The Effects of Political Participation on Missing Women: Evidence from the Egyptian Protests of 2011-2014*

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Abstract

We examine the effects of political protests during the Egyptian revolution between 2011 and 2014 on missing women in Egypt. We hypothesize that the increased female participation in these protests improved women's empowerment and helped reduce missing women. Using a difference-in-differences analysis, our identification strategy is based on protest intensity heterogeneity and changes in missing women for age group [0-1] before and after the protests across different governorates in urban and rural areas. We find convincing causal evidence that the number of missing women decreased significantly in high protest intensity governorates compared to low protest intensity ones. Based on protest heterogeneity across different periods, we also show that the reduction in missing women in high protest intensity governorates was most visible after the fourth and final phase of protests.

Keywords: Egyptian revolution; Women's empowerment; Missing women; Relative death ratio; Protest heterogeneity.

JEL Codes: B54; D04; D63; D72; O5

1 Introduction

In this paper we explore the effects of women's participation in political protests during the Egyptian revolution of 2011-2014 on missing women in Egypt. Empowerment, political participation and missing women are intrinsically interconnected. The 'missing women' question is first brought to public attention by Sen (1990) and has been studied extensively since then. It is defined by the number of women missing at birth as well as excess female mortality and lower survival rates caused by infanticide, neglect, nutritional deficiency, lack of health care or poor treatment (Alkema et al., 2014; Chen et al., 1981; Clark, 2000; Duflo, 2012; Gupta, 1987; Jayachandran, 2015; Kynch and Sen, 1983; Qian, 2008; Sen, 1989). Despite renewed efforts, including those by the United Nations in its Sustainable Development Goals, gender discrimination against women continues to be a major problem and the number of missing women around the world is estimated to reach 150 million by 2035 (Bongaarts and Guilmoto, 2015).

A large number of studies on the causes of missing women highlight the role of male-biased societal choices, which reveal themselves through selective sex abortion, female infanticide, unequal access to health care and nutrition, and domestic violence (Bhalotra and Cochrane, 2010; Gupta, 2005; Jayachandran, 2015; Jha et al., 2006; Junhong, 2001). For example, Bhalotra and Cochrane (2010) estimate that between 1995 and 2005 around half a million girls went missing due to selective sex abortions in India. Moreover, there are a wide range of studies investigating the importance of women's household conditions, showing that male-biased allocation of resources and women's lack of bargaining power contribute to the missing women problem (Anderson and Ray, 2010; Bardhan and Klasen, 1999; Maharana and Ladusingh, 2014). We, therefore, expect that increasing women's empowerment can help propel societal change in favor of gender equality and reduce the number of missing women.[1] Previous studies also show that the rate of missing women is significantly higher

[1] There are other complementary reasons to explain skewed sex ratios, including falling fertility rates (Das Gupta and Mari Bhat, 1997; Park and Cho, 1995). As fertility rate decreases, parents with strong son

in developing countries where women face a higher degree of gender discrimination.[2]

Our study relates to previous work that highlights the importance of increasing women's political participation, leadership, and activism to improve their social and economic conditions and empowerment (Beaman et al., 2009, 2012; Ghani et al., 2014; Iyer et al., 2012). Among studies that are closest to ours, El-Mallakh et al. (2018) find that Arab Spring had a positive effect on women's labor force participation and reduced intra-household gender gap in Egypt. Likewise, Bargain et al. (2019) report that women's participation in political protests during the Egyptian uprising had a significantly positive effect on women's empowerment. Furthermore, increased political participation and activism is shown to promote women's empowerment in the marketplace and improve their likelihood of reporting domestic violence and sex crimes (Ghani et al., 2014; Iyer et al., 2012; Sahay, 2021). Linking women's empowerment to missing women, previous studies also show that girls' survival is higher in households where females distribute resources (Duflo, 2012).

However, it is also possible that increased political instability and uncertainty can further reinforce gender-biased household decisions and hurt women. Giesing and Musić (2019), for example, argue that the very short-term effects of the 2011 Egyptian uprising included cuts in overall health expenditures and increased spending for son's but not daughter's tertiary education. Shemyakina (2011) reports a similar negative effect of exposure to the armed conflict in Tajikistan on girls' but not boys' school enrollment rates.[3] Therefore, there are

preference are more likely to do sex-selective abortions (Jayachandran, 2017).

[2]While most research focuses on developing countries, there is evidence of similar contributing factors being present in developed countries as well, such as son-preferring behaviors and higher male-to-female ratios, especially among first- or second-generation immigrants (Abrevaya, 2009; Anderson and Ray, 2010; Blau et al., 2020; Dubuc and Coleman, 2007).

[3]Verwimp and Van Bavel (2014) and Diwakar (2015) also report significant negative effects of armed conflict on education, although more for boys than girls, therefore reducing intra-household gender gap. In contrast, El-Mallakh et al. (2018) find no effect of protest intensity in Egyptian revolution on the probability of school enrollment or the educational gender gap.

potentially two opposing effects that counter each other during times of political instability and social mobilization, one with a positive and another with a negative effect on missing women. In this paper, we examine the net effect of these two opposing forces.

The Arab Spring, which included a wide range of democratic protests and civil disobedience, is one of the most important political movements in the Middle East and North Africa (MENA) region in recent history. It started in Tunisia in December 2010, then spread to other MENA countries. In Egypt, the protests started in January 2011 and were immediately met with state violence, leading to arrests, injuries, and deaths. Our focus here is on one unique and widely reported aspect of these protests, which was the unprecedented level of women's participation (Alvi, 2015; Bargain et al., 2019; Dyer, 2013; Gurpinar, 2015; Shalaby, 2016). The Arab Spring and the ensuing Egyptian protests, therefore, offer an interesting case study to explore the effects of political and civic participation on women's empowerment and missing women. In the 2020 Human Development Report of the United Nations Development Program, Egypt came 108 in gender inequality out 162 countries (Bardhan and Klasen, 1999). In Egypt, 34% of women were reported to experience domestic violence and have comparatively worse health conditions (Diop-Sidibé et al., 2006; Zaghloul and Megahed, 2019). Meanwhile, the death rate of women in Egypt is also significantly higher than that in developed countries (Zaghloul and Megahed, 2019). We hypothesize that participation in political protests helped increase women's empowerment and allowed for gains in gender equality, and thus helped reduce the number of missing women.

The 2011 Egyptian revolution and the ensuing waves of political protests and social movements also allow us to explore event heterogeneity. As discussed elsewhere (Acemoglu et al., 2018; Alexander and Apell, 2016; Bargain et al., 2019; Costello et al., 2015), the Egyptian revolution was not homogeneous and encompassed different waves of protests with varying political, economic, and social motivations and goals, including women's rights. While "bread, liberty and social justice" was a rallying cry for millions of demonstrators, including many for whom this was their very first political participation and activism, the protests evolved and took different forms over time. (Costello et al., 2015; Drukan, 2011). Relying on previous research and the report of Egyptian Center for Economic and Social Rights in 2015, we identify four phases of the Egyptian revolution under three different political powers between 2011 and 2014: President Hosni Mubarak and his National Democratic Party (NDP), the Military, and the Muslim Brotherhood (Acemoglu et al., 2018; Bargain et al., 2019). As is examined further in the empirical section, the first wave started in 2011 and targeted President Hosni Mubarak and the widespread authoritarianism and corruption under his 30-year-long rule. The second phase started after the fall of President Mubarak when the country was ruled by the Supreme Council of the Armed Forces between 2011 and 2012. The third phase between 2012 and 2013 covers the period of Mohammed Morsi's presidency and the reign of Muslim Brotherhood as the governing party. The fourth phase was from July 2013 to June 2014 and covers the period of President Adly Mansour, who was the president after a military coup and lasted until the election of the Egyptian military Chief of Staff, El-Sissi, as president in 2014.

Overall, we contribute to studies on missing women, political and civic participation, and women's empowerment while highlighting the connections between women's agency and missing women. We also explore the effects of protest and political participation heterogeneity during the Egyptian revolution. Our empirical analysis is based on the Egyptian Demographic and Health Survey (EDHS) and Bargain et al. (2019), which uses the Egyptian Revolution Database from the Egyptian Center for Economic and Social Rights in 2015. We employ a difference-in-differences methodology, focusing on missing women for the age group of [0-1]. Our identification strategy relies on protest intensity heterogeneity and changes in missing women before and after the protests across different rural/urban governorates in Egypt.[4] We also analyze the effects of different protests in four phases of the Egyptian revolution on missing women. The empirical results suggest that the missing

[4]The geographic unit rural/urban governorates indicate either rural or urban area within a governorate, and there are a total of 25 governorates in Egypt.

women decreased significantly in high protest intensity rural/urban governorates compared to the low protest intensity rural/urban governorates. Furthermore, we find that these effects on missing women were the highest after the fourth wave of protests. These results are robust to a rich set of sensitivity checks.

The rest of the paper is organized as follows. Section 2 introduces the empirical analysis, including the measurement of missing women, treatment and control area classification, the data, and the empirical model. Section 3 provides the empirical results followed by robustness analysis in section 4. Section 5 concludes.

