition, and others. To examine the fact that access to health care has not been affected by the shock, we conduct a regression in which the number of antenatal visits is the dependent variable; whereas, the

[11] Derivations are shown in Appendix.

[12] A child living in Cairo is assumed to be living only 1 km away from Tahrir Square. This distance becomes larger as the child lives farther from Cairo. We use google maps to calculate the distance between the center of the governorate of residence and Tahrir Square.

indicators of prenatal stress used in the study; namely, the number of fatalities and the distance from Tahrir Square are the explanatory variables. 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.

Results are shown in Tables 4.6 and 4.7. In panel (1), the dependent variable shows the number of antenatal visits for each birth record; whereas, in panel (2), the dependent variable is binary equal to 1 if the mother had 4 or more antenatal visits during pregnancy of child as recommended by the WHO. 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.

As a result, we may conclude that the study estimates using various specifications find that the intensity of political conflict during the earlier phases 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.

Table 4.6: Antenatal Visits and number of fatalities by governorate

	(1) No. of Antenatal Visits	(2) Antenatal Visits (Dummy Variable=1 if 4 visits or more)
No. of fatalities during first trimester in gov.	-0.000 (0.001)	-0.000 (0.000)
No. of fatalities during second trimester in gov.	-0.000 (0.001)	-0.000 (0.000)
No. of fatalities during third trimester in gov.	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)	-0.075 (0.114)	-0.010 (0.007)
Birth order	-0.641*** (0.062)	-0.032*** (0.004)
Mother years of education	0.127*** (0.016)	0.008*** (0.001)
Father years of education	0.065*** (0.015)	0.003*** (0.001)
Married	0.041 (0.515)	-0.010 (0.027)
Urban	0.488*** (0.155)	0.010 (0.008)
Unemployment rate in *Governorate* in year of birth	0.001 (0.029)	0.001 (0.002)
N	9050	9050

Note: *Governorate*, month, and year of birth fixed effects are included. Standard errors in parenthesis. * p <0.10, ** p < 0.05, *** p < 0.01

Table 4.7: Antenatal Visits and Distance from Tahrir Square

	(1) No. of Antenatal Visits	(2) Antenatal Visits (Dummy Variable=1 if 4 visits or more)
Incidence of Violence shock in first tri*Proximity to Tahrir Sq.	-0.507	-0.018
	(0.760)	(0.046)
Incidence of Violence shock in second tri*Proximity to Tahrir Sq.	-0.066	-0.019
	(0.696)	(0.038)
Incidence of Violence in third tri*Proximity to Tahrir Sq.	0.789	0.019
	(0.704)	(0.032)
Wealth Index	0.001	-0.000
	(0.001)	(0.000)
Age of mother at birth	0.065***	0.003***
	(0.015)	(0.001)
Child gender (Female=1)	-0.075	-0.010
	(0.114)	(0.007)
Birth order	-0.641***	-0.032***
	(0.062)	(0.004)
Mother years of education	0.127***	0.008***
	(0.016)	(0.001)
Father years of education	0.065***	0.003***
	(0.015)	(0.001)
Married	0.053	-0.010
	(0.514)	(0.027)
Urban	0.489***	0.010
	(0.155)	(0.008)
Unemployment rate in *Governorate* in year of birth	0.001	0.001
	(0.029)	(0.002)
N	9050	9050

Note: *Governorate*, month, and year of birth fixed effects are included. Standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.7 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.

4.8 Appendix

$$Y_i = \beta_1 \text{distshock\_frsttri}_{ij} + \beta_2 \text{distshock\_scndtri}_{ij} + \beta_3 \text{distshock\_thrdtri}_{ij} + \gamma_1 \text{mbrthage}_i + \gamma_2 \text{mthreduc}_m + \gamma_3 \text{fthreduc}_m + \gamma_4 \text{wealth}_m + \gamma_5 \text{bord}_i + \gamma_6 \text{bsex}_i + \gamma_7 \text{marital}_m + \gamma_8 \text{shock\_frsttri}_{ij} + \gamma_9 \text{shock\_scndtri}_{ij} + \gamma_{10} \text{shock\_thrdtri}_{ij} + \gamma_{11} \text{Proximity to Tahrir sq.}_i + \alpha_i + \varphi_i + \pi_m + \varepsilon_{imj}$$

