Do Parents Selectively Time Birth Relative to Ramadan? Evidence from Matlab, Bangladesh*

Md. Nazmul Ahsan †
University of Southern California

December 29, 2014

Preliminary Draft

Abstract

Studies examining *in utero* health effect of maternal fasting during Ramadan assume that parents do not selectively time birth relative to Ramadan. In Matlab, a region in Bangladesh, family planning program started in 1977 where women in treatment areas received free contraceptives door to door but control areas were not part of the program. Both treatment and control areas were very similar in observable characteristics before the program placement. Using MHSS 1996, we find women living in treatment areas six percentage points less likely to give birth 8 to 9 months after Ramadan after program placement. Moreover, mothers with more education are less likely to overlap pregnancy with Ramadan upon receiving free contraceptives. We examine the height, which reflects both genotype and phenotype influences *in utero*, of the children to their births relative to Ramadan. We find evidence which suggests presence of selection problem may lead us to wrong conclusion about the effect of maternal fasting on child height. **JEL: C52, I12, O15, 017, Z12**

1 Introduction

There is a growing literature based on "Fetal Origin Hypothesis"(Barker 1990) which links adverse environment and the inadequate nutrition *in utero* to later life health outcomes. Numerous evidences from these studies show nine months *in utero* is very critical for individual health (Almond and Currie 2011). Adverse condition *in utero* can have both short term effect such as effect on birth weight and long term effects such as effect on cognition, obesity, cardiovascular disease, diabetes (Almond and Muzumder, 2011; Almond and Currie, 2011; Ewjik 2011). The early studies, however, did not take into account the endogenous exposure to adverse environmental and nutritional condition (Almond and Currie 2011). As a result they could not address the potential confounders appropriately. To establish causal link between *in utero* nutrition shock and health outcomes researchers studied nutrition and health shocks *in utero* exogenous

*I am indebted to John Strauss and Anant Nyshadham for their continuous guidance and advice on this paper. Suggestions from Jeffrey Nugent, Ummul Hasanath Ruthbah,Mohammad Hashem Pesaran, Fei Wang, Shahe Emran, Jared Rubin, Yaoyao Zhu, Joseph Cummins,Khawaja Mamun and discussions with Rakesh Banerjee, Riddhi Bhowmick were essential to this research. I would like to thank conference participants at PACDEV, WEAI, SEA and IRES Chapman University graduate workshop. All remaining errors are my own. Any comments are welcome.

†Department of Economics, Dana and David Dornsife College of Letters, Arts and Sciences, University of Southern California, 3620 S. Vermont Ave. KAP 300, Los Angeles, CA 90089-0253. Email:mdnazmua@usc.edu

to mothers(Currie 2009). Some of the studies are based on severe historic events such as famine and spread of infectious disease and recent few studies are based on regular occurring event such as Ramadan (Almond 2006; Chen and Zhou 2007; Almond and Muzumder 2011; Ewjik 2011 and Majid 2012). The results from these studies conform with the hypothesis that adverse nutritional environment *in utero* has serious consequences on child health.

However, these studies are not free from limitations. One important methodological limitation is that they are based on the assumption that parents don't selectively time birth relative to those shocks. Thomas(2009) suggests that it is a strong identifying assumption and may not hold. Using data from Bangladesh and USA, he finds that parents who gave birth relative to famine and influenza epidemic in 1918 were systematically different from those who didn't.

Unlike the famine and influenza epidemic, Ramadan is a regular occurring event. Therefore, it might be much easier to time birth relative to Ramadan than other nutrition shocks which are irregular. However, no strong evidence exists on whether parents time birth relative to Ramadan. Perhaps due to the lack of strong evidence, studies exploring the effect of maternal fasting on child health and other outcomes assume that parents do not selectively time birth relative to Ramadan. Needless to say, there is an immense need to examine this issue. Around 1 billion alive Muslims on earth today were *in utero* during a period overlapped with Ramadan (Almond and Muzumder 2011). Recent studies (Almond and Muzumder(2011), Ewjik(2011), Majid(2012) and Almond, Muzumder and Ewjik(2014)) find *in utero* exposure to Ramadan has detrimental effects on health outcomes, labor market outcomes and education outcomes. However, all these studies assume that parents do not selectively time birth relative to Ramadan. Failure of this assumption may imply that the effects of maternal fasting on child outcomes are miscalculated.

Using Matlab Health and Socio Economic Survey (MHSS) 1996, we find that parents time birth relative to Ramadan. In October 1977 International Center For Diarrhoeal Disease Research, Bangladesh (ICDDR,B) initiated door to door free contraceptives program in some areas of Matlab. Both the targeted and control areas were very similar in observable characteristics. Using difference-in-difference strategy, we find the women residing in treatment areas are 6-7 percentage points less likely to give birth after 8 to 9 months after Ramadan. We also find that mother with more education are more likely to avoid pregnancy overlapping Ramadan upon receiving free contraceptives. This suggests mothers, who give birth relative to different points of Ramadan, are different from each other on the average in terms of SES. As a result, evidence from Matlab suggests comparison of the children who were exposed to Ramadan *in utero* with who were not may not be appropriate. Therefore, the studies examining maternal fasting on child health outcomes should take into account the selective timing of birth.

This paper makes some key contributions in the literature. First, we show parents selectively time birth relative to Ramadan using a rich data set. To the best of our knowledge this is the first paper that shows selective timing of birth relative to Ramadan. Secondly, we find that community level time varying characteristics affect timing of birth. This suggests comparison of SES of the parents of an affected child with the parents of a non-affected child may not be adequate to determine selection in birth timing. It might be necessary to interact the community level time varying changes with the parental SES. Thirdly, we show that providing free contraceptives may help Muslim mothers to avoid pregnancy overlapped with Ramadan. Free contraceptives are promoted to reduce fertility and reduce exposure of sexually transmitted disease (STD). This study shows an unintended benefit of providing free contraceptives to Muslims is that it allows to them to avoid birth relative to Ramadan to an extent. Moreover, past literature has evaluated the free contraceptive program in Matlab on fertility, health and education. This paper is the first to evaluate the family planning program in Matlab in the context fasting during Ramadan. Lastly, this paper compares the height of the children exposed to Ramadan *in utero* with the non-exposed children in both treatment areas (areas which received free contraceptives) and control areas (areas which did not receive free contraceptives). Interestingly, the intent to treat (ITT) analysis shows that the children who were exposed to Ramadan in first trimester and born in treatment areas are shorter (in centimeter) than the non exposed children born in treatment areas. However, in control areas difference in height between children exposed to Ramadan in first trimester and children non-exposed to Ramadan is not statistically significant. Examination of the children who were not exposed to Ramadan shows more educated mothers in treatment areas are more likely to give birth during non-Ramadan period compared educated mothers in control areas. This suggests that the effect of maternal fasting on health outcomes can be miscalculated when selection is present.

The rest of the paper is organized as follows. In section 2 we briefly the discuss existing literature on maternal fasting on different outcomes from epidemiology and economics. In section 3 we discuss the background of Matlab Family Planning and Child Health Program. In Section 4 we discuss the MHSS and compare it with other data sets used in the literature. In section 5 the we discuss the empirical strategy to study selective timing of birth relative to Ramadan and also how it affects health outcomes. In section 6 we provide the results and also discuss the contrast and similarity of these results with existing literature. In section 7 we make concluding remarks.

2 Literature Review

The literature on maternal fasting on child health outcomes can be broadly divided into two categories. One category is epidemiological literature and another is economics literature. Almond and Muzumder(2011) presents a nice summary of epidemiological literature in their paper. Several studies suggest that fasting during pregnancy can lead to neurological impairments, higher blood pressure in later life (Hunter and Sadler 1987,Moore et al. 1989, Sheehan et al. 1985, Gluckman and Hanson 2005).

Almond and Muzumder (2011) notes some limitations of epidemiological studies. First of all, most of those studies are based on a small number of observations. Secondly, those studies compare the effect on fasters and non-fasters assuming that decision to fast is exogenous. Thirdly, those studies do not disentangle the fasting effect from the seasonality, as they are based on Ramadan overlapping with only one season.

The application of Intent To Treat (ITT) analysis distinguishes the study of Almond and Muzumder (2011) from the epidemiological studies on Ramadan. They were also the first to study the impact of maternal fasting during Ramadan on child outcomes in the economics literature. ITT anaylsis alllows them to get rid of the compliance problem related to fasting. Under the assumption that parents do not selectively time birth relative to Ramadan, it gives causal estimates of the impact of *in utero* nutrition shock. Moreover, unlike most epidemiological studies, the study of Almond and Muzumder(2011) was also based on a large number of cohorts.

Almond and Muzumder (2011) use data from Michigan, Iraq and Uganda. They study the impact of *in utero* nutrition shock on birth weight using data from Michingan and on various forms of disabilities using census data from Iraq and Uganda. They find children who were *in utero* during Ramadan have lower birth weights and are more likely to be disabled. Following Almond and Muzumder (2011), Ewjik (2011) finds that maternal fasting during Ramadan may increase the chances of developing health problem such as coronary heart disease and type 2 diabetes. Majid (2012) finds that maternal fasting during Ramadan leads to fewer hours worked and self-employment in later life. Ewjik(2011) and Majid(2012) use Indonesia Family Life Survey (IFLS) wave 3 and wave 4 respectively. Using English register data, Almond Muzumder and Ewjik (2014) finds that maternal fasting during Ramadan leads to lower test scores.

One obvious limitation in those papers is that they assume parents don't selectively time birth relative to Ramadan. Moreover, the above mentioned studies have serious some limitations with data. In Michigan and Iraq data, Almond and Muzumder(2011) didn't know the religion of the mother. They used Arab as proxy for Muslims in their Michigan data. The birth data from Uganda, Iraq and Indonesia were self-reported. This could be a serious problem as misreported birth dates will lead to wrong classification of birth relative to Ramadan. In comparison to past data sets used, with MHSS we can clearly identify the religion of the mother and get reliable birth data in a single data set for a sufficiently large of number of cohorts.