2 Empirical Analysis

2.1 Measuring Missing Women

We estimate the number of missing women for different age groups, in different rural/urban governorates and in different years following Anderson and Ray (2010) approach, which is based on calculating death ratios for different sexes and comparing them with counterfactuals from developed countries where men and women receive more equal treatment than in developing countries (Sen, 1990). Focusing on the age group 0-1, we calculate the age-specific measure of reference death rate of women, $u^w_{irt}(a)$, at age a in rural/urban governorates ir and year t where i denotes a governorate and and r denotes either rural or urban area within that governorate i ($r \in \{rural, urban\}$) in Egypt in Eq. (1):

$$u^w_{irt}(a) = \frac{d^m_{irt}(a)}{\hat{d}^m_t(a)/\hat{d}^w_t(a)} \tag{1}$$

Where a is the age group, $a = 1$,.., n, and $a = 0$ indicates birth. In any age group $a \geq 1$, a includes all deaths between the age of $a - n$ and a. n can be different based on different age group classifications. $d^m_{irt}(a)$ and $d^w_{irt}(a)$) represent the death rate of men and women at age group a in rural/urban governorates ir and year t (i.e., 2007-2014). Likewise, $\hat{d}^m_t(a)$ and $\hat{d}^w_t(a)$

are the average death rates of men and women (per 100,000 people at age group a in year t) in the reference age and country group. As explained later, our focus here is on the age group 0-1. As the reference group, we choose the developed economies of Western Europe (Austria, Belgium, France, Germany, Luxembourg, Netherlands, Switzerland), Canada, United States, Australia, New Zealand, and Japan, defined by the World Bank in 2020 (WHO, 2020).

As argued by Anderson and Ray (2010), even if there is a natural variation in female and male death ratios, such differences are not expected to vary across countries. Furthermore, and again like Anderson and Ray (2010), we are not suggesting here that there is no gender discrimination in developed countries but that these countries set an upper threshold for gender equality, allowing us to compare other countries against this norm. We also assume that the 'discrimination free' death ratios are the same in developed and developing countries as we see no evidence that the genetic makeup of developed countries, including ethnically diverse colonial settler states of Australia, Canada, New Zealand, and US, is any different than those in developing countries.

We calculate the number of extra female deaths (i.e., missing women, $mw_{irt}(a)$) at age a in rural/urban governorates ir at time t (i.e., 2007 – 2014) in Eq. (2). It equals the actual death rate for women ($d^w_{irt}(a)$) minus the reference death rate for women ($u^w_{irt}(a)$), weighted by the number of women in that age group $pi^w_{irt}(a)$:

$$mw_{irt}(a) = \left[d^w_{irt}(a) - u^w_{irt}(a)\right]\pi^w_{irt}(a) \tag{2}$$

where $\pi^w_{irt}(a)$ is the beginning population of women at age a.

Although the DHS data set contains households' location information by ultimate areas, because of data limitations, we calculate missing women at a higher aggregation level, the urban and rural governorate levels. There are 884 ultimate areas in Egypt and the average number of households surveyed per ultimate area is 20.70, while the average number of households that had children aged between 0 and 1 is 15.65. Furthermore, the average number of male and female children for the age group 0-1 in an ultimate area are 27.58 and 25.35, respectively.[5] Because the average number of households surveyed in an ultimate area that had children aged between 0 and 1 is only 52 (26 for the bottom 20 percentile), we find that the male death rate for that age group is often zero in a given year.[6] As a result, the male/female relative death ratio (d^m_{irt}/d^w_{irt}) in an ultimate area, becomes zero as well.

As shown in equation (2), we cannot estimate the missing women for an ultimate area without the information on the reference death ratio ($u^w_{irt}(a)$). To overcome the missing value problem of relative death ratios in an ultimate area, we choose to use a larger geographic unit, i.e. the governorates, which are 25 in Egypt. To incorporate further regional heterogeneity within a governorate, we calculate missing women in rural and urban areas for each governorate, which becomes our unit of analysis. The total number of observations in our sample for the period of 2007-2014 reaches 328, excluding border governorates.

2.2 Treatment and Control Groups

We use two alternative data sources to classify the treatment and control groups. First, to measure protest intensity in the benchmark analysis we use the number of people who are killed during and after the Arab Spring protests between January 2011 and December 2014 in Egypt. We find that the group classification based on the fatality numbers is identical to that based on the injured and arrested people during this period. The data on the number of killed, injured, and arrested is from Bargain et al. (2019) and is based on Wiki Thawra Statistical Database on the Egyptian Revolution, maintained by the Egyptian Center for Economic and Social Rights (ECESR, 2014).[7] Admittedly, this is an indirect proxy for

[5]The average number of male and female children for the age group 0-1 are calculated based on the average number of households surveyed in an ultimate area in a given year.

[6]the maximum number of children in surveyed households in each area is 294 and the minimum number is 1.

[7]We rely on data provided by Bargain et al. (2019), which provide further description of the dataset. For other studies that used this database to measure protest intensity, see El-Mallakh et al. (2018) and Giesing

women's involvements in these protests. Second, and similar to Bargain et al. (2019), as a robustness check, we also use the Survey for Young People in Egypt (SYPE) to classify the treatment and control groups. We rely on information on the number of killed, injured, and arrested people at the governorate level during the entire period and divide it by the average population of governorates to obtain the index (I_{ij}) in Eq. (3).

$$I_{ij} = \frac{N_{ij}}{P_i} \times 100,000 \tag{3}$$

where j refers to the fatalities, injuries, and arrests in governorate i. The numerator, N_{ij}, is the total number of fatalities, injuries, and arrests in different governorates in Egypt between 2011 and 2014. The denominator, P_i, is the average population in different governorates during this period. We do not estimate I_{ij} at the rural/urban governorate level because of three reasons. First, protests mainly took place in urban areas than rural areas. Second, protesters were from both rural or urban areas. Third, we do not have the hometown location information of the protesters who were injured, arrested, or killed in a protest.

After calculating I_{ij} for the fatality, injury, and arrest cases separately, we pick the median values for each and classify the treatment group in a given governorate as the one with a higher incident value than the median.[8] This is our benchmark classification. The treatment and control groups' classifications in these three indexes across different governorates are 100% consistent with each other and are represented by different colors on vertical lines in Figure 1, which also show the aggregate totals between 2011 and 2014.

< Insert Figure 1 Here >

Second, to examine event heterogeneity, we use the fatality information in each of the four phases of protests separately to categorize the treatment and control groups. There are four

and Musić (2019).

[8]Note that there is no information on the injured protesters in Phase 1 or the arrested protesters in Phase 1 and 2. For a similar use, see El-Mallakh et al. (2018) and Giesing and Musić (2019).

phases of protests in the Egyptian revolution, each of which is ruled by different governments, and characterized by different structural characteristics. In other words, these protests are not homogeneous in terms of political, social, and economic motivations and goals of the protesters, likely affecting the level of female participation and its social, economic, and political effects (Alexander and Apell, 2016). Briefly, the four phases of protests correspond to three different power centers that ruled Egypt between 2011 and 2014: Hosni Mubarak and his National Democratic Party (NDP), the Muslim Brotherhood, and the Egyptian Military (Acemoglu et al., 2018; Bargain et al., 2019).

The first phase of protests started right after the Tunisian protests and targeted the autocratic regime of Hosni Mubarak, who ruled Egypt as president for 30 years, and was widely seen engulfed in corruption. This wave lasted for 18 days from January 25, 2011, to February 11, 2011. There was an unprecedented number of women participating in this first stage of the Arab Spring, which caught world's attention (Alvi, 2015; Bargain et al., 2019; Dyer, 2013; Gurpinar, 2015; Lyden, 2013; Shalaby, 2016).

The second phase targeted the Military Council, which came to power after the fall of Hosni Mubarak and lasted from February 11, 2011, to June 30, 2012. During this time, the Supreme Council of the Armed Forces was responsible for ruling Egypt. The common slogans of the protesters during this phase included dignity, liberty, free and fair elections, and social justice. This is the phase that further attracted the global attention as protesters occupied the Tahrir Square in Cairo (Acemoglu et al., 2018).

The third phase was from June 2012 to the end of June 2013 and corresponds to the ruling period of Mohammed Morsi from the Muslim Brotherhood, who was elected as the fifth president of Egypt. This was a period of increased sectarian divisions and conflicts between the secularist and Islamist segments of the population, especially given the President Morsi's and Muslim Brotherhood's efforts to implement undemocratic, gender biased and Islamist legislation (BBC, 2012; Kirkpatrick and El Sheikh, 2012).[9] Even though an unprecedented number of women joined the protests in Phase 1 and 2, there was an increased focus on gender equality and women's rights in the third phase of protests (Alexander and Apell, 2016; Alvi, 2015; Dyer, 2013; Gurpinar, 2015; Lyden, 2013).[10]

The fourth phase was from July 2013 to June 2014 and corresponds to the military rule under the interim presidency of Adly Mansour, who was appointed by the military as president after a military coup that toppled President Morsi (who later died in military custody in 2019). The military government stayed in power until the head of the Egyptian Armed Forces, general Abdel Fattah El-Sissi, was elected after a controversial and undemocratic election as president in June 2014. Civil liberties, including press freedoms and the right to assembly were heavily restricted during this period. In this phase, the protesters aimed at restoring Morsi presidency and targeted the military government and were mostly from the Islamist leaning segments of the population. Banning protests under sweeping powers, most of these protests were suppressed violently and many were killed or injured and tens of thousands were arrested by the military and security forces (Freedom House, 2021; Hamzawy, 2016).

Using the data from the Egyptian Revolution Rights which is collected by the Egyptian

[9]For example, Egypt's Islamist-led Constituent Assembly during the rule of President Morsi approved a new constitution in December 2012, which was heavily criticized for violating freedom of religion, human rights and women's rights, and faced significant opposition (Amnesty International, 2012). Article 2 of the new constitution stated that "Islam is the state's religion…" and "[T]he principles of Islamic law (sharia) form the main source of legislation." Furthermore, Article 4 gave the task of interpreting the Islamic law to religious scholars at Azhar University (Saleh, 2012). McLarney (2013), however, argued that the issues surrounding Islam and women in the new constitution reflected continuity rather than a break with the previous constitution(s).

[10]The attitudes towards women's right to protest was also seen differently by the Morsi government. For example, Morsi is quoted to have said 'It's undignified for women to protest, and they should leave their brothers and fathers to protest for them" Alvi (2015).