Given that:

$$\text{distshock\_frsttri}_{ij} = \frac{\text{Incidence of shock in first trimester}}{\text{distance from Tahrir Sq.}}$$

$$\text{distshock}_{\text{scndtri}_{ij}} = \frac{\text{Incidence of shock in second trimester}}{\text{distance from Tahrir Sq.}}$$

$$distshock\_thrdtri_{ij} = \frac{Incidence\ of\ shock\ in\ third\ trimester}{distance\ from\ Tahrir\ Sq.}$$

$$Proximity\ to\ Tahrir\ sq._i = \frac{1}{distance\ from\ Tahrir\ Sq.}$$

To calculate the partial effect of distance from Tahrir Square, we need to partially differentiate the outcome variable (Y_i) with respect to distance from Tahrir Square.

$$\frac{\partial Y_i}{\partial distance\ from\ Tahrir\ Sq.}$$

$$= -\beta_1 \frac{Incidence\ of\ shock\ in\ first\ trimester}{(distance\ from\ Tahrir\ Sq.)^2}$$

$$- \beta_2 \frac{Incidence\ of\ shock\ in\ second\ trimester}{(distance\ from\ Tahrir\ Sq.)^2}$$

$$- \beta_3 \frac{Incidence\ of\ shock\ in\ third\ trimester}{(distance\ from\ Tahrir\ Sq.)^2}$$

$$- \gamma_{11} \frac{1}{(distance\ from\ Tahrir\ Sq.)^2}$$

Then we will compute the marginal effects as:

$$\left(\frac{\partial Y_i}{\partial distance\ from\ Tahrir\ Sq.} | Incidence\ of\ Violence\ Shock\ in\ trimester\ x = 1\right)$$

$$- \left(\frac{\partial Y_i}{\partial distance\ from\ Tahrir\ Sq.} | Incidence\ of\ Violence\ Shock\ in\ trimester\ x = 0\right)$$

Where x= 1, 2, or 3.

By computing the partial derivatives and substituting the incidence of shock by 1 and 0, we can deduce that equation

$$\left(\frac{\partial Y_i}{\partial distance\ from\ Tahrir\ Sq.} | Incidence\ of\ Violence\ Shock\ in\ first\ trimester = 1\right)$$

$$- \left(\frac{\partial Y_i}{\partial distance\ from\ Tahrir\ Sq.} | Incidence\ of\ Violence\ Shock\ in\ first\ trimester\ 1\right.$$

$$\left. = 0\right) = \frac{-\beta_1}{(distance\ from\ Tahrir\ Sq)\text{^}2}$$

$$\left(\frac{\partial Y_i}{\partial distance\ from\ Tahrir\ Sq.} | Incidence\ of\ Violence\ Shock\ in\ second\ trimester\right.$$

$$\left. = 1\right)$$

$$- \left(\frac{\partial Y_i}{\partial distance\ from\ Tahrir\ Sq.} | Incidence\ of\ Violence\ Shock\ in\ second\ trimester\ 1\right.$$

$$\left. = 0\right) = \frac{-\beta_2}{(distance\ from\ Tahrir\ Sq)\text{^}2}$$

$$\left(\frac{\partial Y_i}{\partial distance\ from\ Tahrir\ Sq.}|Incidence\ of\ Violence\ Shock\ in\ third\ trimester = 1\right)$$

$$-\left(\frac{\partial Y_i}{\partial distance\ from\ Tahrir\ Sq.}|Incidence\ of\ Violence\ Shock\ in\ third\ trimester\ 1 = 0\right) = \frac{-\beta_3}{(distance\ from\ Tahrir\ Sq)^2}$$

To get the marginal impact of exposure to the shock in each *governorate*, we compute:

$$(Y_i|Incidence\ of\ shock\ in\ trimester\ x = 1) - (Y_i|Incidence\ of\ shock\ in\ trimester\ x = 0)$$

Where x=1,2, or 3.

Marginal impact of exposure to a shock in the first trimester = $\beta_1 * \frac{1}{distance\ from\ Tahrir} + \gamma_8$

Marginal impact of exposure to a shock in the second trimester = $\beta_2 * \frac{1}{distance\ from\ Tahrir} + \gamma_9$

Marginal impact of exposure to a shock in the third trimester = $\beta_3 * \frac{1}{distance\ from\ Tahrir\ Sq.} + \gamma_{10}$

4.9 References

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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.

CURRICULUM VITAE

Ronia Ahmed Hawash

Education

Ph.D. - Economics - Specialization: Health Economics, Minor: Epidemiology, Indiana University-Purdue University in Indianapolis (IUPUI), 2017, USA. Grade Point Average (GPA): 3.87.

M.A.- Economics, American University in Cairo, 2005, Egypt. Grade Point Average (GPA): 4.0.

B.A. - Economics (Very Good with Highest Honors), Faculty of Economics and Political Sciences. Economics Section. Cairo University, 2001, Egypt. Grade: Very Good with Highest Honors.

Teaching, Research and Training Experience

Spring 2016	Lecturer of Health Economics, Department of Economics, Indiana University—Purdue University Indianapolis.

Fall 2015 Lecturer of Introduction to Macroeconomics, Department of Economics, Indiana University—Purdue University Indianapolis.

Guest Lecturer, Economic Development, Indiana University—Purdue University Indianapolis.

Spring 2015 Statistical Analyst/Research Assistant- School of Philanthropy – Indiana University Purdue University in Indianapolis (IUPUI).

Projects:

1. "Where do Men and Women Give? Gender differences in the motivations and purposes for charitable giving." – Women's Philanthropy Institute – Indiana University Purdue University in Indianapolis.
2. "Do Women give more? Findings from three unique datasets." – Women's Philanthropy Institute – Indiana University Purdue University in Indianapolis.

Guest Lecturer, Economic Development, Indiana University—Purdue University Indianapolis.

Fall 2013-Fall 2014 Lecturer of Introduction to Macroeconomics, Department of Economics, Indiana University—Purdue University Indianapolis.

Guest Lecturer, Economic Development, Indiana University—Purdue University Indianapolis.

Fall 2011- Spring 2013

Research Assistant – Department of Economics – Indiana University Purdue University in Indianapolis (IUPUI).

Professional Experience

2004-2010 Lecturer, Department of Economics, German University in Cairo, Egypt.

Courses taught:

Microeconomic Theory

International Trade

Introduction to Econometrics

Economic Development

2006-2007 Part-time Lecturer of the Economics Module, Certified Managerial Accountant Certificate (CMA), American Chamber of Commerce, Cairo. Egypt.

2004-2007 Part-time Lecturer of Applied Econometrics, American University in Cairo, Egypt.

2003-2005	Part-time Lecturer of Mathematical Economics, London School of Economics - External Program in Cairo, Egypt.
2003-2004	Economist, Monitoring and Evaluation - Results Reporting Support Activity (RRSA) – USAID project, Cairo, Egypt.
2002-2004	Teaching Assistant, The American University in Cairo, 2002-2004.
2002-2004	Research Assistant, The American University in Cairo, Egypt.

Research Papers and Publications

Hawash, R. & Osili, U. (2016). The Aftermath of the Biafra War: Early Marriage, Fertility, and Second Generation Infant Mortality. (Working Paper in Progress).

Hawash, R. & Osili, U. (2016). Childhood Shocks and Long-term Domestic Violence. (Working Paper in Progress).

Hawash, R. (2016). Prenatal Stress and Birth Outcomes: Evidence from the Egyptian Revolution. (Working Paper in Progress).

Ammar, N., El-Bassiouny, N., & Hawash, R. (2015). Materialistic Tendencies and Adolescent Healthy Food Consumption: Setting the Research Agenda. *Research Handbook of Marketing in Emerging Economies.* Forthcoming.

El-Bialy, N., Andrés, A. R., & Hawash, R. (2014). Explaining Software Piracy using a New Set of Indicators. Journal of the Knowledge Economy, 1-19.

Hawash, R. & Lang, G. (2010). The Impact of Information Technology on Productivity in Developing Countries. German University in Cairo, Faculty of Management Technology, Working Paper No 19.

Hawash, R. (2007). Industrialization in Egypt: Historical Development and Implications for Economic Policy. German University in Cairo, Faculty of Management Technology, Working Paper No 1.

Hawash, R. (2005). Microeconomics of Brand Loyalty: Learning, Switching, and Uncertainty (Masters Dissertation, American University in Cairo).

Conferences Attended

Indiana University, Vanderbilt University, and University of Louisiana joint conference in Health Economics (2016), Bloomington. Study Presented: "Prenatal Stress and Birth Weight: Evidence from the Egyptian Revolution".

Indiana University mini conference in Health Economics (2012), Bloomington. Study Presented: "The Aftermath of the Biafra War: Early Marriage, Fertility, and Second Generation Infant Mortality"

Honors, Awards, and Fellowships

Robert B. Harris Graduate Teaching Recognition Scholarship in Economics, 2016, School of Liberal Arts, IUPUI.

University Fellowship Award (offered to highest honors PhD applicants), 2011, School of Liberal Arts, IUPUI

Teaching Excellence Award, 2007, German University in Cairo.

Masters Fellowship Grant (offered to highest honors Masters students), 2004, American University in Cairo.