3 Matlab Family Planning and Child Health

Matlab is a *thana* (sub-district) in Chandpur District in Bangladesh. It is located 55 kilometers of South-East of Dhaka. The Demographic Surveillance System(DSS) has been operating in Matlab thana since 1966. Initially 132 villages were included in the system, and 101 villages were added in 1968.All households in the DSS area are within the Monitoring system. A typical village consists of several *baris*, or groups of houses around a central courtyard. In DSS area, the record of birth, death and migration (in and out) are collected from the start of the project. The enumeration of marital union and dissolution began in 1975 (Razzaque and Streatfiled). In October 1977 the DSS area was contracted to 149 villages by excluding 84 villages. The family planning and health project was launched in 70 villages(treatment area)and the remaining villages were comparison area. No report of using randomization mechanism has been found (Schultz 2009). The figure (1)[1] in appendix also shows that the treatment area grouped into clusters. Schultz (2009) argues that the clustering of villages into treatment area retain the spillover effect. Table 3 in appendix presents 1974 census data which shows that the treatment and the comparison area were very similar except for few observable characteristics such as sources of drinking water, number of cows and age of both household head and spouses of household head. In our estimation strategy we will control household and biological sibling fixed effects to account for the household and mother level fixed unobservables.

Barham (2012) also describes the other treatments added to the treatment areas which are documented in Bhatia et al.(1980), Phillips et al.(1984) and Koening et al.(1990). In October 1977, the family planning program began in treatment areas through the provision of modern contraception. From June 1978, pregnant women received tetanus toxoid vaccination and also pregnant women in their last trimester pregnancy received iron and folic acid tablets. From March 1982, the children aged from 9 months to 59 months in treatment area 1 received measles vaccine. This program was expanded to treatment area 2 on November 1985. From January 1986, DPT, polio and tuberculosis immunization were given to children under age 5. Later in 1986, Vitamin A supplementation for children under age 5 and nutritional rehabilitation for those who were nutritionally risky were added to treatment areas. In appendix section, I reproduced the table 1 from Barham(2012) which gives a summary of the programs introduced in the treatment areas and age cohorts the programs have affected.

[1]Figure 1, table 2 and 3 are reproduced from Bahram (2012)

4 Data

This paper uses Matlab Household and Socioeconomic Survey 1996 which was funded by National Institute of Aging and was collaborative effort of RAND, the Harvard School of Public Health, the University of Pennsylvania and the University of Colorado at Boulder . The primary sample was drawn from a probability sample of 2,883 *baris* from 7,440 *baris* in the DSS 1994 sample frame. *baris* usually consists of cluster of households in close physical proximity. In all *baris*, interviews were completed in 2,781 *baris* out of 2883 eligible *baris*. Within each bari, upto two households were randomly selected. For each *baris*, one household was randomly chosen and designated as primary household or $Status = 1$. If there are more than 2 households, the second household was randomly chosen and designated as $Status = 2$. Otherwise the second household was designated as $Status = 2$. Out of the 2,781 *baris*, 94 *baris* were inappropriately interviewed and therefore disregarded from analysis which leaves us with 2,687 *baris*. Out of these *baris*, 656 are one household *baris* and rest of them have two or more households. Ideally, there should be 2,013 households but the survey team could find only 1,677 households. The remaining $Status = 2$ households are purposive sample based on relationship to the first household. In this paper we limit our studies to only $Status = 1$ households or primary households.

In the survey mothers were asked about birth dates of each their children. Later the birth dates were matched with the DSS data sets for their consistency and accuracy. Although DSS started in 1966, during the data collection process of MHSS,the events (i.e. birth, marriage) which took place from 1974 were linked to computerized system of DSS. Therefore, we have reliable birth dates for 22 birth year cohorts from 1974 to 1995. All birth dates before 1974 are self reported (Menken et al. 1999). There are also some other limitations with this data. We get the birth data from the pregnancy history of the women interviewed in the MHSS 1996. This is a limitation because we can know about births prior to 1996, only if the women living in sampled household survived till 1996. Since the treatment area got maternal health care, one might argue that the women who survived in treatment area may not have survived in absence of maternal health treatment. Ronsmans et al. (1997) finds that maternal mortality from all causes declined in both treatment and control area from 1976 to 1993 but the difference is no significant between treatment and control areas. Moreover, if the survival of the women correlates with birth timing relative to Ramadan, this will create a downward bias. To illustrate, let's suppose there are two types of women high type and low type. High type avoids birth and low type doesn't avoid birth relative to Ramadan. The low type is also less likely to survive. The maternal health aspect of the treatment would make it more likely that the low type survives in the treatment area and therefore get included in the sample.
Another limitation of the data is for some births only month and year of birth is known and the birth dates are replaced with zero. It also varies considerably between treatment area and control area. There are 2086 births which had date *zeros* out of 8573 from 1974 to 1995. Out of the 2086 births, the treatment area had 856 births and control area had 1230 births. One possibility is that some of these births took place out of the treatment and control area. Another possibility is these births have date *zeros* because of birth data collection method. We will do the analysis both including and excluding these date zero births.

The final data set, after dropping the unknown birth dates, months and years, consists of 6474 births for birth year cohort from 1974 to 1995. Out of 6474 births, 2965 births are from treatment area and 3509 births are from control area. Out of 2965 births in treatment area, 2580 were born to Muslim mothers and 385 were born to Hindu mothers. Out of 3509 births in control area, 3355 were born to Muslim mothers and 152 were born to Hindu mothers.

For height analysis, we limit our sample to birth cohort born from 1982 to 1995. Therefore, the oldest child in the height sample is 14 years old in 1996. This limits the migration concern of the children in the sample. In the MHSS 1966, height was not measured for all the children. Only 2 children were randomly selected out of all the children present in the household (Menken et al.1999). After limiting our sample to children whose birth dates information are not missing, we have 999 male children and 949 girl children.

To study the impact on height we match the birth dates from the mother's pregnancy with the birth month and year of the individual surveyed in the Matlab. We later match anthropometric data for each individual. We limit our study to only single birth. There are few twin births in MHSS. We found only 28 twins in our data.

5 Ramadan Measures

The month of Ramadan is the 9th Month in the Islamic Calender Year. Islamic law does not require a pregnant woman to fast during pregnancy. However, evidence from different Muslim countries suggests that some Muslim mothers fast when they are pregnant(Almond and Muzumder 2011).

For a given year, we construct the dates Gregorian Calender which overlaps with the Ramadan Month of Islamic Calender [2]. From our birth data we only know the date of birth but we don't know the gestation time. We observe how many months after Ramadan the individual 'i' was born. Generally, the gestation time for human is 266 days. For each date of birth we create century day code(CDC) following Almond and Muzumder(2011). We will denote $ramadan\_0$ if the individual 'i' was born during Ramadan, $ramadan\_1$ if the individual 'i' was born within 30 days after Ramadan, $ramadan\_2$ if the individual 'i' was born between 31 days and 60 days after Ramadan and so on. We also define dummy variable 1 if individuals were born between X and Y months after Ramadan as $ramadanXtoY$ where $X < Y$ and 0 otherwise. For example, $ramadan7to9$ would mean anyone who born between 180 to 270 days after Ramadan. $ramadan7to9$ would mean the individuals were most probably in the first trimester when Ramadan overlapped with pregnancy. Similarly, $ramadan4to6$ and $ramadan1to3$ would mean individuals were most probably in second trimester and third trimester respectively. The variable $nonramadan$ is defined as a time when pregnancy did not overlap with Ramadan.

For individuals whose date of birth is not known or date of birth is replaced with *zero*, we match the month of Gregorian Calender year with Ramadan Month and replace the month of Gregorian Calender year with 1 if more than 50 percent or more of Ramadan days overlap with the Gregorian Month.

6 Estimation Strategy

Empirical strategy is divided in two sections. In the first section we would like to examine whether free contraceptives affected timing of birth and whether timing of birth varies by mother education level upon receiving free contraceptives. In the second section we examine birth relative to Ramadan and height. Most of the analysis is based on cohorts born from 1974 to 1995 because Schultz(2009) and Schultz and Joshi (2013) find that the treatment and control area were balanced in many dimensions. As a robustness check, analysis on birth cohorts born from 1963 to 1995 was also conducted.

[2] Following Almond and Muzumder(2011), we construct the Ramadan month from Institute of Oriental Studies at University of Zurich using their website http://www.oriold.uzh.ch/static/hegira.html

6.1 Timing of Birth

We run the following regression equation to test this assumption:

$$R_{imt} = \beta_1 Treated + \beta_2 Post \times Treated + \beta_3 Hindu + \beta_4 Post \times Hindu + \beta_5 Treated \times Hindu \\ \beta_6 Post \times Treated \times Hindu + \theta_7 X + \gamma_m + \delta_t + \epsilon_{imt} \quad (1)$$

Equation (1) means whether individual i, born in month m and year t, was *in utero* in a time relative to Ramadan (R). The variables γ_m δ_t are month and year fixed effects respectively. The $Treated$ variable takes value 1 if the person living in a village which gets the contraceptive treatment and 0 otherwise. The $Post$ variable takes value 1 for the individuals who were born in 1978 and later. Ideally, the post should take value 1 for individuals born from July,1978 as the program started in the treatment villages from October,1977. The individuals who were conceived from October 1977 were on the average born from July 1978 and later. We define post from 1978 to simplify our estimation. As a robustness check we define post from 1979 and check the consistency of the results with post defined from 1978.

The coefficient β_2, of the interaction of $Post$ and $Treated$, is the coefficient of interest. This would allow us to examine whether contraceptive helped the Muslim mothers to time birth relative to Ramadan. To examine that our results are not driven by any noise, we also compare birth pattern of Hindus relative to Ramadan. Since the Hindus do not observe Ramadan, we should not expect any effect of contraceptive program on birth relative to Ramadan. The interaction term of Hindu with $Post$, $Treated$ and $Post \times Treated$ allows us to check robustness of the avoidance behavior of Muslim mothers relative to Ramadan. In an extension to this analysis, we also apply household fixed effects and biological mother effects in equation (1). Application of household fixed effects and biological mother fixed effects control time invariant household and mother level unobservables. In equation (1) application of household fixed effect and biological mother fixed effect will absorb the main effect of $Treated$, $Hindu$, $Treated \times Hindu$.

R represents several outcome variables. From our discussion on measures of Ramadan, R represents various Ramadan measures $ramadan_0$ to $ramadan_{10}$ and $ramadanXtoY$ for various values of X and Y where $X < Y$.The Hindu dummy is 1 if the the mother is Hindu and 0 otherwise. The variable X represents community variables and interaction of the community level variables with post[3]. The community level variables are whether the village has large market, electricity, post office, primary school and satellite health clinic.