Center for Economic and Social Rights, we find that the death incidence for women protesters were 2.3% in the beginning of the first wave, 2.1% in the second, 1.9% in the third, and 2.8% in the forth wave (ECESR, 2014).[11] In phase 4, the protests continued from phase 3 and included clashes between the pro-Islamists and anti-Islamists as well as between the pro-army and pro-democracy groups (Acemoglu et al., 2018; ECESR, 2014).

In comparing these four phases of Egyptian protests, we only use the fatality information because of lack of data on the number of injured and arrested in Phase 1, and lack of data on the number of arrested protesters in Phases 1 and 2. Eq. (4) shows the fatality index for different phases.

$$I_{it} = \frac{D_{it}}{P_{it}} \times 100,000 \tag{4}$$

where D denotes number of fatality, i is governorates and t is year 2011, 2012, 2013 and 2014.

After calculating the governorate-level fatality indexes for the four phases of the Egyptian revolution, we select the associated median fatality index among all governorates in each phase to classify the treatment groups. Figure 2 reveals that the treatment and control groups overlap around 70% between each phase of the protests. The classification in different phases is also 70%, consistent with the group classification in Figure 1.

< Insert Figure 2 Here >

To further check the treatment and control group classifications, similar to Bargain et al. (2019) and Liu et al. (2019), we also use the Survey of Young People in Egypt (SYPE), which includes information on protest participation of women aged 18 to 35 in non-border governorates and their attitudes on protests.[12] Using this information from SYPE, we conduct a governorate-level measure of women's protest participation. The classification variable

[11]For example, in phase one, the total number of people killed is 1,075 in 22 different governorates including 23 women. We use 23 divided by 1,075 to get 2.1%. Similar calculations are done in other phases.

[12]For further discussion of the SYPE database, refer to Liu et al. (2019).

equals one if they participated in or supported any of the protests, and zero otherwise. This classification, which is in Figure 3, is 70% identical with the one from the Egyptian Revolution dataset in Figure 1.

< **Insert Figure 3 Here** >

2.3 Dataset and Control Variables

We use the 2014 Egyptian Demographic and Health Surveys (EDHS) as our main source for control variables in the regression analysis.[13] EDHS includes information on household and family characteristics, demographics, health and living conditions. Even though this is a one-year dataset, it includes panel information on children from 1978 to 2014 at the household level. Of this period, we focus on 2007-2014 to measure the missing women given that it is the closest to the Egyptian revolution.[14] The 2007-2014 period is also reported to have no significant changes in women rights in Egypt Bargain et al. (2019). Furthermore, the 2014 EDHS was conducted right after the end of Egyptian protests, April-May 2014, and was also after the new presidential election on May 26-28, 2014, which will help with our identification.

As for the sample selection, we focus on married women between ages 15 and 49, and exclude households from the border governorates (i.e., Red Sea, New Valley, Mathroh, North Sinai, and South Sinai), which are mostly occupied by Bedouin tribes who have nomadic traditions and their reactions to the protests could arguably be different from others in urban areas and inner cities Bargain et al. (2019). These border governorates are mostly

[13] We do not use the EDHS dataset in 2004, 2007 or 2010 as they only contain information on children born before the Arab Spring protests started.

[14] There is a high level of volatility in the missing women numbers in Egypt prior to 2007, suggesting possible data problems in the EDHS. An alternative could be to focus on the period of 1978-2006. However, this would be too far away from the Egyptian uprising, making identification difficult.

desert areas where only 2% of Egyptians live (CAPMAS, 2017). However, in the robustness analysis, we include these five border governorates and find consistent result. The final dataset contains 328 rural/urban governorate-level observations. Out of this sample size, 136 and 192 observations are from high-protest and low-protest intensity areas respectively.[15]

Table 1 presents summary statistics on the demographic characteristics of respondents in high and low protest areas at the household level (based on the median level of protest intensity using the aggregate-level classification, which includes the total number of fatalities, injuries, and arrests). The upper panel shows that women in high-protest intensity areas have higher levels of primary but lower levels of secondary education as their terminal degrees than lo-protest intensity areas. They also have a slightly higher rate of higher education, albeit statistically not significant. We find no significant difference in terms of female employment to population ratio (i.e., work rate), number of children, or the respondent age in either areas.

< Insert Table 1 Here >

The middle panel of Table 1 presents the demographic information on respondents' husbands. We find that the share of husbands with primary education is higher in high protest intensity areas. They are also younger and have more skilled and unskilled manual jobs. In contrast, low-intensity areas display a higher share of husbands with secondary and higher education. They are also more employed in services and sales jobs. We do not observe any significant difference in terms of unemployment (i.e., $nojob$) of the prevalence of technical jobs (i.e., $TechJob$), clerical jobs (i.e., $Clerical$), self-employed in agriculture (i.e., $Self - Agriculture$), or employed in agriculture (i.e., $Employed - Agriculture$).

The bottom panel of Table 1 provides information at the household level. We observe no economically or statistically significant difference in the religious characteristics or the share

[15] Although the number of rural/urban governorates is 47 in Egypt, we consider only non-border governorates for our analysis. Hence, we have 41 rural/urban governorates in our data for each year. As a result, we have 328 observations for the sample period 2007-2014.

of female-head households. However, households in high-protest areas are more urban, have fewer number of women in the household, have younger smaller in size and wealthier.

In Table 2 we present the average male, female, and relative death ratios for age group 0-1 for the reference region (i.e., developed countries) and Egypt between 2007 and 2014. We find that the relative death ratio of both girls and boys in Egypt are two to four times higher than those in the reference region. We also see that while the relative death ratio in developed countries is less than one, it is significantly larger than one in Egypt, indicating a higher death ratio for females than males.

< Insert Table 2 Here >

In Table 3 we compare the female, male and relative death ratios, the reference death rate for women of age 1 (u^w_{it}), the starting population of females of age 1 (π) and the missing women in the high- and low-protest intensity regions in Egypt between 2007 and 2014. We find that the female death ratio (column (1))is significantly lower in high-protest areas in every year. The same is true for male death ratio (column (2)) in most years. As a result, except for two years, 2007 and 2008, we find the relative death ratio for females to be significantly lower in high-protest areas (column (3)). The reference death ratio for females aged between 0 and 1 (columns (4) vs. (10)) is also lower in this group, except for in three of the eight years analyzed here. Furthermore, we observe a steady decline in missing women (column (6)) in the high-protest areas after 2011 while no such change is visible in low-protest areas. In Table 4, we highlight the differences in female and male death ratios, relative death ratios, reference death rates, starting populations and missing women and their statistical significance between high and low protest intensity regions. We find that while the difference in missing women between the two regions was not statistically significant prior to 2013, it became significant at the 1% level after that.

< Insert Table 3 & 4 Here >

Before moving to the empirical model, in Figure 4 we check the missing women trend in both treatment and control groups. We find that while the missing women in the treatment group was lower than that in the control group before the Egyptian protests started in 2011, they both displayed a parallel trend, suggesting no major changes affecting either group deferentially. After 2011, however, we see a sharp decline in missing women in the treatment group compared to the control group. While both Table 4 and Figure 4 suggest a significant effect of protests on missing women, likely through the effect of increased civic participation of women in political protests, they are not conclusive regarding a causal relationship. We will explore this question more in depth in the next subsection.

2.4 Empirical Model

We use a difference-in-differences method to explore the extent to which the likely participation of women in Egyptian protests affected missing women in the age group of 0-1, which is likely to suffer the most from the negative effects of gender discrimination.[16] We focus on missing women of age 0-1, given that the higher mortality rates for girls at younger ages is a major contributor to the missing women problem (Anderson and Ray, 2010, 2012). Previous studies show that the mortality rates for girls are higher than those for older women due to imbalances in health investment (Jensen and Oster, 2009) and parental discrimination (Barcellos et al., 2014; Jayachandran and Kuziemko, 2011; Junhong, 2001). Gender discrimination worsens the health care and food availability for girls, causing higher female mortality (Gupta, 1987) and lower survival rate (Chen et al., 1981). The shorter time span of the data also makes it easier to identify the effect of political participation on missing women for this age group. Given the short-run findings in Giesing and Musić (2019), we also expect the reduced household health care spending during the 2011 Egyptian protests to hurt girls more than boys. By focusing on the 0-1 age group, we also avoid a possible heterogeneity problem,

[16]For similar uses of the difference-in-differences methodology in the context of the effects of Egyptian revolution, see El-Mallakh et al. (2018), Bargain et al. (2019), Giesing and Musić (2019), and Liu et al. (2019).

caused by the effect of political participation on women's agency, influencing missing women directly for older age groups. In the sample, we find that the share of missing women in total number of women for different age groups is the highest for the age group of 0-1 (Appendix Table A1). We also see that it is higher in the low-protest intensity governorates than that in the high-protest intensity ones (Appendix Table A1). Here the identification works through the effect of political participation on mothers', fathers' and other family members' gender attitudes and women's empowerment. We use Eq. (5) to estimate this relationship:

$$mw_{irat} = \alpha + \beta_1 Post_t \times Treat_{it} + \beta_2 Post_t + \beta_3 Treat_{it} + \gamma X_{irat} + V_{ir} + \varepsilon_{irat} \tag{5}$$

here mw_{irat} measures the missing women, calculated from equations (1) and (2), in rural/urban governorate ir where i denotes a governorate and $r \in \{rural, urban\}$, at age a (i.e., 0-1), and in year t. $Treat_{it} = 1$ if the missing women are in the high-protest intensity governorate areas, and $Treat_{it} = 0$ if they are in low-protest intensity governorate areas. $Post_t = 1$ for year t in the post-Egyptian revolution period of 2011-2014, and $Post_t = 0$ for 2007-2010.) V_{ir} is a vector of rural/urban governorate level fixed effects and ε_{irat} is the error term. We cluster the standard errors at the rural/urban governorate level because missing women measure does not vary within a rural/urban governorate. In estimating Eq. (5) we use information on children from 2007 to 2014 using the 2014 EDHS.[17]

The coefficient β_1 from the interaction of $Post$ and $Treat$ is the difference-in-differences estimation term, capturing the effect of the Egyptian protests on missing women in the treatment group (i.e., the high-protest governorates). β_2 captures the effect of Egyptian protests in both control and treatment groups and β_3 shows the effect of existing differences in missing women rates between the treatment and control groups, irrespective of protest intensities. Here, we rely on the common trend assumption (see Figure 4) and the exogeneity of the protests to the households. Given the double difference and the inclusion of fixed effects

[17] All estimations are done in Stata 17.

in Eq. (5), any location specific cultural difference should not affect the results.