One way to examine selection in birth timing is that the more educated mothers are more likely to have pregnancies which do not overlap with Ramadan upon receiving free contraceptives. We regress following equation for that analysis:

$$Nonramadan^M_{ikmt} = \alpha_0 + \alpha_1 Motherage + \alpha_2 Treated + \alpha_3 Post \times Treated + \alpha_4 Mothereduy + \\ \alpha_5 Post \times Mothereduy + \alpha_6 Treated \times Mothereduy + \alpha_7 Post \times Treated \times Mothereduy + \\ \gamma_m + \delta_t + \varepsilon_{imt} \quad (2)$$

The dependent variable $Nonramadan$ takes value 1 if the individual 'i' was pregnant during a time period which did not overlap with Ramadan and 0 otherwise. The omitted category is the mother with no education. The variable $Motherage$ is age of mothers at the time of survey. As in equation (1), γ_m and δ_t represent month and year fixed effects respectively. The variables

[3]The village level variables include whether the village has large market, post office, electricity,primary school, any health facility and any water facility.

$Post$ and $Treated$ are defined as in the equation (1). The variable $Mothereduy$ measures the mother education in years. We also extend the model by applying village fixed effects, household fixed effects. Application of household fixed effects and village effects absorbs the main effect of $Treated$. Application of biological mother fixed effects absorbs main effect $Mothereduy$, $Treated$ and interaction of $Mothereduy$ and $Treated$. Equation (2) would allow us to examine whether mother with more education are more likely to be pregnant during a time period non-overlapping with Ramadan upon receiving free contraceptives. The coefficient of interest is α_6. If the coefficient α_6 is statistically different from zero, a positive value of the estimate would mean that more educated mothers are more likely to give birth during $Non - Ramadan$ time period and vice-versa for a negative value.

We also study a variant of the equation (2) by regression $Nonramadan$ only on variables $mothereduy$ and $motherage$. The variant model would allow us to document the consequence of ignoring the interaction of mother education and the contraceptive treatment.

6.2 Birth Relative to Ramadan and Child Height Correlations

If we find that parents are selectively timing birth relative to Ramadan, it is important that we study the effect of maternal fasting on child health controlling for selection. Although free contraceptives program is exogenous to households in Matlab, it may affect the child health production through child quality quantity trade off. Therefore, due to exclusion restriction violation free contraceptive program can not be used as instrument for birth time relative to Ramadan in child health outcome function. However, we can study the correlations of child height and birth time relative to Ramadan to find a pattern between maternal fasting and child height correlations in both treatment areas and control areas. If mother with higher SES can avoid birth overlapping with Ramadan upon receiving free contraceptives, we may find the correlations between pregnancy overlapped with Ramadan is negative with child height in the treatment areas. On the other hand, if mothers with higher SES can not time birth relative to Ramadan in control areas because of absence of free contraceptive program, we may not find any correlation between child height and pregnancy overlapped with Ramadan. Under this scenario we should be worried that perhaps selection is driving the results rather than maternal fasting during Ramadan. We regress following equation:

$$\begin{aligned} H_{ijhkmt} = \Gamma_0 + \Gamma_1 ThirdTrimester + \Gamma_2 SecondTrimester + \Gamma_3 FirstTrimester \\ + \Gamma_4 Hindu + \Gamma_5 Hindu \times ThirdTrimester \\ + \Gamma_6 Hindu \times SecondTrimester + \Gamma_7 Hindu \times FirstTrimester + \gamma_m + \delta_t + \xi_{imt} \end{aligned} \tag{3}$$

Where outcome of interest is child height (H). Ideally, one should examine the child birth weight instead of child height. Unfortunately, MHSS 1996 does not have any information on child birth weight. However, Currie and Vogl(2013) argues that child height is a good proxy for child birth weight. Following Ewjik(2011) and Majid(2011), we define third trimester, second trimester and first trimester as children who were born after 7 to 9, 4 to 6 and 1 to 3 months after Ramadan respectively. In Matlab the treatment areas also received other treatments which enter in the health production function. $gamma_m$ and δ_t are month and year fixed effects respectively.

7 Results

7.1 Free Contraceptive Program and Birth Timing

To study selective timing of birth we regress $ramadan_0$ to $ramadan_{10}$ on *post*, *treated* and $post \times treated$ for Muslims controlling for birth month and year fixed effects. The cohorts under study were born from year 1974 to 1995. The results are presented in table 1. We find that women living in treatment areas are around 4 percentage points less likely to give birth 9 months after Ramadan post contraceptive program. This suggests upon receiving contraceptives women are less likely to conceive when Ramadan is imminent. Although not statistically significant, the sign of the coefficient of $post \times treated$ is also negative for $ramadan_8$. On the other hand, the coefficient of $post \times treated$ is positive for $ramadan_5$ to $ramadan_7$ and the coefficient is statistically significant at 10% for $ramadan_7$. It is important to note that in table 1 we are examining the effect of contraceptive treatment on birth for each separate month relative to Ramadan. Clubbing the months would allow us gain more power statistically as well as be more informative. Based on the sign of coefficients we construct variables $ramadan5to7$ and $ramadan8to9$ where for example $ramadan8to9$ takes value 1 if individual i is born either during $ramadan_8$ or $ramadan_9$ and 0 otherwise and regress these variables with the same independent variables. To check that our results are not driven by any other event other than Ramadan, we want to check the birth patterns of Hindus. We should expect the variables Hindu and post, treated and treatment interacted with Hindu should not be statically significant from zero. We also would like to check the robustness of our results with regression specifications with household fixed effects and biological mother fixed effects.

The results are presented in table 2. The dependent variables from column 1 to 3 and from 4 to 6 are $ramadan5to7$ and $ramadan8to9$ respectively. All regression specifications include birth month and year fixed effects. The coefficient of $post \times treated$ is positive in column 1 to 3. However, it is not statistically significant when household and biological fixed effects are applied. On other hand, the coefficient is negative in column 4 to 6 and robust to inclusion of household or biological mother fixed effects. Results from column 4 to 6 suggest that mothers in the treatment areas are 5 to 6 percentage points less likely to give after 8 to 9 months after Ramadan.

In MHSS data we find that more births take place on date 1 than any other dates. Moreover, data shows unusually high amount of birth birth takes place on January 1st than any other day of the year. We try to check the further robustness of our results in table 2 by dropping these dates. In table 3 we replicate the exercise by dropping date 1. We find the the results are robust to dropping these dates. In table 4 we drop the births taken place on January 1st and we find that the treatment coefficient is statically significant for all regression specifications. The results in table 4 is even more robust than the results in table 2. This suggest there might be some misreporting of birth dates in Matlab data. We don't know which birth took place in Matlab and which didn't. It is quite possible some of these births actually took place out of surveillance area and were not registered in DSS.

Recall that we have defined post from 1978. To check whether this does not corrupt the estimates we redefine post where post takes value 1 for 1979 and onward and 0 otherwise. We do same exercise of table 2 with redefined post variable. The results are presented in table 5. We find that results are consistent with our results in table 2.

So far we have limited our analysis to birth dates known in MHSS. In MHSS data there are some births which have dates recorded zero. The results are presented in table 6. We find that the treatment coefficient is negative for $ramadan8to9$ and positive for $ramadan5to7$ as in table 2.

Although the signs of the estimates are consistent with earlier tables, they are not statistically significant when household and biological mother fixed effects. One obvious problem is when only the birth month of the children are known, the overlap of Ramadan during pregnancy is not appropriately measured. Another issue is the child with missing months may have been born outside the treatment and control areas. This can bias the result downward.

We again limit our analysis to population whose birth dates are known and further check the robustness by studying the birth cohorts born from 1963 to 1995. This gives us 33 birth year cohorts. Recall that it takes Ramadan around 32 to 33 years to complete a full circuit of western calender. The results are presented in table 7. The results conforms with the findings in table 2.

In table 8 we control for post interacted with village level characteristics and do the same analysis in table 2 for cohorts born from 1974 to 1995. We find that even including village level characteristics and interacting them with post do not alter our findings.

7.2 Selection in Birth Timing

So far we have established that free contraceptives help parents time birth relative to Ramadan. It is important to examine whether the provision of free contraceptives changes the avoidance behavior by mother SES for Muslim mothers. To examine whether more educated mothers are more likely avoid birth relative to Ramadan we study relation of mother education and pregnancy which did not overlap with Ramadan. The results are presented in table 9. The variable *nonramadan* takes value 1 if pregnancy did not overlap with Ramadan and 0 otherwise. Mother education is denoted by *mothereduy* which is measured in years of education by mother. We find that both in treatment and control areas the coefficient is almost close to zero. In table 10 we present the results interacting mother education and the free contraceptive program. We find the for each year of education mothers are 1.6 percentage points more likely to have pregnancy during a time period which do not overlap with Ramadan. The results are robust to inclusion of village effects. When household and biological effects are applied, the coefficient is not statistically significant. However, the magnitude is very similar.

It is important measure whether educated mothers are significantly giving birth post program placement. To measure that we need to add the coefficients of $treated \times mothereduy$ and $post \times treated \times mothereduy$ and examine the significance of calculated F. We find that the calculated F is not significant even at 10%. It is important to note that in table 10 we studying birth cohorts born from 1974 to 1995 and the free contraceptives program started in 1978. Several things can change over this time. For example, mother with no education may learn from educated mothers to time pregnancy non-overlapping Ramadan. Moreover, changes in community level characteristics may change the incentive to avoid pregnancy overlap with Ramadan.

To resolve these issues we focus on birth cohorts born from 1974 to 1982 in table 11. Interestingly, we find that in treatment areas mother education is positive and statically significant for Muslims. Moreover, the calculated F for treatment areas is significant at 1% level. The birth patterns of Hindu mothers living in treatment area do not show similar pattern(column 3). For control areas the calculated F is not significant even at 10% level. We check the robustness of the results presented in table 11 by dropping the birth dates observed in January 1 and defining post from 1979 [4]. The results are consistent with the main results in table 11.

In table 12, we do a similar exercise as in table 11 but include biological mother fixed effects and keep the entire birth cohort born from 1974-1995. In control area (column 1), the coefficient of

[4] Results not shown in the paper

$post \times mothereduy$ is negative but almost close to zero and it is not statistically significant. In treatment area (column 2), however, the coefficient is positive and statically significant at 10%. The result from column 2 means, for each year of education mothers are 1.1 percentage points more likely to have pregnancy not overlapping with Ramadan upon receiving free contraceptives program. In column (3), the birth patterns of Hindu mothers living in treatment are checked. We find, for Hindus, pregnancy not overlapping with Ramadan do not vary by education level following free contraceptives program.

7.3 Discussion on Timing of Birth

Based on the results from table 1 to 8 we can conclude that free contraceptives program allow mothers to time the birth of their children relative to Ramadan. Our results show mothers in the treatment area are around 6 percentage points less likely to give birth 8 or 9 months after Ramadan and more likely to give birth 5 to 7 months after Ramadan. The avoidance of births 8 to 9 months after Ramadan are robust to inclusion of biological mother fixed effects and household fixed effects. The individuals, who are born 8 to 9 months after Ramadan, were exposed to Ramadan in the first and second month of gestation. Almond and Muzumder finds for Arabs[5] in Michigan that pregnancies, which are exposed to Ramadan, in first and second month of gestation are associated with 38 to 44 grams of lower birth weight. If selection in birth timing does not confound the estimates of their paper, the results in this paper suggest that providing free contraceptives can be an effective way to avoid pregnancies overlapping with Ramadan at a time when it is very detrimental to fetal health.

We also find that Muslims mothers are around 5 percentage points more likely to give birth 5 to 7 months after Ramadan upon receiving free contraceptives. If mothers are concerned about avoiding pregnancy with Ramadan, they should choose a time period do not overlap with Ramadan. We have already noted that mothers with more education are less likely to have pregnancies overlapping with Ramadan, if they receive free contraceptives program. Then why do we also find that mothers in treatment areas are more likely to give birth 5 to 7 months after Ramadan. Several factors can play a role here. We do not know what are determinants of fasting decision. One possibility is that mothers, pregnant for a longer time, are less likely to fast or asked to fast by family and friends during Ramadan. Recall that in Islamic law it is not mandatory for Muslim mothers to fast during pregnancies. Another possibility is that agents are myopic in nature and can take into account about Ramadan as Ramadan approaches nearby. Please note that the coefficient $post \times treated$ is positive but not statistically significant when household or biological mother fixed effects are included in the model. It is possible that application of household or biological mother fixed effects in the model takes into account time invariant characteristics that may drive results.

In table 11, we find that mothers with more education gave birth more after receiving free contraceptives program. In table 12 we find that Muslim mothers with more education are more likely to avoid pregnancy overlapping with Ramadan even when we control for biological mother fixed effects.Biological mother fixed effects control mother level fixed unobservables that might affect the timing of birth and also affect health outcomes of the children. Ewjik(2011) and following Ewjik(2011), Majid(2012) motivates to solve the problem of selective timing of birth by controlling biological mother fixed effects. Our results suggest controlling biological mother time invariant unobservables may not be enough to take care of the community level changes which allow mothers to time the birth of their children.

Literature on child health has extensively documented the health benefits of children associated

[5]Arabs are mostly consist of Muslims

with educated mothers (Thomas et al.1991 and many others). The findings in this paper suggest that mothers of children exposed to Ramadan and not exposed to Ramadan can very different in observable characteristics due to program placement. Therefore, it is important to take care of the selection before comparing the health outcomes of children exposed with non-exposed to Ramadan *in utero*. Another important findings is that the consequences of ignoring the interaction of free contraceptive program and mother education in birth timing. To detect selection, researchers typically compare the means parental covariates of the exposed with non-exposed children. Even this paper, in table 9, we do not find any significant difference in mother education between exposed children compared to non-exposed children. However, results from table 11 and 12 show that more educated do time birth if they have access to free contraceptives. Therefore, interaction of community level changes and parental covariates can be an important determinant in birth timing.

7.4 Alternative Hypothesis

One limitation in our data set is that we observe only birth dates of the children born in Matlab but we do not know about the gestation period. Therefore, it is important to understand whether premature births of babies can potentially contaminate our regression results. For premature births to explain these results, two things should also take place. Firstly, mothers in treatment areas should give birth prematurely within 7 months after Ramadan after getting the free contraceptives program. Secondly,only Muslim mothers living in the treatment areas should be affected. Chances of both happening is very rare. If anything we should observe more premature births in control areas than in treatment areas because the mothers living in treatment areas not only received free contraceptives but also health care which was not available to control areas. Therefore, the treatment areas should have less premature births relative to control areas and our results should have, if anything,downward bias. Moreover, if any health shocks affecting mothers and leading to premature births in treatment areas, it should affect both Muslims and Hindus living treatment areas. The fact that we do not observe similar birth pattern of Hindus relative to Ramadan attests to our results that health shocks leading to premature births are not responsible for this result.

7.5 Birth Relative to Ramadan and Height Correlation

In table 13 we examine the correlation between height of the children and their births relative to Ramadan for children born to Muslim mothers from 1982 to 1995. Column 1 and 2 present results on boys and girls respectively in control areas and column 3 and 4 present results on boys and girls respectively in treatment areas. In column 3 and 4 we find that boys and girls in the treatment areas who were exposed to Ramadan in first trimester around 2.78 and 3.6 inches shorter in height respectively. The coefficients are also statistically significant. However, in control areas not only that the coefficients are insignificant but also they are small in magnitude.

To examine whether birth relative to Ramadan is correlated for Muslim as well as Hindus, we compare heights of the Hindu children who were exposed to Ramadan *in utero* with whom were not exposed. We find that Hindu children exposed to Ramadan are not shorter in height than who were not exposed. However, the finding for Muslims in treatment areas remain the same as in table 14.

In table 14 we include mother age and mother education to whether including the covariates affect the magnitude of the coefficient size. We do not find any drastic change in the magnitude of the coeffient.

7.6 Discussion on Height

Interestingly, the regression exercise on height shows that both boy and girl children, who were exposed to Ramadan in first trimester *in utero* in treatment areas, were shorter in height than non-exposed children. Suppose we only had data available from treatment areas. If we had followed the earlier studies (Almond and Muzumder 2011, Ewjik 2011, Majid 2013, Almond, Muzumder and Ewjik 2014) we might have concluded the children in the treatment areas who were exposed to Ramadan in first trimester have shorter height because of maternal fasting during Ramadan. To make it a causal argument we might have cross checked whether Hindu children exposed to Ramadan *in utero* had any effect on health. The results presented in table 14 would have conformed with our conclusion because we find only effects for Muslims but do not find any effects for Hindus. To make it even more robust we might have included mother level observables as in table 14 and concluded that Muslim children who are exposed to Ramadan are shorter.

However, the absence of any negative effects for pregnancies overlapped with Ramadan in control areas as well as the findings on relation between mother education and birth relative to Ramadan deter us to call our findings in table 14 and 15 as causal. Recall from table 9 that in treatment areas mothers with more education were more likely to have pregnancies not overlapped with Ramadan. However, we could not find any such relations for control areas. Many studies find that mother education is positively correlated with child height (Thomas et al.1991). In table 16, we find that in Matlab children height is positively correlated with mother education. If more educated mothers give birth in a time period not overlapped with Ramadan, the children not exposed to Ramadan *in utero* would be taller on the average than children exposed to Ramadan. As a result, children exposed to Ramadan *in utero* would be shorter than children not exposed to Ramadan.

Another explanation for observing negative effects in treatment areas but no effects in control areas is that survival bias could be different between two areas. If children exposed to Ramadan, who might have been shorter on the average, did not survive till the survey period in control area, we might not find any difference in height between children exposed children and non-exposed children. We, however, do not find any statistical difference in mortality of children in treatment and control areas. Moreover, mortality is also an extreme event.

Since in our sample the children are 0 to 14 years old, another potential driver of these results can be growth spurt. It is unlikely that growth spurt would only affect children not exposed to Ramadan during maternal pregnancy living in treatment areas. Moreover, we have limited to our sample 0 to 11[6] years old to avoid the problem of adolescent growth spurt. Although the coefficients on different trimester for boys and girls in the treatment areas are not statistically different. They, however, are negative and comparable in magnitude.

It could be also possible that that the pregnant women in treatment areas are more likely to fast during Ramadan compared to control areas. In our paper we can not rule out this possibility because we do not have information on fasting practice of pregnant women by treatment and control areas. However, it might seem unlikely because of geographical proximity and similar observable characteristics.

It should be noted that above discussion are based on correlations. Therefore, we should not interpret that maternal fasting has no effect on child height once we control for selection in timing of birth. The aim of above discussions is to point out the consequence of avoiding selection in birth timing in Matlab. The future studies, therefore, should appropriately take into account the selection in birth timing before exploring the effect of maternal fasting during

[6] Results not shown in the paper

Ramadan on child outcomes.

8 Conclusion

There is little doubt about the welfare implications of the impact of adverse condition *in utero* on health outcomes. We have seen proliferation of studies which have documented the consequences of *in utero* shocks. In the context of Ramadan, this paper shows that mothers with more education can time birth relative to Ramadan upon receiving free contraceptives. As a result selection in timing of birth can lead to unequal outcomes between exposed children and non-exposed children. Therefore, comparing the mean outcomes of exposed children with that of non-exposed children, we might come to wrong conclusions about the impact of maternal fasting. Thus, it is important to examine the nature of selection appropriately and then to take care of selection problem when evaluating impact of maternal fasting on child outcomes. Another aspect of the paper is that it shows that free contraceptives program can help Muslim mothers to avoid pregnancy overlapping with Ramadan to an extent. This paper, however, do not suggest that findings of the other papers on this topic are invalidate. Not only the geographical contexts are different but also the outcomes under study are also different.

Moreover, this paper also documents that beneficial aspect of provision of free contraceptives. Although the earlier studies have documented negative consequence on health, labor and education outcomes of pregnancy overlapping Ramadan, there was no evidence what kind of policy may help mothers to avoid pregnancy overlapping with Ramadan. The evidence from Matlab suggests providing free contraceptives may allow mothers to time birth relative to Ramadan.

Policies are often based on empirical results. However, if the results do not represent the true magnitude of the problem it would be hard to design, target and benefit from policies. Moreover, there is an opportunity cost of every policy. This paper shows presence of selection may give us incorrect estimates. Therefore, future studies examining impact of maternal fasting on health outcomes should carefully address the selection in birth timing.