X_{irat} controls for other observables that can affect missing women rates in both the treatment and control groups, and include the respondent's education level (i.e., primary, secondary, higher), employment status, age, religion, income level (i.e., poorest, middle, richer, richest), husbands' age, employment status, and education, urban/rural residence, birth order of children, and the number of children in the households.

3 Results

3.1 Main Results

The benchmark empirical results for the effect of protests on the treatment group (i.e., $Post \times Treat$) from Eq. (6) are presented in Panel A of Table 5 (full regression results are provided in Appendix Table A5 Panel A). Column (1) includes the bare-bones version of Eq. (5) and includes only the treatment group dummy, the time dummy, and their interaction term. Column (2) adds a full set of individual controls. Column (3), which is our benchmark specification, adds governorate urban and rural fixed effects, in addition to individual control variables. Columns (4)-(6) replicate column (3) but using different weighting methods: propensity score weighting (PS) in column (4), DHS survey weighting (Survey) in column (5), and a self-created weighting in column (6) (Kids Age-1 weighting).[18] The standard errors are clustered at the governorate urban and rural levels.

< Insert Table 5 Here >

The results suggest that Egyptian protests helped reduce the number of missing women significantly, around 0.722 in the treatment group in the benchmark estimate of column (3)

[18] The self-created weighting uses the number of kids in age-1 group in different governorates in different years from EDHS divided by the relative number of kids in age1 in different governorates in different years from the Egyptian census.

(per 1,167 people, where 1,167 is the average number of women in the treatment group before the Arab Spring). Based on point estimates in columns (1)-(6), the number of missing women decreased by around 50-89 per 100,000 women in the high-protest intensity governorates compared to the low-protest intensity governorates.[19] This is an economically and statistically significant effect. Furthermore, in columns (4) we repeat the regression analysis using the propensity score reweighting method to relax the linearity assumption. Because the treatment variable is a dummy variable, we use the propensity of being treated and use the inverse propensity score (PS) to get the propensity score weighting (Hirano et al., 2003). First, we use $p_i = P(Treat_i = 1)$ as the probability of i being in a high protest intensity group, based on the set of control variables X_{iat}. We then calculate the weights to use as $1/p_i$ for the treatment group and $1/(1 - p_i)$ for the control group. We also experiment with the survey weighting instead of the propensity score weighting and report the results in columns (5). We also created our own weights in column (6) by using the number of total populations in different governorates in different years from EDHS divided by the number of total populations in different governorates in different years from Egyptian census. The results from these exercises in columns (4)-(6) are quite consistent with our benchmark results. Overall, the findings are quite significant (at 10%, 5%, or 1% level), showing a significant reduction in missing women in high-protest intensity areas. These findings are robust to additional control variables, estimation method, clustering of standard errors and weighting method.

3.2 Event Heterogeneity and Missing Women

The Egyptian protests, as discussed earlier, came in multiple waves between 2011-2014. Even though the treatment and control groups in different phases of the Arab Spring overlap with

[19]We use the coefficient of interaction term in column (3) (0.722), divided by the average number of women in the treatment group before the Arab Spring from 2007 to 2010 (1,167), and then multiply by 100,000. We then get the estimated missing women per 100,000 women, 61.87. The differences with the table are because of rounding. We use the same method to estimate all the missing women in this paper.

each other and with the benchmark classification for the full period by 70% (see Figures 1 and 2), there are still substantial differences across the four waves of protests, including demands and motivations of protesters. Therefore, in this section we address the event heterogeneity and examine if the effect of protests on missing women differs across different phases of the Egyptian revolution.

Using the same analytical model and group classification, we repeat the analysis in Table 5 for each wave of the protests and report the results in columns (1)-(4) of Table 6. While we use the same group classification method (i.e., the median value of protest intensity), the governorate urban and rural areas in the treatment and control groups are now different in each phase. We find that the effect of protests on missing women is statistically significant and negative in the first and the fourth phases but loses statistical significance in the second and third phases, while remaining negative, likely to reflect the cumulative snowball effect of political participation over time. In fact, the effect becomes the highest in the fourth phase, a 71% increase compared to the first phase (i.e., -0.949 in column (4) compared to -0.554 in column (1)). While we cannot pinpoint the exact reason for this increased effect, we hypothesize that it is because of changing nature of the protests and protesters with an increased focus on women's rights in later phases.[20] As discussed earlier, the initial protests targeted President Mubarak as well as corruption and authoritarianism. After the fall of Mubarak, the attention during the 2nd phase of the protests was on democracy, free and fair elections, and social equality. Then came phase 3 where women's rights were a central demand as protesters clashed with the Islamist Morsi government and its attempts to erode secularism and reinforce Islamic rule in the country (BBC, 2012). Another reason for the increased effect of protest participation is the cumulative and lagged effects of protests on missing women as women participants become politically more involved and empowered together with increased awareness of women's rights (Acemoglu et al., 2018; Bargain et al.,

[20]We should note that even though statistically insignificant, the economic effect estimated in column (3) is larger than that in column (1).

2019). The same is likely true for male participants, particularly fathers, influencing their attitudes towards their daughters.

< Insert Table 6 Here >

4 Robustness Analysis

In this section we conduct a large set of robustness checks to scrutinize our earlier findings. All these checks are based on the benchmark linear model in column (3) of Table 5.

First, to rule out the possibility that other unobserved factors might have influenced the missing women in the treatment and control groups before the Egyptian protests started in 2011 and therefore affected our results, we implement a placebo test by setting an artificial intervention event before 2011, which is similar to the method followed by Bargain et al. (2019). Thus, we use 2010 as the artificial "Egyptian revolution" date and only use the sample before 2011. We use the same approach as in Panel A of Table 5 to analyze the changes in missing women from 2007 to 2010. In this placebo test, we set $Post_{it} = 1$ for missing women observed in 2010 and $Post_{it} = 0$ for missing women observed from 2007 to 2009. If the Egyptian revolution and ensuing protests were the true drivers of changes in missing women in the treatment group, we should find no significant effect of the placebo event and the coefficient of the interaction variable should be zero. Panel B in Table 5 shows the results from this exercise. Independent of specification methods in columns (1)-(6), we find that the interaction term is not significant and is near zero, both economically and statistically, supporting our earlier findings. This result is also consistent with the common trend changes before and after 2011 in treatment and control groups in Figure 4.

Second, we cluster the standard errors at the aggregate governorate level, rather than governorate urban and rural levels, and use different regional fixed effects (i.e., municipality vs. governorate levels) and a different bootstrap approach. The results are reported in Table 7 where column (1) is the benchmark result from Table 5 column (3). In column (2), we replace governorate urban and rural fixed effects with aggregate governorate fixed effects. In column (3) we keep the governorate urban and rural fixed effects but cluster the standard errors at the governorate level. In column (4)-(6), we use the bootstrap at 800 replications, 1,000 replications, and the 'wild bootstrap' i, respectively (Cameron et al., 2008; Roodman et al., 2019). The results are consistent with those from Table 5.

< Insert Table 7 Here >

Next, we check the sensitivity of our results to sample selection, treatment and control group classification, and missing women in different age groups, and present the results in Tables 8 and 9. First, women's age can influence the baby's health conditions (UNICEF, 2008). Thus, to rule out any heterogeneous effects among mothers based on age, in column (1) we limit the sample to those women aged from 20 to 40, which is 93.4% of sample observations. Next, because we rely on respondent women's answers to survey questions, the presence of their husbands during the interviews may bias their survey responses and influence the accuracy of our missing women calculations. Societal factors may cause the respondents to give incorrect answers not to disclose any discrimination towards women. To account for this possibility, we exclude women, who are interviewed in the presence of their husbands (column 2) or any other family members (column 3). The results are again consistent with our earlier findings.

< Insert Table 8 Here >

In the benchmark regressions, we excluded the border governorates, which display structural differences from the rest of the country, including their lower population density (i.e., only 2% of the total population lives in those locations between 2007 and 2015) and ethnic composition (i.e., mostly Bedouin tribes) (CAPMAS, 2017). Their inclusion may increase the societal, cultural, and political heterogeneity of the sample and influence the participants' reactions to protests. To test the sensitivity of our results to this exclusion, we include these governorates in the sample. The results in column (4) are again consistent with those from before even if slightly lower.

In the benchmark analysis we use the protest incident intensity to classify the treatment and control groups. As a robustness test, and like Bargain et al. (2019) and Liu et al. (2019), we now use the 2014 Survey of Young People in Egypt (SYPE), which sampled around 10,000 women aged 19-35, not living in the border governorates. SYPE includes information about their protest participation experience and their attitudes towards all protests in the Arab Spring. We classify all women who participated in those protests at least once and had a supportive attitude of those protests into the treatment group; and otherwise into the control group. With this new classification, our treatment and control groups display a 70% overlap with the original classification. Column (5) reports results using this exercise, showing even a larger effect whereby the the point estimate increases (in absolute value) from -0.722 to -0.759 and remain significant. The most intense protests during the Egyptian revolution took place in big cities, particularly Cairo and Alexandria, whose distinct socio-political and economic characteristics may bias our results. Therefore, we drop Cairo (column (6)) and Alexandria (column (7)) and repeat the benchmark regression analysis. The results are again very robust.