9 References

Almond,Douglas(2006) Is the 1918 influenza pandemic over? Long-term effects of in utero influenza exposure in the post-1940 U.S. population. *Journal of Political Economy, 114(4):672-712, August 2006.*

Almond, Douglas,Muzumder, Bhaskar and Ewjik, Reyn Van(2014): In Utero Ramadan Exposure and Children's Academic Performance. *Economic Journal(forth coming)*
Almond, D.and Currie,J.(2011) Killing Me Softly: The Fetal Origins Hypothesis. *The Journal of Economic Perspectives Vol. 25, No. 3 (Summer 2011), pp. 153-172*

Almond,Doug and Muzumder, Bhakar(2011) Health Capital and the Prenatal Environment: The Effect of Ramadan Observance During Pregnancy. *American Economic Journal: Applied Economics, 3(4) 56-85*

Barker,D.J. Fetal origins of coronary heart disease. *British Medical Journal, 311(6998):171-174, July 1995.*

Barham,Tania(2012):Enhancing Cognitive Functioning: Medium-Term Effects of a Health and Family Planning Program in Matlab. *American Economic Journal:Applied Economics 2012, 4(1):245273*

Bhatia, S., W. H. Mosley, A. S. G. Faruque, and J. Chakraborty. 1980. The Matlab Family Planning- Health Services Project. *Studies in Family Planning, 11(6): 20212.*

Chen, Y., Zhou, L. (2007). The long-term health and economic consequences of 1959-1961 famine in China. *Journal of Health Economics 26, 659681.*

Currie, Janet. 2009. "Healthy, Wealthy, and Wise: Is There a Causal Relationship between Child Health and Human Capital Development?" *Journal of Economic Literature, 47(1): 87-122.*

Currie, Janet and Almond, Douglas (2011): Killing Me Softly: The Fetal Origin Hypothesis. *The Journal of Economic Perspectives, Vol. 25, No. 3 (Summer 2011), pp. 153-172*

Currie, Janet and Vogl, Tom(2012): Early Life Health and Adult Circumstance in Developing Countries. *NBER Working Papers 18371, National Bureau of Economic Research, Inc.*

Ewjik, Reyn Van: Long-term health effects on the next generation of Ramadan fasting during pregnancy. *Journal of Health Economics Volume 30, 2011. page 1246-1260.*

Gluckman, Peter and Hanson, Mark. The Fetal Matrix: Evolution, Development and Disease. *Cambridge University Press, Cambridge, 2005.*

Hunter ES and Sadler,TW(1987). beta hydroxybutyrate induced effects on mouse embryos in vitro. *Teratology, 36:259 64, 1987.*

Janet Currie. Healthy, wealthy, and wise: Is there a causal relationship between child health and human capital development? *Journal of Economic Literature, XLVII(1): 87,122, March 2009.*

LeGrand,T.K. and Phillips, J.F., The Effect of Fertility Reduction on Infant and Child Mortality: Evidence from Matlab in Rural Bangladesh. *Population Studies Vol. 50, NO.1(Mar.1996),pp.-51-68*

Koenig, Michael A., Vincent Fauveau, and Bogdan Wojtyniak. 1991. Mortality Reductions from Health Interventions: The Case of Immunization in Bangladesh. *Population and Development Review, 17(1): 87104.*

Majid, Muhammad Farhan(2012):The Persistent Effects of in Utero Nutrition Shocks over the Life Cycle: Evidence from Ramadan Fasting in Indonesia.

Martorell, R., Habicht, J.-P. (1986). Growth in early childhood in developing countries. *In: Falkner, F.,Tanner, J.M. (Eds.), Human Growth, vol. 3, Methodology. Ecological, Genetic, and Nutritional Effects on Growth. second ed. Plenum, New York, pp. 241262.*

Omar Rahman, Jane Menken, Andrew Foster and Paul Gertler (1999) Matlab [Bangladesh] Health and Socioeconomic Survey (MHSS), 1996 Overview and Users Guide Second ICPSR Version December 1999

Moore DCP, Stanisstreet M., and Clarke, CA(1989). Morphological and physiological effects of beta-hydroxybutyrate on rat embryos grown in vitro at different stages. *Teratology, 40: 237(51)*

Phillips, James F., Ruth Simmons, J. Chakraborty, and A. I. Chowdhury. 1984. Integrating Health Services into an MCH-FP Program: Lessons from Matlab, Bangladesh. *Studies in Family Planning, 15(4): 15361.*

Razzaque,A. and Streat,P.K Matlab DSS. *INDEPTH Monograph: Volume 1 Part C*
Ronsmans, C.,Vanneste A.M.,Chakraborty, J.,Ginneken, J.V. Decline in Maternal Mortality in Matlab, Bangladesh: A Cautionary Tale, *Lancet 1997, Vol. 350;pp; 1810-1814*

Schultz, P. and Joshi, S. Family Planning and Womens and Childrens Health: Long-Term Consequences of an Outreach Program in Matlab, Bangladesh, *Demography,February 2013, Volume 50, Issue 1, pp 149-180*

Schultz, T.P.(2009) How Does Family Planning Promote Development? : Evidence from a Social Experiment in Matlab, Bangladesh, 1977 1996
Sheehan EA, Beck, F., Clarke, C.A, and Stanisstreet,M.. Effects of beta-hydroxybutyrate on rat embryos grown in culture.*Experentia, 41:273 75, 1985.*

Strauss, J.Households, Communities, and Preschool Children's Nutrition Outcomes: Evidence from Rural Côte d'Ivore,*Economic Development and Cultural Change, Vol 38, NO.2 (Jan 1990)pp-231-261*

Thomas, Duncan (2009)-The causal effect of health on social and economic prosperity: Methods and findings.

10 Tables

Table 1: Treatment Effect on Birth Timing for Muslims Born from Year 1974 to 1995

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	ramadan_0	ramadan_1	ramadan_2	ramadan_3	ramadan_4	ramadan_5	ramadan_6	ramadan_7	ramadan_8	ramadan_9	ramadan_10
treated	0.00674	-0.00581	-0.00916	0.0292	-0.0306	-0.0175	-0.00580	-0.0112	0.0202	0.0196	-0.00937
	(0.0222)	(0.0185)	(0.0189)	(0.0240)	(0.0201)	(0.0177)	(0.0145)	(0.0140)	(0.0146)	(0.0168)	(0.0186)
$post \times treated$	0.00374	0.00572	0.0125	-0.0274	0.0193	0.0257	0.00184	0.0259*	-0.0212	-0.0357**	0.00995
	(0.0240)	(0.0201)	(0.0174)	(0.0240)	(0.0223)	(0.0210)	(0.0164)	(0.0156)	(0.0156)	(0.0174)	(0.0210)
Constant	-0.00593	0.0305*	0.0108	0.191***	0.163***	0.124***	0.137***	0.0821***	0.0660***	0.0953***	0.0891***
	(0.0197)	(0.0180)	(0.0184)	(0.0336)	(0.0250)	(0.0239)	(0.0266)	(0.0204)	(0.0172)	(0.0222)	(0.0211)
Mean of D.V.	0.082	0.068	0.076	0.093	0.103	0.100	0.092	0.094	0.081	0.073	0.075
Observations	5,935	5,935	5,935	5,935	5,935	5,935	5,935	5,935	5,935	5,935	5,935
R-squared	0.065	0.054	0.051	0.056	0.046	0.052	0.036	0.052	0.041	0.045	0.058
Month & Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Standard errors clustered at village level
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Note:The dependent variables are based on Ramadan month. ramadan_0 is the month of Ramadan. ramadan_1 is first 30 days after the month of Ramadan, ramadan_2 is the second 30 days after the month of Ramadan and so on. Each dependent variable takes value either 1 or 0. Post is defined from 1978. It takes value 1 the birth took place from 1978 and 0 otherwise. The variable *treated* takes value 1 if mother lives in a treatment area and 0 otherwise. The variable $post * treated$ is the interaction of post and treated. The analysis in this table are based on pregnancy history Muslim mothers only. D.V. is short form for dependent variable.

Table 2: Treatment Effect on Birth Timing Born from Year 1974 to 1995

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	ramadan5to7	ramadan5to7	ramadan5to7	ramadan8to9	ramadan8to9	ramadan8to9
treated	-0.0347			0.0406*		
	(0.0236)			(0.0214)		
$post \times treated$	0.0532**	0.0656	0.0468	-0.0568**	-0.0656**	-0.0608*
	(0.0255)	(0.0429)	(0.0444)	(0.0223)	(0.0331)	(0.0311)
Hindu	0.124			-0.0528		
	(0.116)			(0.0641)		
$post \times Hindu$	-0.116	-0.0356	0.00369	0.0513	0.0244	-0.0541
	(0.125)	(0.175)	(0.173)	(0.0722)	(0.182)	(0.129)
$treated \times Hindu$	-0.131			0.107		
	(0.125)			(0.0742)		
$post \times treated \times Hindu$	0.0782	-0.0615	-0.0387	-0.0732	-0.0380	0.0332
	(0.136)	(0.191)	(0.200)	(0.0884)	(0.194)	(0.148)
Constant	0.348***	0.338***	0.330***	0.157***	0.185***	0.195***
	(0.0337)	(0.0450)	(0.0480)	(0.0255)	(0.0339)	(0.0347)
Mean of D.V.	0.287	0.287	0.287	0.154	0.154	0.154
Observations	6,474	6,474	6,474	6,474	6,474	6,474
R-squared	0.127	0.418	0.437	0.080	0.385	0.403
Month & Year FE	Y	Y	Y	Y	Y	Y
HH FE	N	Y	N	N	Y	N
Mother FE	N	N	Y	N	N	Y

Standard errors clustered at village level

*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0. *ramadanAtoB* takes value 1 if the individual is born A to B months after Ramadan where $A < B$ and 0 otherwise. Post is defined from 1978. It takes value 1 the birth took place from 1978 and 0 otherwise. The variable *treated* takes value 1 if mother lives in a treatment area and 0 otherwise. The variable $post * treated$ is the interaction of post and treated. The variable Hindu takes value 1 if the mother is Hindu and 0 otherwise. D.V. is short form for dependent variable.