We also want to confirm the robustness of our findings to the treatment group classification. After the fall of Hosni Mubarak's regime, the first free and fair election in Egyptian history took place in 2012 and the political Islamist Muslim Brotherhood won 51.7% of the votes with Mohammed Morsi becoming the president. Given significant academic research on the degree of conservatism of Muslim Brotherhood as well as the ensuing popular protests against Morsi government's efforts to undermine secularism and women's rights, we hypothesize that the electorate who voted for President Morsi were more conservative than others. If this was the case, we should see a weaker effect of protest intensity on missing women among this group of electorates.[21] This is also an indirect way of testing our main hypothesis that protest participation helps with women's empowerment and lowers the missing women incidence. we use two governorates, Matruh and Fayoum, where Mohammed Morsi won 75% of the votes as the treatment group and the rest as the control group. The results are reported in column (8) and provide further support to our identification approach and confirm previous findings. We find that the effect of protest incidence on missing women is considerably weaker (and insignificant) in those governorates where Mohammed Morsi was the winning presidential candidate.

Next, in Table 9 we check the robustness of our results to different age groups of missing women, using the benchmark specification. For comparison purposes, in column (1) we report the benchmark result from Table 5. Column (2) shows the results for age group 1-9, where the economic size of the effect drops by almost half and becomes statistically significant only at the 10% level. In columns (3) and (4) we repeat the same exercise for age groups 10-19 and 20-29 and find no effect, both economically and statistically speaking. In fact, the point estimate for the interaction variable drops to near zero. The results here suggest that the effect of Egyptian protests was most visible only for younger women.

5 Conclusion

The Arab Spring is one of the most important events in recent world history and provides a good opportunity for a random experiment to analyze the linkages between political participation, women's empowerment, and missing women. Using the geographical variation in political protests, this paper studies the effects of protest intensity on missing women before and after the Egyptian revolution of 2011-2014. Using a difference-in-differences method, we find that these protests had an economically and statistically significant negative effect on missing women, reducing it substantially in high-protest intensity areas. We also find

[21] Note that Giesing and Musić (2019) undertakes a similar exercise.

that the negative effect on missing women reached its highest level in the last wave in 2014, highlighting both the cumulative snowball effect of protest participation as well as event heterogeneity. These effects are robust to using different specifications, protest intensity measures, a variety of robustness tests, and in different age groups. We also find that the effect was mostly limited to missing women at younger age groups, [0-1] and [1-9].

Previous studies suggest several possible channels through which these protests might have affected missing women in Egypt, including their effects on women's empowerment (Bargain et al., 2019), which is again likely to be influenced by the relative increase in women's labor force participation after the protests started (El-Mallakh et al., 2018). Recent studies also highlight the positive transformative effect of Egyptian revolution on gender equality (Alexander and Apell, 2016). Our findings also contribute to the literature on the effects of political events and civil conflicts on gender equality. While some previous studies suggest a negative effect of political instability and protest intensity on gender gaps in education (Giesing and Musić, 2019; Shemyakina, 2011), our work complements studies that show a positive effect of such events on women's empowerment (Bargain et al., 2019; Ghani et al., 2014; Iyer et al., 2012; Sahay, 2021).

Assuming improved data availability, future work can examine the channels through which political and civic participation affects missing women, as well as the effects of participant heterogeneity, based on individual characteristics. We should also note that our findings relate to an exceptional period of political activism by both men and women and therefore cannot speak for the long-term effects. Whether the improvements in missing women in high protest intensity areas will be persistent and/or diffuse to non-protest areas remains to be seen. We should also acknowledge that our identification is based on the effect of protests at the governorate urban and rural level and therefore ignores spatial effects that can transmit across regions. As pointed out by Liu et al. (2019), the effect of protests, therefore, can spread to non-protest areas and individuals through the media, word-of-mouth, or protesters who lived in the non-protest areas but traveled to protest locations. Lastly, the marriage and matching decisions may also be affected by the protests, affecting the missing women rates.

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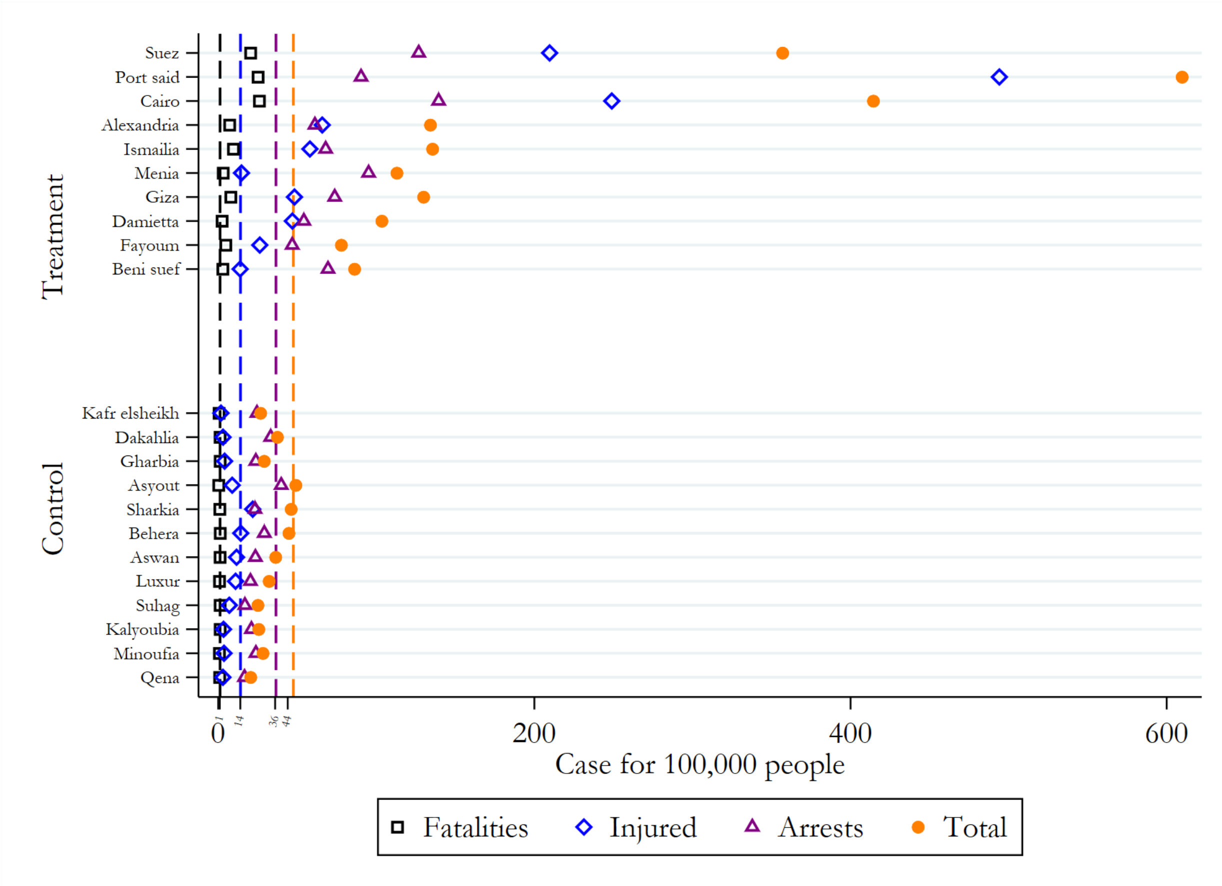
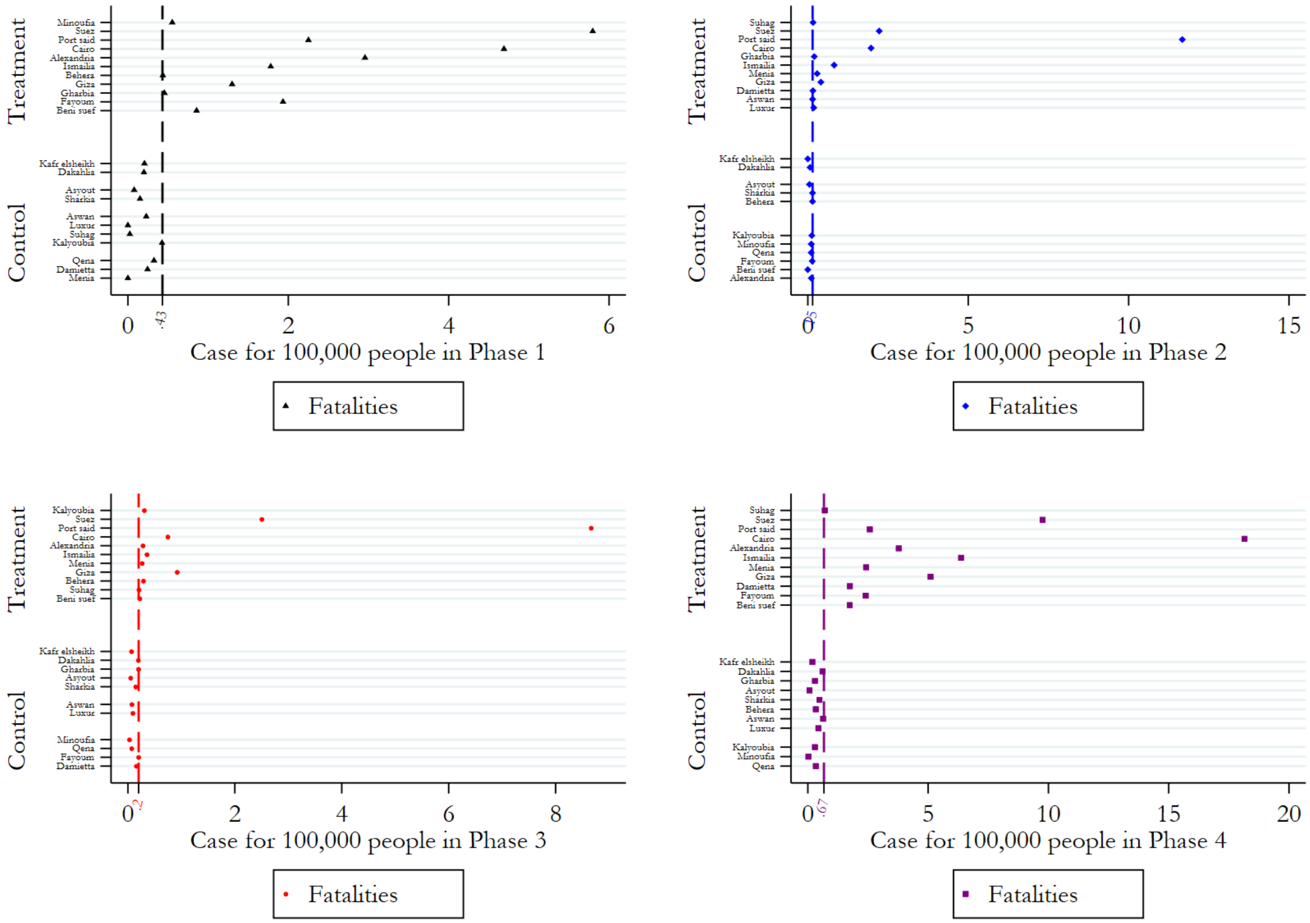
Figure 1: Control and Treatment Group Classification