Table 3: Robustness Check of Treatment Effect on Birth Timing: Dropped Date 1

VARIABLES	(1) ramadan5to7	(2) ramadan5to7	(3) ramadan5to7	(4) ramadan8to9	(5) ramadan8to9	(6) ramadan8to9
treated	-0.0237			0.0489*		
	(0.0258)			(0.0271)		
$post \times treated$	0.0404	0.0687	0.0506	-0.0639**	-0.0815*	-0.0790*
	(0.0288)	(0.0490)	(0.0499)	(0.0289)	(0.0435)	(0.0423)
Hindu	0.216			-0.0124		
	(0.170)			(0.0720)		
$post \times Hindu$	-0.209	-0.116	-0.0730	0.0127	-0.0212	-0.0777
	(0.183)	(0.264)	(0.250)	(0.0706)	(0.187)	(0.164)
$treated \times Hindu$	-0.219			0.0849		
	(0.178)			(0.0829)		
$post \times treated \times Hindu$	0.171	0.0149	0.0214	-0.0456	0.0382	0.0912
	(0.191)	(0.282)	(0.279)	(0.0904)	(0.203)	(0.184)
Constant	0.352***	0.341***	0.334***	0.182***	0.208***	0.218***
	(0.0384)	(0.0567)	(0.0616)	(0.0316)	(0.0416)	(0.0438)
Mean of D.V.	0.290	0.290	0.290	0.156	0.156	0.156
Observations	5,754	5,754	5,754	5,754	5,754	5,754
R-squared	0.128	0.434	0.454	0.082	0.416	0.431
Month & Year FE	Y	Y	Y	Y	Y	Y
HH FE	N	Y	N	N	Y	N
Mother FE	N	N	Y	N	N	Y

Standard errors clustered at village level

*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0. $ramadanAtoB$ takes value 1 if the individual is born A to B months after Ramadan where $A < B$ and 0 otherwise. The date 1 is most observed birth date in the pregnancy history. The robustness check is performed by excluding births which reported date 1. Post is defined from 1978. It takes value 1 the birth took place from 1978 and 0 otherwise. The variable *treated* takes value 1 if mother lives in a treatment area and 0 otherwise. The variable $post * treated$ is the interaction of post and treated. The variable Hindu takes value 1 if the mother is Hindu and 0 otherwise. D.V. is short form for dependent variable.

Table 4: Robustness Check of Treatment Effect on Birth Timing:Dropped January 1

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	ramadan5to7	ramadan5to7	ramadan5to7	ramadan8to9	ramadan8to9	ramadan8to9
treated	-0.0310			0.0460**		
	(0.0241)			(0.0232)		
$post \times treated$	0.0483*	0.0760*	0.0563	-0.0606**	-0.0804**	-0.0754**
	(0.0263)	(0.0422)	(0.0440)	(0.0244)	(0.0364)	(0.0346)
Hindu	0.185			-0.0361		
	(0.148)			(0.0698)		
$post \times Hindu$	-0.173	-0.0802	-0.0486	0.0252	-0.0156	-0.0555
	(0.157)	(0.202)	(0.196)	(0.0712)	(0.169)	(0.145)
$treated \times Hindu$	-0.196			0.0910		
	(0.156)			(0.0803)		
$post \times treated \times Hindu$	0.142	0.00250	0.0392	-0.0480	0.0361	0.0700
	(0.166)	(0.218)	(0.224)	(0.0892)	(0.182)	(0.164)
Constant	0.356***	0.335***	0.326***	0.185***	0.214***	0.226***
	(0.0342)	(0.0515)	(0.0566)	(0.0271)	(0.0384)	(0.0392)
Mean of D.V.	0.285	0.285	0.285	0.154	0.154	0.154
Observations	6,317	6,317	6,317	6,317	6,317	6,317
R-squared	0.125	0.420	0.440	0.080	0.393	0.409
Month & Year FE	Y	Y	Y	Y	Y	Y
HH FE	N	Y	N	N	Y	N
Mother FE	N	N	Y	N	N	Y

Standard errors clustered at village level

*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0. $ramadanAtoB$ takes value 1 if the individual is born A to B months after Ramadan where $A < B$ and 0 otherwise. The robustness check is performed by excluding births which were reported to take place on January 1. Post is defined from 1978. It takes value 1 the birth took place from 1978 and 0 otherwise. The variable *treated* takes value 1 if mother lives in a treatment area and 0 otherwise. The variable $post * treated$ is the interaction of post and treated. The variable Hindu takes value 1 if the mother is Hindu and 0 otherwise. D.V. is short form for dependent variable.

Table 5: Robustness Check of Treatment Effect on Birth Timing: Post 1979)

VARIABLES	(1) ramadan5to7	(2) ramadan5to7	(3) ramadan5to7	(4) ramadan8to9	(5) ramadan8to9	(6) ramadan8to9
treated	-0.0318			0.0399**		
	(0.0227)			(0.0188)		
$post79 \times treated$	0.0525**	0.0611	0.0410	-0.0590***	-0.0651**	-0.0576*
	(0.0249)	(0.0417)	(0.0437)	(0.0206)	(0.0323)	(0.0309)
Hindu	0.0801			-0.0479		
	(0.0927)			(0.0529)		
$post79 \times Hindu$	-0.0684	0.0145	0.0434	0.0479	-0.00462	-0.0639
	(0.108)	(0.166)	(0.161)	(0.0635)	(0.147)	(0.100)
$treated \times Hindu$	-0.0817			0.0771		
	(0.102)			(0.0640)		
$post79 \times treated \times Hindu$	0.0218	-0.120	-0.0912	-0.0377	0.0222	0.0754
	(0.118)	(0.181)	(0.189)	(0.0806)	(0.162)	(0.125)
Constant	0.348***	0.338***	0.330***	0.158***	0.185***	0.194***
	(0.0337)	(0.0449)	(0.0479)	(0.0247)	(0.0339)	(0.0348)
Mean of D.V.	0.287	0.287	0.287	0.154	0.154	0.154
Observations	6,474	6,474	6,474	6,474	6,474	6,474
R-squared	0.127	0.418	0.437	0.080	0.385	0.403
Month & Year FE	Y	Y	Y	Y	Y	Y
HH FE	N	Y	Y	N	Y	Y
Mother FE	N	N	N	N	N	N

Standard errors clustered at village level
*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0.$ramadanAtoB$ takes value 1 if the individual is born A to B months after Ramadan where $A < B$ and 0 otherwise. In this table post is defined from 1979 as a robustness check. It takes value 1 the birth took place from 1979 and 0 otherwise. The variable *treated* takes value 1 if mother lives in a treatment area and 0 otherwise. The variable $post * treated$ is the interaction of post and treated. The variable Hindu takes value 1 if the mother is Hindu and 0 otherwise. D.V. is short form for dependent variable.

Table 6: Robustness Check of Treatment Effect on Birth Timing:Include Date Zero

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	ramadan5to7	ramadan5to7	ramadan5to7	ramadan8to9	ramadan8to9	ramadan8to9
treated	-0.0295			0.0259		
	(0.0237)			(0.0192)		
$post \times treated$	0.0456*	0.0561	0.0470	-0.0394*	-0.0373	-0.0342
	(0.0247)	(0.0394)	(0.0414)	(0.0203)	(0.0311)	(0.0339)
Hindu	0.176			-0.0804		
	(0.109)			(0.0599)		
$post \times Hindu$	-0.149	-0.0631	-0.0342	0.0515	0.00350	-0.0636
	(0.113)	(0.133)	(0.139)	(0.0684)	(0.127)	(0.0930)
$treated \times Hindu$	-0.192*			0.140**		
	(0.115)			(0.0676)		
$post \times treated \times Hindu$	0.133	0.00963	0.0295	-0.0789	-0.00607	0.0555
	(0.120)	(0.155)	(0.170)	(0.0808)	(0.138)	(0.113)
Constant	0.337***	0.321***	0.316***	0.205***	0.233***	0.233***
	(0.0303)	(0.0399)	(0.0444)	(0.0255)	(0.0321)	(0.0338)
Mean of D.V.	0.282	0.282	0.282	0.161	0.161	0.161
Observations	7,914	7,914	7,914	7,914	7,914	7,914
R-squared	0.119	0.396	0.418	0.100	0.378	0.400
Month & Year FE	Y	Y	Y	Y	Y	Y
HH FE	N	Y	N	N	Y	N
Mother FE	N	N	Y	N	N	Y

Standard errors clustered at village level
*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0.$ramadanAtoB$ takes value 1 if the individual is born A to B months after Ramadan where $A < B$ and 0 otherwise. Post is defined from 1978. It takes value 1 the birth took place from 1978 and 0 otherwise. The variable *treated* takes value 1 if mother lives in a treatment area and 0 otherwise. The variable $post * treated$ is the interaction of post and treated. The variable Hindu takes value 1 if the mother is Hindu and 0 otherwise. In this table the observations include births which had date zero. The month in the Gregorian calender is defined as the month of Ramadan, if Ramadan overlaps with that Gregorian month more than or equal to 50% of the days. D.V. is short form for dependent variable.

Table 7: Robustness Check of Treatment Effect on Birth Timing: Muslim Cohort Born from Year 1963 to 1995

VARIABLES	(1) ramadan5to7	(2) ramadan5to7	(3) ramadan5to7	(4) ramadan8to9	(5) ramadan8to9	(6) ramadan8to9
treated	-0.0397**			0.0117		
	(0.0164)			(0.0109)		
post × *treated*	0.0535***	0.0483	0.0302	-0.0302**	-0.0304	-0.0139
	(0.0191)	(0.0303)	(0.0324)	(0.0130)	(0.0218)	(0.0250)
Constant	0.256***	0.242***	0.272***	0.239***	0.281***	0.299***
	(0.0484)	(0.0653)	(0.0706)	(0.0545)	(0.0764)	(0.0767)
Mean of D.V.	0.263	0.263	0.263	0.152	0.152	0.152
Observations	7,475	7,475	7,475	7,475	7,475	7,475
R-squared	0.058	0.319	0.348	0.023	0.292	0.315
Month & Year FE	Y	Y	Y	Y	Y	Y
HH FE	N	Y	N	N	Y	N
Mother FE	N	N	Y	N	N	Y

Standard errors clustered at village level

*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0. *ramadanAtoB* takes value 1 if the individual is born A to B months after Ramadan where $A < B$ and 0 otherwise. Post is defined from 1978. It takes value 1 the birth took place from 1978 and 0 otherwise. The variable *treated* takes value 1 if mother lives in a treatment area and 0 otherwise. The variable $post * treated$ is the interaction of post and treated. The variable Hindu takes value 1 if the mother is Hindu and 0 otherwise. The birth cohort in the table include births from 1963 to 1995. D.V. is short form for dependent variable.