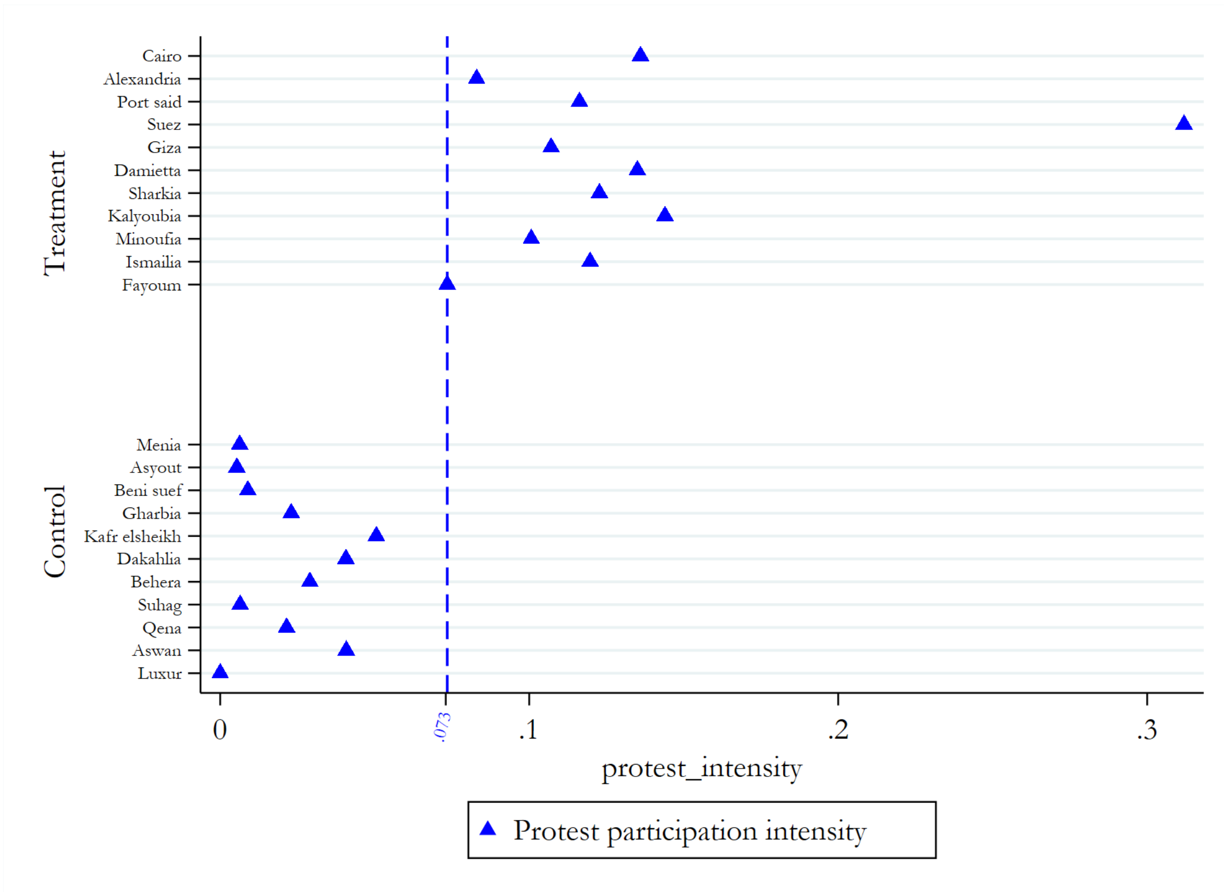
Notes: The baseline analysis treatment and control groups classification during the entire Arab Spring. This Figure does not include all border governorates which are Red Sea, New Valley, Matroh, North Sinai, and South Sinai. Source: Author's calculations based on Bargain et al. (2019) and the Egyptian Revolution Database.

Figure 2: Control and Treatment Groups in Different Phases of Egyptian Protests



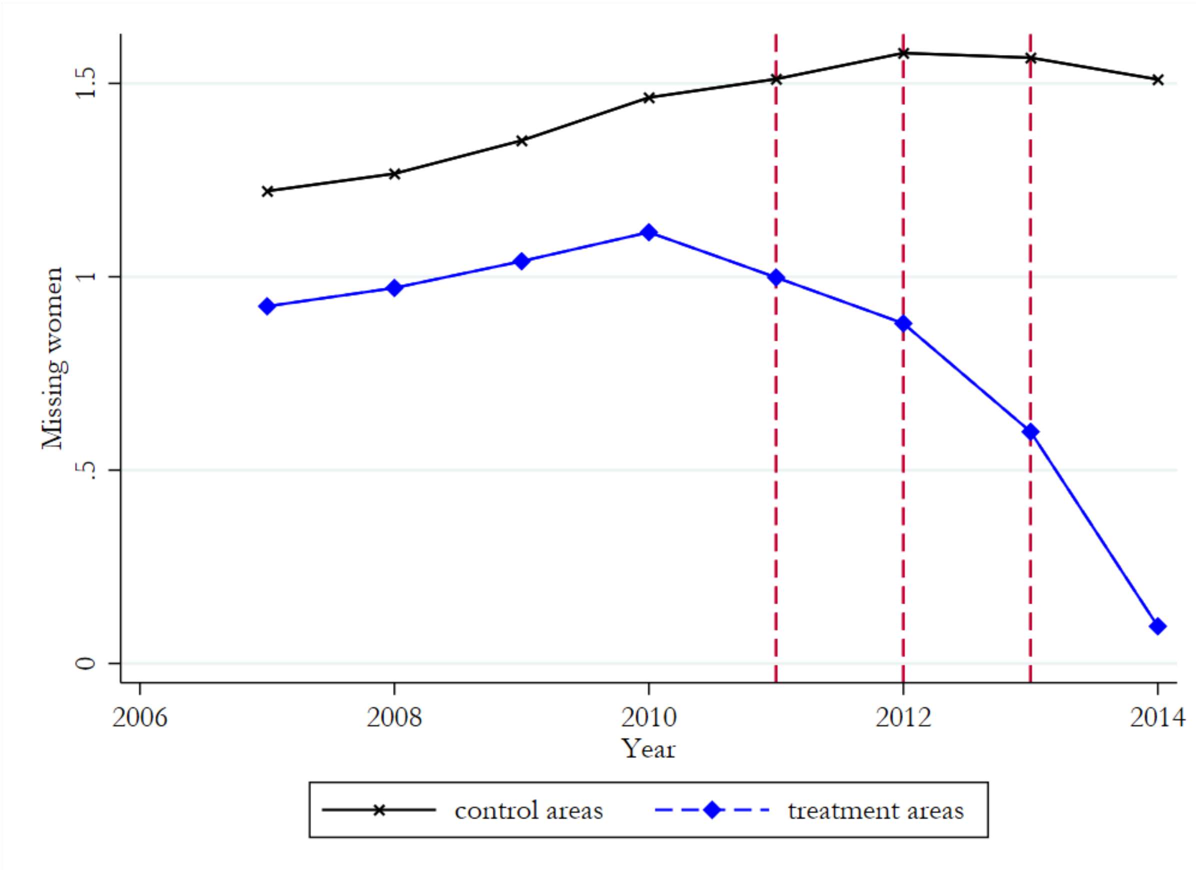
Notes: The treatment and control groups classification in different phases in the Arab Spring. This Figure does not include border governorates of the Red Sea, New Valley, Matroh, North Sinai, and South Sinai. Source: Author's calculations based on Egyptian Revolution Database