Table 8: Robustness Check of Treatment Effect on Birth Timing:Village Facilities Interacted with Post

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	ramadan5to7	ramadan5to7	ramadan5to7	ramadan8to9	ramadan8to9	ramadan8to9
treated	-0.0315			0.0370*		
	(0.0281)			(0.0217)		
post × *treated*	0.0395	0.0362	0.0103	-0.0546**	-0.0733**	-0.0644**
	(0.0294)	(0.0478)	(0.0483)	(0.0226)	(0.0331)	(0.0320)
Hindu	0.0899			-0.0486		
	(0.128)			(0.0768)		
post × *Hindu*	-0.0813	0.0568	0.0901	0.0447	0.0421	-0.0567
	(0.142)	(0.211)	(0.216)	(0.0882)	(0.221)	(0.154)
treated × *Hindu*	-0.106			0.0963		
	(0.136)			(0.0831)		
post × *treated* × *Hindu*	0.0588	-0.127	-0.0991	-0.0603	-0.0412	0.0468
	(0.150)	(0.224)	(0.240)	(0.0996)	(0.231)	(0.171)
Constant	0.411***	0.348***	0.341***	0.131***	0.180***	0.190***
	(0.0545)	(0.0466)	(0.0498)	(0.0427)	(0.0360)	(0.0365)
Mean of D.V.	0.285	0.285	0.285	0.154	0.154	0.154
Observations	6,359	6,359	6,359	6,359	6,359	6,359
R-squared	0.127	0.418	0.438	0.083	0.383	0.401
Month & Year FE	Y	Y	Y	Y	Y	Y
HH FE	N	Y	N	N	Y	N
Mother FE	N	N	Y	N	N	Y

Standard errors clustered at village level

*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0. *ramadanAtoB* takes value 1 if the individual is born A to B months after Ramadan where $A < B$ and 0 otherwise. Post is defined from 1978. It takes value 1 the birth took place from 1978 and 0 otherwise. The variable *treated* takes value 1 if mother lives in a treatment area and 0 otherwise. The variable $post * treated$ is the interaction of post and treated. The variable Hindu takes value 1 if the mother is Hindu and 0 otherwise. The village facility include if the village had large market, post office, electricity,primary school, any health facility and any water facility. For each village facility, the variable takes value 1 if the facility is in the village and 0 otherwise. The regression specification include controls post interacted with the village facilities. D.V. is short form for dependent variable.

Table 9: Mother education and Birth Non-Overlapped with Ramadan for Muslims by areas for Birth Cohort 1974 to 1995

VARIABLES	(1) nonramadan(C)	(2) nonramadan(T)
motherage	-0.0000674	0.000145
	(0.000954)	(0.000953)
mothereduy	-0.00116	0.0000512
	(0.00268)	(0.00219)
Constant	0.115**	0.118**
	(0.0555)	(0.0462)
Mean of D.V.	0.133	0.137
Observations	3,158	2,473
R-squared	0.121	0.140
Month FE	Y	Y
Vill FE	Y	Y

Standard errors clustered at village level
*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0. The variables *nonramadan* takes value 1 if the pregnancy did not overlap with Ramadan and 0 otherwise. The variable *mothereduy* is mother education in years. The column (C) and (T) mean control and treatment areas respectively. D.V. is short form for dependent variable.

Table 10: Birth Non-overlapped with Ramadan and Mother Education by Treatment for Muslims

	(1)	(2)	(3)	(4)
VARIABLES	nonramadan	nonramadan	nonramadan	nonramadan
motherage	-0.0000151	-.000064	-0.00212	
	(0.000614)	(0.000644)	(0.00277)	
treated	0.0342			
	(0.0266)			
post × *treated*	-0.0421	-0.0487	-0.0269	-0.0287
	(0.0298)	(0.0306)	(0.0438)	(0.0442)
mothereduy	0.00789	0.00635	0.00326	
	(0.00561)	(0.00572)	(0.0167)	
post × *mothereduy*	-0.00969*	-0.00853	-0.00542	-0.00534
	(0.00526)	(0.00564)	(0.00729)	(0.00740)
treated × *mothereduy*	-0.0144**	-0.0133*	-0.0303	
	(0.00666)	(0.00675)	(0.0201)	
post × *treated* × *mothereduy*	0.0162**	0.0162**	0.0141	0.0153
	(0.00678)	(0.00722)	(0.00922)	(0.00963)
Constant	0.0881**	0.108**	0.205	0.101***
	(0.0426)	(0.0421)	(0.130)	(0.0343)
Mean of D.V.	0.287	0.287	0.154	0.154
Observations	5,631	5,631	5,631	5,631
R-squared	0.092	0.115	0.392	0.406
Month & Year FE	Y	Y	Y	Y
Vill FE	N	Y	N	N
HH FE	N	N	Y	N
Mother FE	N	N	N	Y
F-test(*treated* × *mothereduy*+*post* × *treated* × *mothereduy*)	0.33	0.70	0.77	
Prob>F	0.56	0.40	0.38	

Standard errors clustered at village level

*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0. The variables *nonramadan* takes value 1 if the pregnancy did not overlap with Ramadan and 0 otherwise. The variable *mothereduy* is mother education in years. Post is defined from 1978. It takes value 1 the birth took place from 1978 and 0 otherwise. The variable *treated* takes value 1 if mother lives in a treatment area and 0 otherwise. The variable $post * treated$ is the interaction of post and treated. D.V. is short form for dependent variable.

Table 11: Birth Non-overlapped with Ramadan and Mother Education by Treatment for Muslims for cohort 1974 to 1982

VARIABLES	(1) nonramadan(C)	(2) nonramadan(T)	(3) nonramadan(T)
mothereduy	0.00459	-0.00458	-0.00425
	(0.00549)	(0.00370)	(0.00356)
$post \times mothereduy$	-0.000991	0.0148***	0.0144***
	(0.00572)	(0.00508)	(0.00530)
Hindu			0.0716**
			(0.0334)
$Hindu \times mothereduy$			-0.0110*
			(0.00604)
$post \times Hindu \times mothereduy$			0.0102
			(0.0114)
Constant	0.0442	-0.0214	-0.0140
	(0.0771)	(0.0559)	(0.0516)
Observations	1,195	1,056	1,218
R-squared	0.414	0.400	0.417
Month & Year FE	Y	Y	Y
Vill FE	Y	Y	Y
F test: $mothereduy$+$post \times mothereduy$=0	0.90	7.44	7.33
Prob>F	0.345	0.0083	0.0086
F test:($Hindu \times mothereduy$+$post \times Hindu \times mothereduy$)			0.01
Prob>F			0.94

Standard errors clustered at village level
*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0. The variables *nonramadan* takes value 1 if the pregnancy did not overlap with Ramadan and 0 otherwise. The variable *mothereduy* is mother education in years. Post is defined from 1978. It takes value 1 the birth took place from 1978 and 0 otherwise. The column C and T denote control and treatment areas respectively. D.V. is short form for dependent variable.

Table 12: Birth Non-Overlapping Ramadan and Mother Education. Birth Cohort 1974-95

VARIABLES	(1) nonramadan(C)	(2) nonramadan(T)	(3) nonramadan(T)
$post \times mothereduy$	-0.00508	0.0109*	0.0120*
	(0.00756)	(0.00631)	(0.00635)
$post \times Hindu \times mothereduy$			0.00516
			(0.0272)
Constant	0.0969**	0.108**	0.118**
	(0.0478)	(0.0495)	(0.0463)
Observations	3,158	2,473	2,858
R-squared	0.407	0.416	0.426
Month & Year FE	Y	Y	Y
Mother FE	Y	Y	Y

Standard errors clustered at village level

*** p<0.01, ** p<0.05, * p<0.1

Note: Each dependent variable takes value either 1 or 0. The variables *nonramadan* takes value 1 if the pregnancy did not overlap with Ramadan and 0 otherwise. The variable *mothereduy* is mother education in years. Post is defined from 1978. It takes value 1 the birth took place from 1978 and 0 otherwise. The column C and T denote control and treatment areas respectively. D.V. is short form for dependent variable.

Table 13: Birth Relative to Ramadan and Height Correlations for cohort born between 1982 to 1995 for Muslims

VARIABLES	(1) height(B-C)	(2) height(G-C)	(3) height(B-T)	(4) height(G-T)
Third Trimester	2.084	-1.774	-0.567	-4.739**
	(2.869)	(1.390)	(1.153)	(1.865)
Second Trimester	0.867	0.787	-1.446	-3.313*
	(1.821)	(1.529)	(1.439)	(1.958)
First Trimester	-0.236	-0.498	-2.778*	-3.608**
	(1.506)	(1.434)	(1.478)	(1.683)
Constant	139.9***	136.7***	145.3***	147.8***
	(1.829)	(1.858)	(2.498)	(2.417)
Mean of D.V.	113.24	109.89	112	111.71
Observations	505	496	397	377
R-squared	0.845	0.841	0.881	0.872
Month & Year FE	Y	Y	Y	Y

Standard errors clustered at village level

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable height is measured in centimeters. Each trimester takes value 1 if the pregnancy overlapped with Ramadan during that trimester and 0 otherwise. The trimesters are calculated from the birth date based on the assumption that pregnancy lasts for 9 months. The omitted category is the pregnancies which did not overlap with Ramadan. The births which took place on Ramadan are excluded from the analysis. The columns B and G denote boy and girl respectively. The columns C and T denote control and treatment areas respectively. D.V. is short form for dependent variable.

Table 14: Birth Relative to Ramadan and Height Correlation in Treatment Areas for cohort born between 1982 to 1995 for Muslims

VARIABLES	height(B-T)	height(G-T)
Third Trimester	-0.938	-3.924**
	(1.137)	(1.941)
Second Trimester	-1.702	-2.533
	(1.376)	(1.920)
First Trimester	-2.778*	-3.150*
	(1.455)	(1.626)
Hindu	0.520	-3.391
	(2.499)	(2.162)
$Hindu \times ThirdTrimester$	1.445	0.975
	(2.489)	(3.867)
$Hindu \times SecondTrimester$	-1.372	3.802
	(2.875)	(3.328)
$Hindu \times FirstTrimester$	0.253	3.382
	(3.357)	(2.375)
Constant	145.2***	146.8***
	(2.304)	(2.294)
Mean of D.V.	112.04	111.40
Observations	469	440
R-squared	0.883	0.873
Month & Year	Y	Y

Standard errors clustered at village level

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable height is measured in centimeters. Each trimester takes value 1 if the pregnancy overlapped with Ramadan during that trimester and 0 otherwise. The trimesters are calculated from the birth date based on the assumption that pregnancy lasts for 9 months. The omitted category is the pregnancies which did not overlap with Ramadan. The births which took place on Ramadan are excluded from the analysis. The columns B and G denote boy and girl respectively. The column T denote treatment areas. The variable Hindu takes value 1 if the mother is Hindu and 0 otherwise. D.V. is short form for dependent variable.

Table 15: Birth Relative to Ramadan and Height Correlation in Treatment Areas Controlling Mother Covariates for cohort born between 1982 to 1995 for Muslims

VARIABLES	height(B-T)	height(G-T)
Third Trimester	-1.087	-4.119**
	(1.106)	(1.917)
Second Trimester	-1.854	-2.469
	(1.352)	(1.885)
First Trimester	-2.786*	-2.837*
	(1.431)	(1.548)
Hindu	0.834	-3.723*
	(2.549)	(2.053)
$Hindu \times ThirdTrimester$	1.571	1.356
	(2.444)	(3.535)
$Hindu \times SecondTrimester$	-1.180	4.209
	(2.941)	(3.110)
$Hindu \times FirstTrimester$	-0.0614	3.414
	(3.571)	(2.336)
mothereduy	0.392***	0.628***
	(0.0951)	(0.178)
motherage	0.0728	0.0148
	(0.0746)	(0.0594)
Constant	141.5***	144.5***
	(3.559)	(3.254)
Observations	469	440
R-squared	0.928	0.906
Month & Year	Y	Y

Standard errors clustered at village level

*** p<0.01, ** p<0.05, * p<0.1

Note: The dependent variable height is measured in centimeters. Each trimester takes value 1 if the pregnancy overlapped with Ramadan during that trimester and 0 otherwise. The trimesters are calculated from the birth date based on the assumption that pregnancy lasts for 9 months. The omitted category is the pregnancies which did not overlap with Ramadan. The births which took place on Ramadan are excluded from the analysis. The columns B and G denote boy and girl respectively. The column T denote treatment areas. The variable Hindu takes value 1 if the mother is Hindu and 0 otherwise. The variable *mothereduy* is mother education measured in years and *motherage* is mother age at survey. D.V. is short form for dependent variable.

Table 16: Mother Education and Children Height for Cohort Born Between 1982 to 1995 for Muslim

VARIABLES	(1) height(B)	(2) height(G)	(3) height(B)	(4) height(G)
mothereduy	0.333***	0.546***	0.333***	0.546***
	(0.0987)	(0.134)	(0.0987)	(0.134)
motherage	0.0698	0.00413	0.0698	0.00413
	(0.0490)	(0.0334)	(0.0490)	(0.0334)
Constant	138.3***	139.5***	138.3***	139.5***
	(2.456)	(1.902)	(2.456)	(1.902)
Mean of D.V.	112.63	110.56	112.63	110.56
Observations	999	949	999	949
R-squared	0.857	0.858	0.883	0.877
Month & Year	Y	Y	Y	Y
Vill FE	N	N	Y	Y

Standard errors clustered at village level
*** p<0.01, ** p<0.05, * p<0.1

Note:The dependent variable height is measured in centimeters. The columns B and G denote boy and girl respectively. The variable *mothereduy* is mother education measured in years and *motherage* is mother age at survey. D.V. is short form for dependent variable.

11 Appendix

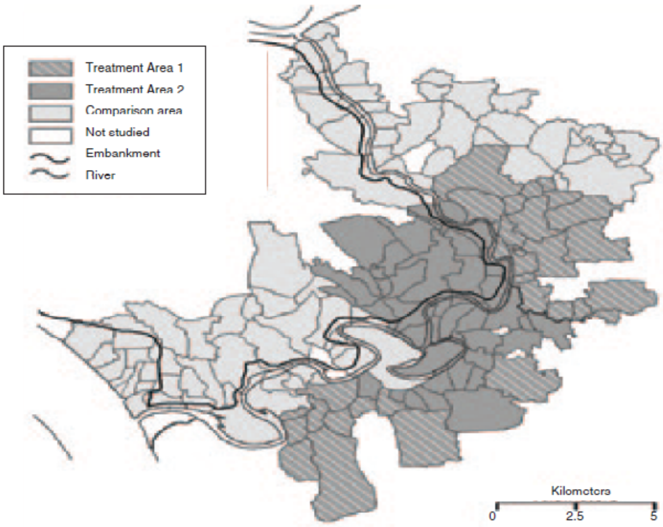

FIGURE 1. MAP OF MATLAB STUDY AREA

TABLE 3—1974 BASELINE CHARACTERISTICS

	Treatment Area			Comparison Area			Difference in Means		
	Mean	SD	Obs.	Mean	SD	Obs.	Mean	T-stat	Mean/SD
Panel A. Full Sample									
Family size	7.01	(5.15)	2,124	6.82	(4.20)	2,548	0.18	1.34	0.04
Owns a lamp (=1)	0.65	(1.18)	2,124	0.61	(0.92)	2,548	0.04	1.37	0.04
Owns a watch (=1)	0.16	(0.94)	2,124	0.16	(0.62)	2,548	0.00	0.05	0.00
Owns a radio (=1)	0.08	(0.63)	2,124	0.08	(0.47)	2,548	0.00	0.15	0.00
Wall tin or tinmix (=1)	0.32	(1.08)	2,124	0.31	(0.78)	2,548	0.01	0.27	0.01
Tin roof (=1)	0.83	(0.66)	2,124	0.84	(0.69)	2,548	0.00	−0.10	0.00
Latrine (=1)	0.83	(0.78)	2,124	0.85	(0.86)	2,548	−0.03	−1.22	−0.03
Number of rooms per capita	0.21	(0.15)	2,124	0.21	(0.18)	2,548	0.00	0.39	0.01
Number of cows	1.55	(3.30)	2,124	1.37	(3.05)	2,548	0.19	2.02	0.06
Number of boats	0.68	(1.50)	2,124	0.68	(1.42)	2,548	−0.01	−0.20	−0.01
Drinking water, tubewell (=1)	0.31	(1.41)	2,124	0.16	(0.93)	2,548	0.15	4.35	0.11
Drinking water, tank (=1)	0.38	(1.72)	2,124	0.33	(1.68)	2,548	0.05	1.01	0.03
Drinking water, other (=1)	0.31	(2.21)	2,124	0.51	(1.84)	2,548	−0.20	−3.39	−0.09
HH age	47.8	(22)	2,124	46.5	(22)	2,548	1.28	1.97	0.06
HH years of education (edu.)	2.52	(6.72)	2,124	2.34	(5.25)	2,548	0.17	1.25	0.02
HH works in agriculture (=1)	0.61	(0.89)	2,124	0.59	(0.99)	2,548	0.02	0.79	0.02
HH works in fishing (=1)	0.05	(0.53)	2,124	0.06	(0.49)	2,548	−0.01	−0.57	−0.02
HH spouse's age	37.0	(17)	2,124	36.2	(16)	2,548	0.86	1.72	0.05
HH spouse's years of edu.	1.14	(3.58)	2,124	1.21	(2.56)	2,548	−0.07	−0.95	−0.02
Panel B. Age 8–14									
Family size	6.59	(3.09)	188	6.87	(3.20)	304	−0.27	−0.97	−0.08
Owns a lamp (=1)	0.63	(0.52)	188	0.60	(0.69)	304	0.03	0.63	0.05
Owns a watch (=1)	0.16	(0.71)	188	0.17	(0.43)	304	−0.01	−0.13	−0.01
Owns a radio (=1)	0.09	(0.51)	188	0.09	(0.29)	304	0.01	0.14	0.01
Wall tin or tinmix (=1)	0.29	(0.72)	188	0.32	(0.43)	304	−0.03	−0.49	−0.05
Tin roof (=1)	0.81	(0.45)	188	0.88	(0.52)	304	−0.07	−1.57	−0.14
Latrine (=1)	0.85	(0.39)	188	0.85	(0.52)	304	−0.01	−0.13	−0.01
Number of rooms per capita	0.21	(0.08)	188	0.21	(0.18)	304	0.00	0.09	0.01
Number of cows	1.52	(2.51)	188	1.38	(2.22)	304	0.14	0.60	0.06
Number of boats	0.67	(0.98)	188	0.67	(0.92)	304	−0.01	−0.07	−0.01
Drinking water, tubewell (=1)	0.27	(0.71)	188	0.13	(0.58)	304	0.14	2.28	0.21
Drinking water, tank (=1)	0.37	(0.84)	188	0.31	(0.99)	304	0.06	0.75	0.07
Drinking water, other (=1)	0.36	(1.12)	188	0.56	(0.97)	304	−0.21	−2.09	−0.18
HH age	48.9	(17)	188	46.3	(18)	304	2.58	1.61	0.15
HH years of education	1.92	(3.84)	188	2.10	(3.15)	304	−0.18	−0.61	−0.05
HH works in agriculture (=1)	0.67	(0.45)	188	0.55	(0.67)	304	0.12	2.29	0.19
HH works in fishing (=1)	0.07	(0.35)	188	0.07	(0.38)	304	0.00	0.11	0.01
HH spouse's age	37.6	(15)	188	35.8	(14)	304	1.82	1.37	0.13
HH spouse's years of edu.	1.00	(1.39)	188	1.20	(1.58)	304	−0.20	−1.58	−0.12

Table 1—MCH-FP Program Eligibility by Birth Year

Birth cohorts	Birth cohort label[a]	Program eligibility[b]
October 1947–September 1972	25–49	*Pre-intervention group*
October 1972–September 1977	20–24	*No interventions, potential sibling competition*
		i. Not eligible for child health interventions and unlikely to use family planning and maternal health interventions. ii. Potentially affected by the program through sibling competition.
October 1977–February 1982	15–19	*Intensive family planning and maternal health interventions*
		i. Mother eligible for family planning, tetanus toxoid vaccine, folic acid, and iron in last trimester of pregnancy. ii. Children under age five eligible for mainly late measles vaccination in Treatment Area 1. iii. Potentially affected by sibling competition from younger groups.
March 1982–December 1988	8–14	*Child health interventions added*
March 1982–October1985	12–14	*Child health interventions added in Treatment Area 1* i. Mother eligible for family planning, tetanus toxoid vaccine, folic acid, and iron in last trimester of pregnancy. ii. Children under age five eligible for on-time measles vaccination in Treatment Area 1, but for late DPT, polio, and tuberculosis vaccination in entire treatment area.
November 1985–December 1988	8–11	*Child health intervention extended to entire treatment area* i. Mother eligible for family, tetanus toxoid vaccine, folic acid and iron in last trimester of pregnancy. ii. Children under age five eligible for on-time vaccination (measles, DPT, polio, tuberculosis) and vitamin A supplementation. iii. Nutrition rehabilitation for children at risk.