Figure 3: Control and Treatment Group Groups using SYPE



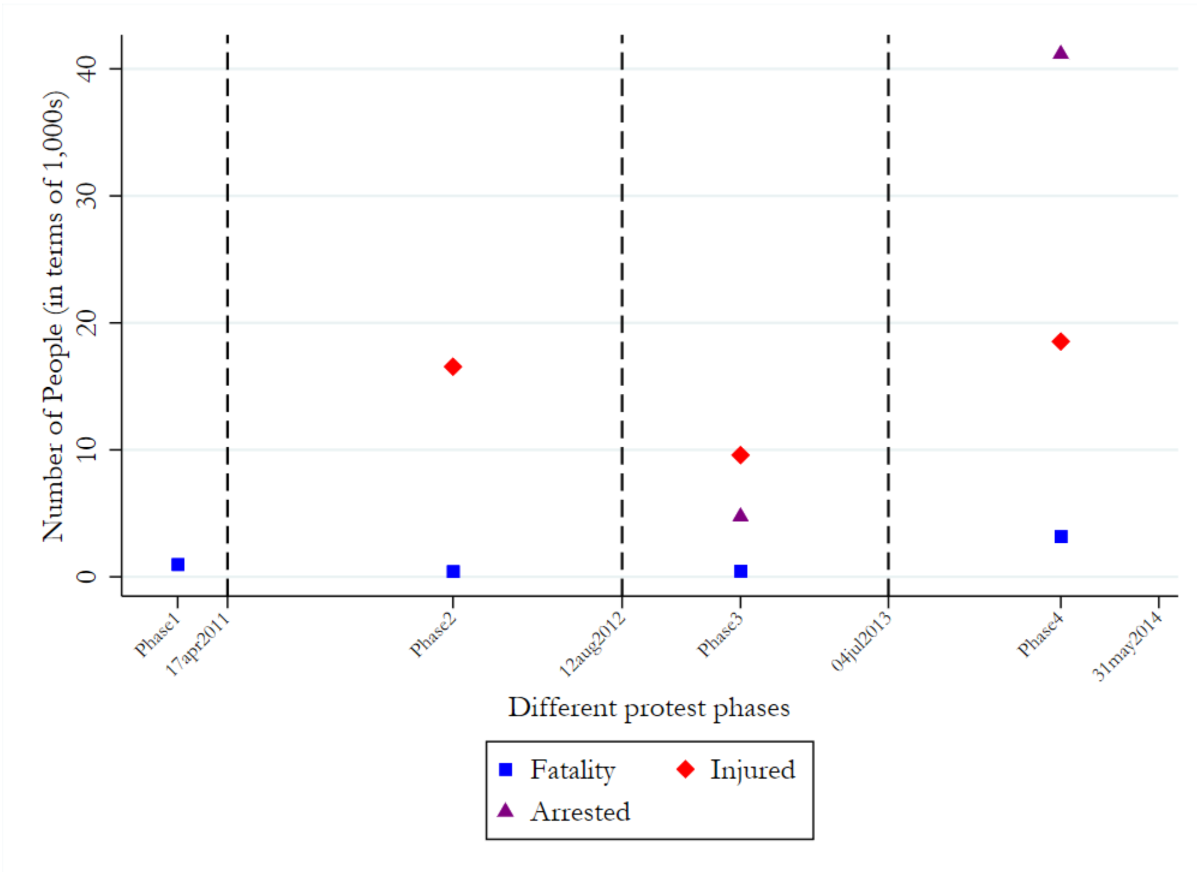
Notes: The treatment and control group classification during the entire Arab Spring through SYPE dataset. This Figure does not include all border governorates which are Red Sea, New Valley, Matroh, North Sinai, and South Sinai. Source: Author's calculations based on SYPE.

Figure 4: Missing Women Trend before and after the Arab Spring



Note: These two lines represent the missing women from 2007 to 2014 in treatment and control areas for ages 0-1 group. The first vertical red dash line is the Arab Spring period which is also the first phase starting time during the Arab Spring. The second and third dash lines are the second and third phases of the Arab Spring. Source: Author's calculations based on DHS.

Figure 5: Different Phases of the Egyptian Revolution



Note: This is about the four phases in the Arab Spring. Different dots represent the different information on fatalities, injuries, and arrests. Source: Author's calculations based on Egyptian Revolution Database.

Table 1: Summary Statistics

	Aggregate	High Protest	Low Protest	Difference
	(1)	(2)	(3)	(4)
Female Respondent Information				
No Education	0.154	0.163	0.147	0.016
Primary Education	0.078	0.085	0.073	0.012**
Secondary Education	0.574	0.559	0.584	-0.025**
Higher Education	0.184	0.189	0.181	0.008
Work Rate	0.149	0.149	0.150	-0.001
Age	30.216	30.120	30.284	-0.163
	(2.218)	(2.208)	(2.228)	(0.249)
All Children Ever Born	2.943	2.902	2.972	-0.071
	(0.515)	(0.470)	(0.544)	(0.058)
Husband Information				
No Education	0.124	0.129	0.120	0.008
Primary Education	0.137	0.160	0.121	0.039***
Secondary Education	0.551	0.537	0.561	-0.024***
Higher Education	0.190	0.178	0.198	-0.020**
No Job	0.020	0.019	0.020	-0.001
Tech Job	0.237	0.235	0.238	-0.003
Clerical	0.046	0.043	0.048	-0.005
Sale	0.054	0.050	0.057	-0.007**
Self-Agriculture	0.055	0.053	0.057	-0.004
Employed Agriculture	0.074	0.076	0.073	0.003
Services	0.110	0.102	0.115	-0.012**
Skilled manual	0.353	0.364	0.346	0.019*
Unskilled manual	0.090	0.102	0.082	0.020***
Unknown	0.011	0.010	0.012	-0.002
Husband Age	37.128	36.811	37.353	-0.541*
	(2.671)	(2.544)	(2.742)	(0.298)
Household Information				
Female Heads	0.0471	0.0485	0.0461	0.002
Muslim	0.963	0.966	0.960	0.006
Christian	0.036	0.033	0.039	-0.006
Unknown Religion	0.001	0.001	0.001	0.000
Urban	0.537	0.588	0.500	0.088
Household Size	5.414	5.271	5.515	-0.245***
	0.729	0.513	0.837	-0.041
Women Number	1.107	1.085	1.123	-0.038***
	(0.107)	(0.082)	(0.120)	(0.0119)
Household Head Age	39.336	38.952	39.609	-0.657**
	(2.758)	(2.478)	(2.917)	(0.307)
Wealth	3.325	3.516	3.189	0.327***
	(1.044)	(1.049)	(1.021)	(0.116)
No of observations	328	136	192	

Notes: Standard deviations, except for dummy variables, are reported in parenthesis. Column (4), Difference reports the t-test results of the difference between the treatment and control group. *NoEducation* refers to respondents with no education.

Table 2: Summary Statistics (continued)

Primary, *Secondary*, and *HigherEducation* means the highest education of the respondent is the primary, secondary or higher school (i.e., college, Masters, or Ph.D.) education, respectively. *WorkRate* is the number of women with a job divided by the total number of women. *Age* is the average age of the respondent. *Allchildreneverborn* is the average total number of children born to the respondent until the survey time. *NoJob* is the share of husbands without a job. *TechJob* is the share of husbands with a technology job, professional jobs, and managerial jobs. *Clerical* is the share of husbands with a religious job. *Sale* is the share of husbands with a sale job. $Self-Agriculture$ is the share of husbands with their own farmland. *EmployedAgriculture* is the share of husbands in other people's farmlands. *Services* is the share of husbands with service jobs. *SkilledManual* and *UnskilledManual* are the shares of husbands with skilled and unskilled manual jobs, respectively. *Unknown* refers to husbands for whom we have no occupational information. *FemaleHeads* is the share of households with women household heads. *Muslim* and *Christian* are the shares of households who are Muslim or Christian, respectively. *UnknownReligion* is the share of households with no information on their religion. *Urban* is the share of households living in urban areas. *HouseholdSize* is the average number of household members. *WomenNumber* is the average number of women in a household. *HouseholdHeadAge* is the average age of the household head. *Wealth* is the household wealth index, including poor, middle, richer, and richest, increasing in wealth. N is the number of observations. Standard deviations are reported in brackets. All job classifications and information in this table are based on the country specific coding system.

Table 3: Summary Statistics of Death Ratios in the Reference Group and Egypt from 2007 to 2014

	Reference Group Death Ratio			Egyptian Death Ratio		
Year	Female DR	Male DR	Relative DR	Female DR	Male DR	Relative DR
	(1)	(2)	(3)	(4)	(5)	(6)
2007	0.004	0.005	0.812	0.032	0.015	2.126
2008	0.004	0.004	0.815	0.029	0.015	1.884
2009	0.004	0.004	0.817	0.027	0.011	2.392
2010	0.004	0.004	0.819	0.032	0.014	2.281
2011	0.004	0.004	0.827	0.027	0.010	2.644
2012	0.003	0.004	0.829	0.027	0.011	2.476
2013	0.003	0.004	0.833	0.024	0.012	2.055
2014	0.003	0.004	0.838	0.026	0.008	3.106

Notes: $FemaleDR$, $MaleDR$, and $RelativeDR$ represent female, male, and relative death ratio at age 0-1. $RelativeDeathRatio$ is calculated by Female Death Ratio divided by Male Death Ratio. We use the group of Established Market Economies as defined by the World Bank: Western Europe, Canada, United States, Australia, New Zealand, and Japan.

Source: Author's calculations based on EDHS and the information of Western Europe, Canada, United States, Australia, New Zealand, and Japan (WHO, 2020).

Table 4: Summary Statistics of Death Ratios in High- and Low-Protest Areas in Egypt

Panel A: High Protest Intensity

Year	Female Death Ratio	Male Death Ratio	Relative Death Ratio	u^w_{irt}	π^w_{irt}	Missing Women
	(1)	(2)	(3)	(4)	(5)	(6)
2007	0.023	0.010	2.332	0.007	61.588	0.924
2008	0.023	0.012	1.959	0.007	75.471	0.971
2009	0.024	0.012	2.023	0.010	72.588	1.040
2010	0.029	0.015	1.956	0.011	64.941	1.115
2011	0.023	0.009	2.404	0.007	70.529	0.998
2012	0.020	0.009	2.160	0.005	71.941	0.879
2013	0.018	0.012	1.472	0.009	75.588	0.599
2014	0.009	0.008	1.139	0.005	53.294	0.096

Panel B: Low Protest Intensity

Year	Female Death Ratio	Male Death Ratio	Relative Death Ratio	u^w_{irt}	π^w_{irt}	Missing Women
	(1)	(2)	(3)	(4)	(5)	(6)
2007	0.039	0.020	1.944	0.015	52.792	1.222
2008	0.037	0.020	1.896	0.013	59.208	1.267
2009	0.033	0.011	3.001	0.007	56.417	1.352
2010	0.037	0.014	2.662	0.010	55.708	1.464
2011	0.034	0.012	2.934	0.007	61.917	1.511
2012	0.034	0.013	2.694	0.009	67.000	1.579
2013	0.031	0.011	2.757	0.008	70.292	1.566
2014	0.041	0.010	4.070	0.008	47.167	1.510

Notes: $u^w_{k_lt}$ is the reference death ratio for women aged 0-1, which is calculated using equation (1), $u^w_{irt}(a) = \frac{d^m_{irt}(a)}{\hat{d}^m_t(a)/\hat{d}^w_t(a)}$ where $a \in \{0, 1\}$. The notation π^w_{irt} represents the starting population of women aged 0-1 in a rural/urban governorate (ir). For other variable definitions, refer to Table 2. The missing women is calculated using the equation (2), The number of missing women is based on equation (2), $mw^w_{irt}(a) = [d^w_{irt}(a) - u^w_{irt}(a)]\pi^w_{irt}(a)$.

Table 5: Differences in Death Ratios in High- and Low-Protest Areas in Egypt

Year	Female Death Ratio	Male Death Ratio	Relative Death Ratio	u^w_{irt}	π^w_{irt}	Missing Women
	(1)	(2)	(3)	(4)	(5)	(6)
2007	-0.017	-0.011	0.388	-0.009*	8.797	-0.298
2008	-0.015	-0.008	0.063	-0.006	16.26	-0.295
2009	-0.009	0.0009	-0.978	0.003	16.17	-0.312
2010	-0.008	0.0008	-0.706	0.001	9.233	-0.348
2011	-0.012	-0.002	-0.531	-0.0002	8.613	-0.513
2012	-0.015	-0.004	-0.534	-0.004	4.941	-0.699
2013	-0.014	0.0008	-1.285	0.0009	5.297	-0.967***
2014	-0.032	-0.002	-2.931	-0.003	6.127	-1.414***

Notes: $u^w_{k_l t}$ is the reference death ratio for women aged 0-1, which is calculated using equation (1), $u^w_{irt}(a) = \frac{d^m_{irt}(a)}{\hat{d}^m_t(a)/\hat{d}^w_t(a)}$ where $a \in \{0, 1\}$. The notation π^w_{irt} represents the starting population of women aged 0-1 in a rural/urban governorate (ir). For other variable definitions, refer to Table 2. The missing women is calculated using the equation (2), The number of missing women is based on equation (2), $mw^w_{irt}(a) = [d^w_{irt}(a) - u^w_{irt}(a)]\pi^w_{irt}(a)$. The values refer to the differences between high and low protest intensity areas.
Source: Author's calculations based on DHS in Egypt and the information of Western Europe, Canada, United States, Australia, New Zealand, and Japan (WHO, 2020).

Table 6: Effect of Egyptian Protests on Missing Women

				Propensity Score	Survey weighting	Children Age-1 weighting
	(1)	(2)	(3)	(4)	(5)	(6)
A. Missing Women						
Post × *Treatment Group*	-0.585**	-0.450*	-0.722**	-0.696**	-0.663*	-1.039**
	(0.295)	(0.270)	(0.305)	(0.294)	(0.353)	(0.396)
Number of deaths prevented per 100,000 women	-50.115	-38.571	-61.885	-59.654	-56.829	-89.074
Observations	328	328	328	328	328	328
R^2	0.060	0.290	0.515	0.537	0.561	0.472
B. Placebo: 2007–2010						
Post × *Treatment Group*	-0.047	0.0041	0.143	0.026	-0.579	0.347
	(0.492)	(0.442)	(0.490)	(0.493)	(0.644)	(0.677)
Number of deaths prevented per 100,000 women	-3.987	0.354	12.215	2.235	-49.602	29.774
Observations	164	164	164	164	164	164
R^2	0.016	0.311	0.666	0.691	0.685	0.634
Controls	No	Yes	Yes	Yes	Yes	Yes
FE	No	No	Yes	Yes	Yes	Yes
PS reweighting	No	No	No	Yes	No	No
Survey weighting	No	No	No	No	Yes	No
Self-created weighting	No	No	No	No	No	Yes
Cluster	No	No	Yes	Yes	Yes	Yes

Notes: Linear estimations based on 2014 DHS. Estimation of missing women is from the missing women calculation in equation (1). The treatment group includes those governorates whose protest intensity is above-median protest intensity (based on the Egyptian Revolution database and defined as the governorate-level proportion of fatalities, injured, and arrested). Number of deaths prevented per 100,000 refers to predicted effect of $Post \times Treat$ on missing women per 100,000 population. $Controls$ refer to control covariates and include wealth of households, work condition of respondents, urban, number of kids in the households, education of the respondents, age of wife and husband, husbands' work condition, religion, and kids birth order. FE are governorate urban and rural level fixed effects. $PropensityScore$ refers to propensity score reweighting; $Surveyweighting$ refers to DHS survey weighting. $ChildrenAge-1weighting$ refers to the number of children in age 1 group in different governorates in different years from EDHS divided by the relative number of children in age 1 in different governorates in different years from Egyptian census. $Cluster$ refers to the standard errors in parentheses being clustered at governorate urban and rural level. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively.

Table 7: Different Phases of Egyptian Protests and Missing Women

	Phase 1	Phase 2	Phase 3	Phase 4
	(1)	(2)	(3)	(4)
Post × *Treat*	-0.554*	-0.0907	-0.618	-0.949**
	(0.293)	(0.306)	(0.372)	(0.469)
Number of deaths prevented per 100,000 women	-47.498	-7.730	-52.312	-79.302
Observations	328	328	328	328
R^2	0.509	0.500	0.510	0.516
Controls	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes
Cluster	Yes	Yes	Yes	Yes

Notes: Linear estimations based on 2014 DHS. Standard errors in parentheses are clustered at the governorates urban and rural level. ***, ** and * indicate significance at the 1%, 5% and 10% levels. Phase 1 is protests against Mubarak's autocratic regime. Phase 2 is against the Military rule from February 2011 to June 2012. Phase 3 is under the presidency of Mohammed Morsi, from June 2012 to July 2013. Phase 4 is the post-Islamist period from July 2013 to June 2014. For other definitions, refer to Table 5

Table 8: Sensitivity to Alternative Clustering Choices

	(1)	(2)	(3)	(4)	(5)	(6)
Post × *Treatment Group*	-0.722**	-0.568*	-0.722**	-0.722**	-0.722**	-0.722***
	(0.305)	(0.307)	(0.329)	(0.316)	(0.320)	(0.256)
Number of deaths prevented per 100,000 women	-61.8847	-48.6942	-61.8847	-61.8847	-61.8847	-61.8847
R^2	0.515	0.380	0.515	0.515	0.515	0.515
No of Observations	328	328	328	328	328	328
All Other Controls	Yes	Yes	Yes	Yes	Yes	Yes
Clustering	G_{UR}	G_{UR}	G	G	G	G
FE	G_{UR}	G	G_{UR}	G_{UR}	G_{UR}	G_{UR}
Bootstrap	No	No	No	800 rep	1,000 rep	Wild BS

Notes: *Clustering* and Fixed Effects (FE) units at the governorate urban and rural G_{UR} or governorate (G) level. Bootstrap refers to clustering based on standard bootstrap (800 or 1000 replications) or wild bootstrap. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively.

Table 9: Robustness to Sample Selection

	Age 20-40	Interview: No Husband	Interview: Alone	Border Governorates	SYPE	No Cario	No Alexandria	75% Support
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post × Treat	-0.790***	-0.628**	-0.458*	-0.577*	-0.759***	-0.624**	-0.806**	-0.700
	(0.280)	(0.276)	(0.256)	(0.310)	(0.260)	(0.294)	(0.330)	(0.493)
Number of deaths prevented per 100,000 women	-67.699	-53.812	-39.238	-49.412	-65.075	-53.489 -	-69.055	-59.982
R^2	0.488	0.494	0.365	0.522	0.518	0.521	0.511	0.518
No of Observations	328	328	328	376	328	320	312	376
All Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: All regressions include governorate urban and rural fixed effects. Subsample in column (1) is the age of respondents from 20 to 40. Subsample in column (2) is the interview condition without husband's presence. Subsample in column (3) is the interview condition for the respondent alone. Column (4) includes all border governorates (Red Sea, Matrouh, New Valley, North Sinai and South Sinai). Column (5) used the SYPE data set to classify the treatment and control groups. Columns (6) and (7) exclude Cairo and Alexandria. Column (8) uses the Matrouh and Fayoum as the treatment group. Standard errors in parentheses are clustered at the governorate urban and rural level. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively.

Table 10: Missing women in different age groups

	Age 1	Age 1-9	Age 10-19	Age 20-29
	(1)	(2)	(3)	(4)
Post × Treatment Group	-0.722**	-0.396*	0.052	0.009
	(0.305)	(0.204)	-0.067	-0.047
Number of deaths prevented per 100,000 women	-61.885	-9.152	1.859	1.586
R-squared	0.515	0.264	0.194	0.144
No of Observations	328	328	328	328
All Other Controls	Yes	Yes	Yes	Yes
Governorate Urban and Rural FE	Yes	Yes	Yes	Yes
Governorate Urban and Rural Cluster	Yes	Yes	Yes	Yes

Notes: All independent variables in all regressions refer to column (3) in Table 5. The dependent variables are missing women in different age groups. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively.