Impact of Prenatal Exposure to Fasting on Child Health Outcomes

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Thesis submitted to the Lahore School of Economics in partial fulfilment of the requirements for the degree of

MPhil in Economics

2017

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Abstract

Early life factors play an important role in the foetal development as stated by Barker's "womb with a view" hypothesis. This study explores how prenatal exposure to Ramadan, the month of fasting, has an impact on the child's health outcomes in terms of height-for-age and weight-for-age Z-scores. In order to explore the relationship between prenatal exposure to the month fasting and child health outcomes, in the absence of actual reported fasting behaviours, the "Intent to Treat" (ITT) approach is used as in Randomized Control Trial (RCT) evaluations, as it allows for the unbiased impact of an intervention to still be measured, even when there is imperfect compliance with random assignment into control and treatment groups. It does not require or assume all women who are pregnant during Ramadan are fasting. What is critical, however, is that Ramadan is exogenous to the timing of pregnancy; in other words, women do not intentionally time their pregnancies to fall outside of Ramadan. In our study, the ITT framework is used to compare the health outcomes of children whose time period in the utero happened to coincide with the month of Ramadan (treatment group) to those who were not exposed (control group), without using any information on actual fasting behaviour. The date of birth of children under age of five has been used to identify whether pregnancy overlapped with the month of Ramadan and gestational month of exposure variables were constructed using this information. The data for our analysis is provided by the Punjab Multiple Indicator Cluster Survey for 2008 and 2011 gathered by the Punjab Bureau of Statistics. The results of this study indicate that exposure to the month fasting during the first two trimesters has negative implications in terms of height of children. In addition, children who were prenatally exposed to fasting in second and third trimester were on average thinner compared to unexposed children. We did not find evidence of selection bias arising due to parents selectively timing their pregnancy to avoid Ramadan; which was one of the major concerns of our study.

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1. Introduction

Early life factors often have long lasting impacts on individuals either in the form of general health status or educational attainment later in life. Barker (1990) has explained the importance of the early life factors through his famous “womb with a view” hypothesis, also referred to as “foetal origins”. According to this hypothesis, nutritional deficiencies at the time of foetal development may result in higher risks of coronary heart diseases, hypertension, and diabetes later in life.

Recent literature is also focusing on the importance of investments made in the early childhood period and how they are more effective in increasing human capital as compared to those made after starting formal schooling. Doyle et al (2009) discussed the importance of early childhood interventions by proposing the “antenatal investment hypothesis”. According to this hypothesis, early childhood interventions such as prenatal care may reap greater benefits at lower costs as compared to post-natal investments. Thus early childhood inputs yield much greater social and economic returns. Moreover Heckman and Masterov (2007) also emphasized that the early environment of a child is much more productive in enhancing human capital. The rational provided by Heckman and Masterov (2007) is that early childhood intervention will increase the efficiency of schools as a result of the enrolment of students with already high productivity due to better cognitive abilities. Educational attainment cannot be only achieved through investment in the educational sector; rather early childhood interventions play a large role in determining later years’ outcomes either in the form of health or education.

As the early life environment is crucial for the mental and physical development of an individual, so the mother’s behaviour during pregnancy should not be ignored. According to Van Ewijk (2011), the behaviour of mothers during pregnancy regarding diet and health inputs can have long lasting impacts on the development of the foetus. Van Ewijk (2011) stated that reducing food intake due to skipping meals or fasting can have negative implications on the health status of individuals starting from childhood. This is because the maternal diet permanently programs the foetus and that these adaptations become more observable in later life. Barker's "womb with view" hypothesis can be used to explain the alteration in the programming of the foetus. Barker suggests that nutritional deficiencies during pregnancy causes the foetus to direct resources toward the development of those organs that are immediately required (till the age of reproduction) rather than focusing long term development.

Several studies have shown that the risks of various diseases like coronary heart disease, diabetes, and hypertension may have its roots in the period before birth. Harding (2001) concluded that it is not maternal nutrition but rather foetal nutrition that alters the growth of the foetus and can be later associated with the risk of diseases[1]. Moreover Karimi (2015) found that Ramadan-induced prenatal malnutrition causes Muslim boys of ages 3 and 4 to be 3.5 to 10.5 millimetres shorter compared to the non-exposed. Lack of foetal nutrition may not only increase the risk of diseases but it can even alter the overall programming of the foetus and thus have a permanent impact on the physical and mental development of an individual in terms of BMI and cognitive skills respectively.

Complications visible in later years, related to physical and mental wellbeing and risk of diseases may have their origins in the period before birth. Therefore the focus of our study is to draw attention towards the issue of how maternal nutritional intake during pregnancy can have impact on the physical health status (in terms of height for age and weight for age) of children under five. According to a cross-sectional study conducted by Mubeen et al (2012), 87.5 percent of women out of the sample of 353 females interviewed by the gynaecology departments of various hospitals of Pakistan observed the fast during Ramadan;

[1] Harding (2001) has described foetus nutrition as the "net supply of metabolic substrates to the foetus". It includes mother's nutritional intake, maternal metabolism, umbilical blood flow and placental transfers etc.

42.5 percent fasted daily and 23.8 percent fasted every other day while the remained fasted less frequently. The basis of our research is to analyse how exposure to the month of fasting by pregnant women in Punjab has an impact on their children's health status in terms of height-for-age and weight-for-age. For the purpose of analysis, pooled cross-sectional data from Multiple Indicator Cluster Survey (MICS) of Punjab conducted in 2008 and 2011 is used to obtain data on health outcomes of children under five years of age. The aim of the study is to analyse the link between the exposure to Ramadan during pregnancy and offspring anthropometry. The research question under focus is whether fasting during pregnancy has an impact on the anthropometric status of children under five whose period inside the womb overlapped with the month of fasting (Ramadan). It is important here to note that we cannot separate out the impact of fasting from other activities that takes place during the month of fasting as stated by Almond et al (2014). So the results of this study will capture the overall impact of all the aspects of the month of fasting. Some of the different facets of the month of fasting include changes in sleeping and eating patterns, reduction in caloric intake and indulgence into unhealthy eating habits (since meals after the fast often include large portions of fried foods).

2. Literature Review

Ramadan is the 9th month of the lunar calendar and it is regarded as a month of fasting by Muslims. It is an obligatory religious practice for all Muslims to observe fast [2]during this month except people who are sick or travelling, children under 12 and breastfeeding mothers. Pregnant women are allowed to skip fast during this month and makeup for the missed fasts later, if they fear that it may have negative implications on their health or the health of the foetus. Even with this leverage, many Muslim women during pregnancy are seen to observe the fast during Ramadan. According to a study conducted to understand the perception and practices of fasting during pregnancies in major cities of Pakistan, 88 percent of the women from a sample of 353 believed that fasting during a healthy pregnancy is mandatory (Mubeen et al, 2012). As mentioned in the introduction, Mubeen et al (2012) also found that women also practiced what they perceived and 87.5 percent of women fasted during pregnancy.

The link between prenatal fasting and long-term health outcomes can take place through various mechanisms and medical studies have used these biomedical channels to explain their findings. Almond et al (2014) has discussed some of the pathways through which prenatal fasting has an impact on cognitive skill development, an important channel being "accelerated starvation" associated with long hours of fasting. Prentice et al (1983) showed that accelerated starvation can occur during Ramadan when pregnant women observe the fast as there is a sudden decline in blood glucose levels and an increase in ketones and fatty acids. According Rizzo (1991) increased ketone levels in pregnant women with diabetes can increase the risk of lower cognitive abilities. Another channel referred to as the predictive adaptive response (PARs) is used to explain how the early environment encountered by the

[2] Muslim observe fast by abstaining from food and water before break of dawn till sunset during month of Ramadan.

foetus due to nutritional deficiencies can permanently alter the program of the body development system. Gluckman and Hanson (2005) explained that if the foetus suffers from nutritional deficiency it utilizes the resources it has to develop organs needed up until the reproductive age of an individual. This increases the chances of diseases related to the heart and diabetes later in life.

Previous studies in this area can be distinguished into two types, the medical studies and studies done by social scientists. These studies can be categorised based on the different methods being used. Medical studies take smaller samples for analysis, usually clinical patients, but in most of the cases they are not able to control for confounding factors, in particular the endogeneity of the fasting decision resulting in omitted variable bias. Endogeneity of fasting can result because women experiencing pregnancy complications are less likely to fast, so that the non-fasting group is comprised of less healthy subjects. If not controlled for, this will lead to a bias toward zero effect in the coefficient on fasting's impact, since the outcomes for healthy fasting women are compared against a group of non-fasting but less healthy pregnancies, which makes the impact of fasting look less damaging than if they were being compared to a group of equally healthy women who fasted. In contrast, there are studies that are performed by social scientists that analyse large demographic data sets in order to understand the relationship that may persist between fasting during pregnancy and child mental and anthropometric health status. However these studies can also fall prey to omitted variable bias.

Several medical studies have been conducted in order to analyse the long-lasting impact of fasting during pregnancy. One such cohort study conducted on historical cohort by Shahgheibi et al (2005) concluded that maternal fasting during the third trimester did not have any impact on the growth parameters of the new-born babies. Moreover a study conducted in Tehran by Ziaee et al (2010) revealed that there was no significant difference in terms of BMI in the early stage of pregnancy, average mean height, weight and other anthropometric development of infants between fasting and non-fasting pregnant women. Also there was no significant difference in pregnancy outcome due to pregnant women fasting during a different trimester. According to research conducted in Birmingham by Cross et al (1990) on 13,351 new-born babies, Ramadan was not found to have any significant impact on average birth weights of infants at whatever period of gestation it occurred. However Cross et al (1990) did mention that there was increase in occurrence of low birth weights among infants who were prenatally exposed to Ramadan during second trimester, but it was not found to be significant. Similarly results from the cohort study conducted in Tehran by Kavehmanesh (2004) suggested that prenatal fasting had no significant impact on the neonatal birth weight.

Most of the medical literature suggests that the fasting during pregnancy has no significant impact on the pregnancy outcomes. However, in addition to the aforementioned endogeneity problems, these studies have mostly used small samples of the population in order to conduct the analyses. These sample sizes may not be large enough to detect statistically significant differences, nor do they consider longer term effects after the perinatal period.

By failing to control for factors like mother's age, education, BMI, smoking behaviour and birth order that might have an impact on both child health outcomes and the decision to fast during pregnancy, these medical studies suffer from a severe simultaneity problem. In other words, due to these omitted variables, the results might become upward or downward bias depending on the relationship of the omitted variable with the dependent and independent variables[3]. Some of the omitted variables may lead to an underestimate of the impact of fasting, others an overestimate, as we discuss in the next paragraphs.

In particular, if an omitted variable is inversely related to the decision to fast and also negatively correlated with child health outcomes, then the impact of fasting can be underestimated, because the "control group" of non-fasting mothers are likely to have less healthy pregnancies on average to begin with, and therefore in comparison it will be harder to detect a negative impact of fasting. This can happen, for example, if older mothers are less likely to fast (Patherick et al, 2014) because at the same time it is well known that older mothers also experience worse birth outcomes. Factors that are both positively related to the decision to fast as well as health outcomes will also lead to an underestimate of the impact of fasting, because these factors make the "treatment group" of fasting mothers more likely to experience relatively more healthy pregnancies in comparison to those not fasting, again making an impact of fasting more difficult.

Other factors may work in the opposite direction. If the omitted variable is positively (negatively) correlated with fasting but negatively (positively) correlated with child health outcomes, then the impact of fasting can be overestimated. This could potentially be the case with birth order, parental consanguinity, and maternal education.

However, even if studies controlled for observable maternal characteristics associated with both the decision to fast and child health outcomes, unobserved factors such as pregnancy complications are likely to confound the analysis. Women experiencing complications are less likely to fast and to have poorer pregnancy outcomes as well, biasing studies against finding an impact of fasting.

[3] Even if a study were to control for these observable demographics, unobservables would remain (like pregnancy complications) that would continue to confound the estimates.

One study, Patherick et al (2014), was an advance over the previous medical literature and controlled for mother's age, BMI, education, and ethnicity in a study of South Asian Muslim women in the UK. The study found that factors like mother's age, BMI and education do have an impact on a woman's decision to fast. This study did not find a statistically significant association (at the normal significance levels) between the decision to fast and child health outcome when controlling for these factors, although the sample was small at 300 women. However a closer look at the results is revealing: Women who fasted most days were more than twice as likely to have a low birth weight baby, but with a p-value of 0.17, it is shy of the 10 percent standard significance level. The standard error is large and a larger sample size may have provided stronger evidence. Interestingly, it is also the women who fasted most days that were *less likely* to experience a pre-term birth (p=0.16), in comparison to women who did not fast. Since there is no clear medical reason why fasting should prevent pre-term birth, we hypothesize that reverse causality is driving this result, which provides some indirect support for our conjecture above that women with more complex pregnancies are less likely to fast, making it more difficult to detect a negative impact of fasting if those who are deliberately choosing not to fast are less healthy from the outset.

Thus in order to counter such problems, social scientists have been begun to develop a literature to address the shortcomings of the medical literature in order to analyse to what extent fasting during pregnancy can influence the development of the offspring from childhood up until adulthood.

Social scientists have implemented natural experiments to control for the self-selection of women out of fasting. Almond and Mazumder (2011) was among the first papers to address the problem arising in many of the medical studies that have compared pregnant women fasting at a point in time to those who were not fasting, since the decision to fast is not exogenous. Almond and Mazumder's (2011) approach was to compare outcomes of births where the month of Ramadan happened to coincide with pregnancy to those when it did not, over a period of many years, without using any information on actual fasting behaviour. The paper used "intent to treat" approach in order to make the selection of treatment and control groups random: as long as women do not time their pregnancies with regards to Ramadan and the timing of Ramadan relative to the period of pregnancy can be considered to be exogenous. This approach is used in clinical trials and in the RCT/program evaluation literature since it allows for the unbiased impact of an intervention to still be measured, even when there is imperfect compliance with researchers' random assignment into control and treatment groups. It does not require or assume all women who are pregnant during Ramadan are fasting. What is critical, however, is that Ramadan is exogenous to the timing of pregnancy; in other words, women do not intentionally time their pregnancies to fall outside of Ramadan.

There is growing literature that presents evidence on the influence of maternal fasting on the overall physiological development of the offspring. Several studies including Aguero and Valdivia (2010), Hidrobo (2014), Alderman et al (2006) and Almond (2006) have identified various economic and environment shocks such as recessionary shocks, wars, droughts and spreading of influenza that can have long lasting impacts on children's health outcomes. Foetal exposure to fasting during Ramadan can also be considered as a shock that can affect an individual later in life.

Van Ewijk et al (2013) conducted a study using the Indonesian Life Survey in order to determine the association between prenatal exposure to Ramadan and growth parameters (BMI, height and weight) of offspring in adulthood. Moreover the paper also investigated whether exposure to Ramadan during different gestational periods had any effect on the growth parameters. Van Ewijk et al (2013) found that adults who were in the utero during Ramadan were thinner as compared those who were not in the utero during Ramadan. Furthermore those who were conceived during Ramadan were reported to be shorter in height compared to those who were not. Thus the findings from the Indonesian study suggest that adult Muslims exposed to Ramadan in utero had slightly reduced weight and height. Karimi (2015) conducted a similar study using Demographic and Health Survey data for 35 developing countries and found that Ramadan-induced prenatal malnutrition causes Muslim boys of ages 3 and 4 to be 3.5 to 10.5 millimetres shorter compared to the non-exposed.

Brainerd and Menon (2015) found that foetal exposure to Ramadan fasting in utero may lead to positive selection of Muslim male infants. Moreover results also suggest that Muslim infants have better height for age z-scores than Hindu infants but this partially due to the positive selection of male infants. On the contrary study conducted on census data of U.S, Iraq and Uganda by Almond and Mazumder (2011) found that exposure to Ramadan during first month of gestation is associated with negative selection of males in Uganda. Moreover Almond and Mazumder (2011) found strong associations between in utero exposure to Ramadan and lower birth weights and likelihood of mental disability as an adult. Similar results in terms of prenatal exposure to Ramadan and general health status in the next generation was found by the study conducted by Van Ewijk (2011). The paper took children's general health as rated by professional health workers on a 9 points scale and found that people who were prenatally exposed to Ramadan fasting had a poorer general health status as compared to the reference group.

Chen (2014) used an interesting example of mild shock causing undernourishment in addition to Ramadan fasting, which is festival over-spending. The paper states that over-spending on festivals is a social norm present in some societies that can negatively affect the foetuses because little is left for basic consumption of pregnant women after the excessive spending on food and presents by the household during the holiday. Moreover Chen (2014) also identified that Ramadan fasting can have an impact on foetus through various channels such as changes in eating behaviour (intake of oily and unhealthy food) and altered timing of nutritional intake even if the caloric intake is the same.[4]

Prenatal exposure to fasting does not only affect the anthropometric growth parameters of the offspring but it can also influence the mental development of an individual. Several studies have tried to analyse how foetus exposure to Ramadan has an effect on the mental/learning abilities of children. Greve et al (2015) tried to examine the effect of foetal nutrition on the academic performance based on standardized test scores of English, Maths and Science of Muslim students living in Denmark. The study used foetal exposure to Ramadan as a natural experiment, using non-Muslims as control group[5]. The results suggest that foetal exposure to Ramadan has negative impact on the academic performance of Muslims and the results are more pronounce for females and children with low social economic status background. Almond et al (2011) conducted study on Pakistani and Bangladeshi children in the UK and found similar results in terms of test scores. The study examined the impact of fasting during pregnancy on academic performance. The results suggest that children at the age of 7 and exposed to Ramadan in the early period of pregnancy have 0.5 to 0.8 standard deviation lower test scores. These studies are important in understanding how lack of nutrition during pregnancy due to fasting can affect the offspring in later years.

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[4] While some people shift some of their waking hours to the night-time and sleep in the day during Ramadan, many others have to go to work or school and go about their normal days. Even pregnant women are likely to go about their normal routine if they have to send their children to school and do other household chores.

[5] If non-Muslims differ on time-varying observables, they may prove to be a weak control group.

Almond and Mazumder (2008) identified some issues related to intent to treat strategy in terms of separating out the seasonality factors from the fasting during pregnancy because studies like Doblhammer (2001), Costa (2005), and Buckles (2008) stated that season of birth also has long term impacts. Moreover age at which one is assessed can also play an important role in determining the health outcome. In order to separate the seasonality effects studies have taken advantage of the gradual movement of Ramadan as it follows the lunar calendar so it starts 11 days prior every year. So with a larger data set on birth cohorts, the seasonality factors can be separated out by including the month dummies for seasonal controls. Almond et al (2014) used a different technique applied to a smaller number of birth cohorts. The paper utilized a difference in difference approach to separate out the seasonal effects by subtracting out the effect on non-Muslims that may be arising because of seasonal variation from the effects on Muslims.

In order to identify the treatment and control group Almond et al (2014) assumed that the timing of pregnancy was not planned to avoid Ramadan. This strategy of identification is based on the assumption that there is no systematic selection of the timing of conception in accordance to the timings of Ramadan. Almond et al (2014) took this based on the findings of Almond and Mazumder (2011) and van Ewijk (2011). Both these paper found no selection bias in timing of pregnancy relative to Ramadan based on a comparison of mean values for exposed and non-exposed individuals along dimensions such as parental education, parental health, income and maternal smoking behaviour. However Ahsan (2015) found selection bias in pregnancy timing relative to Ramadan in Bangladesh when allowing for *time-varying* factors such as the availability of family planning[6]. Thus it essential for us to analyse, as a

[6] Ahsan (2015) found women who were exposed to family planning were less likely to give birth eight to nine months after Ramadan whereas more educated mothers were less likely to time their pregnancy relative to Ramadan.

robustness check, whether selection bias is present or not; that is, whether women are selectively timing their pregnancy to fall outside of Ramadan.

3. Methodology

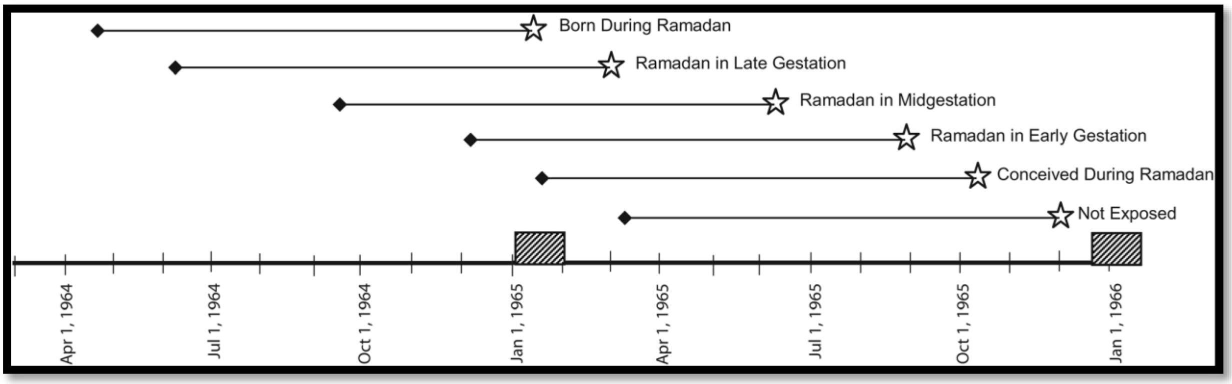
Our study aims analyse the impact of the month of fasting occurring during pregnancy by women on their child health outcomes such as weight and height for age of children under 5 years of age. It is important to understand how exposure to fasting during Ramadan impacts child health outcomes and the magnitude of the impact during different phases of pregnancy will be quantified in order to analyse their relationship. Health outcomes and month of fasting (Ramadan) exposure measures will be discussed in detail below.

3.1 Month of Fasting (Ramadan) Exposure Measures

In order to understand the association of prenatal exposure to the month of fasting (Ramadan) and child health outcomes, it is essential to develop categories of prenatal exposure to month of fasting based on date of birth as previously done by various studies conducted by Van Ewijk (2011), Van Ewijk et al (2013), Almond et al (2014). Thus for our analysis, the Ramadan exposure variable will be generated based on the date of birth of children between zero to five years of age. Children will be considered to be prenatally exposed to month fasting if any of their 266 days before their birth of date overlapped with the month of Ramadan. It is essential to note that it will be assumed that the average pregnancy period of 266 days will be considered in order to analyse the Ramadan exposure. Different categories of prenatal exposure to Ramadan will be developed based of the date of birth of children. Ten dummy variables to be created depending on the period in which the foetus was exposed to Ramadan include: conceived during Ramadan and exposed to Ramadan during month 1 to month 9 in utero. The control group will consist of those children not exposed to Ramadan; these will be those children who were conceived just after the Ramadan and born before the month of the next Ramadan.[7]

Figure 1 demonstrates the procedure how exposure to fasting is determined using the date of birth of an individual. The shaded areas indicate the month of fasting (Ramadan), whereas a diamond indicates the date of conception and a star is indicative of the date of birth as stated by van Ewijk (2011), van Ewijk et al (2013) and Almond et al (2014).

Figure 1



Source: van Ewijk et al (2013)

[7] According to Van Ewijk (2011) those for children who were born within 21 days after end of Ramadan but remained in the utero for a relatively longer period of time it would be erroneous to consider them as subject not exposed to Ramadan. However the study considered less equal to 21 days after Ramadan conception to be a safe margin because it is rare that pregnancy last three week beyond the average period of 266 days of pregnancy.

The aim of the paper is to investigate the difference between the children prenatally exposed to the month of fasting (treatment group) and the control group in terms of their health outcomes.

3.2 Health outcome measures

Various studies have linked the exposure to Ramadan in the utero to different outcomes like academic performance and anthropometric development status, general health status and short-term impact such as the birth weight of an individual. However in our study the aim is to focus on the anthropometric status of children between zero to five years of age. Hence it can provide a clearer picture in terms of the association between the exposure to Ramadan in utero and anthropometric development of children. Data for height-for-age and weight-for-age will be taken from MICS Punjab 2008 & 2011.

3.3 Statistical Methods

Recent studies like Van Ewijk (2011) and Almond and Mazumder (2011)[8] have used the "Intent to Treat" ITT framework in order to compare the outcomes between subjects who were prenatally exposed to Ramadan (treatment group) to those who were not (control group). "Intent to treat" ITT is a statistical concept that can used as a possible solution to overcome the problems arising in randomized control trials (RCTs) such as non-compliance and missing outcome data (Gupta, 2011). ITT approach includes all the randomized subjects

[8] Almond and Mazumder (2011) estimated the reduced form effect of Ramadan timing by taking in consideration those births where timing of Ramadan coincided with their time in the utero. The paper assumed the timing Ramadan in relation to pregnancy is exogenous whereas the decision to fast is endogenous.

in groups to which they were randomly assigned regardless of non-compliance, protocol deviation, withdrawal and everything that happens after process of randomization. According to Fisher et al (1990), ITT takes into account all the random patients in groups to which they are randomly assigned regardless of whether the treatment was actually received by the treatment group and regardless of whether subject later withdrew from the treatment or not. According to Lachin (2000), intent-to-treat analysis is considered unbiased if all the patients randomly allocated into groups are included in the analysis and followed from the beginning regardless of taking into account non-compliance. This not only minimizes the potential bias in analysing the treatment effect due to efficacy subset selection but also increases the power of the trial by inclusion of all the patients, which increases sample size for the experiment. Here it is important to highlight that the intent to treat approach overcomes the problem of non-compliance by considering all subjects even if they do not comply with the treatment in the later stage of the experiment. However in order for this approach to be valid subjects should not be self-selecting as to whether to be in the treatment or control group at the start of the experiment i.e. self-selection bias should not exist. The allocation of subject into treatment and control groups should be a randomized process. Van Ewijk (2011) discussed in his paper the problem of selection bias that may exist. According to van Ewijk (2011) if parents selectively timed their pregnancy to avoid Ramadan, their children would likely have better health anyway because of self-selection of those health-conscious parents into the control group. If this is the case, children who are not exposed will have better health just because of a health-favouring environment and not just because they avoided exposure to Ramadan. Thus issue of selection bias would downwardly bias the results (exaggerate the impact of Ramadan) because the omitted variable (selective timing of pregnancy) is positively related to child health outcome but negatively related to the exposure to fasting.

Similar to the studies by Van Ewijk (2011) and Almond and Mazumder (2011), our study will also be using the intent to treat (ITT) approach. So in accordance with the intent to treat approach those children whose time period in the utero overlapped with the month of Ramadan will be allocated to the treatment group regardless of the non-compliance that might be present if women were pregnant during Ramadan but not fasting. According to Almond et al (2014) fasting rates are rarely unity therefore ITT approach will underestimate the treatment effect of fasting. As discussed earlier in order for intent to treat analysis to be valid parents should not time their pregnancies to avoid Ramadan. If they do time conception to be outside of Ramadan, self-selection bias will exist in the analysis.

Moving forward, it is important to understand that the results from our study should be interpreted as the average impact of ***all*** behaviours associated with the month of fasting and not just the prenatal impact of fasting itself on child health outcomes. First of all, not all women are fasting, and so this average impact includes imperfect compliance. Secondly, there are other customs involved in the observance of Ramadan which may be relevant such as changes in sleeping patterns, changes in quantity and quality of food intake and altered timing of nutritional intake during month of fasting compared to rest of the year.

In order to analyse the impact of prenatal exposure to month of fasting (Ramadan) on child health outcomes the following estimation strategy will be used.

Health outcomes = f (Month of fasting exposure measures, Household specific variables, Mother specific, Child specific variables)

The specific regression equations are as follows:

OLS regression equations

Child Health Outcomes (CHO) $=\beta_0 + \pi$ Exposure Variables + Child Controls +

Mother Controls + HH Controls + Error ………………. eq(1)

$$\mathbf{CHO} = \beta_0 + \boldsymbol{\pi}\mathbf{E}_i + \boldsymbol{\gamma}\mathbf{C}_i + \boldsymbol{\alpha}\mathbf{M}_i + \boldsymbol{\lambda}\mathbf{X}_i + \varepsilon_i$$

Where Child health outcomes (CHO) are defined as either Height-for-Age or Weight-for-Age and E, C, M & X are the vectors for *Exposure variables*, *Child-specific*, *Mother-specific* and *Household-specific* controls respectively

In the above regression *Exposure variables (E) includes* categorical variables for Ramadan exposure and the categories will include the following as treatment group variables:

- *month0*: conceived during Ramadan
- *month1*: exposed to Ramadan in the first month of pregnancy
- *month2*: exposed to Ramadan in the second month of pregnancy
- *month3*: exposed to Ramadan in the third month of pregnancy
- *month4*: exposed to Ramadan in the fourth month of pregnancy
- *month5*: exposed to Ramadan in the fifth month of pregnancy
- *month6*: exposed to Ramadan in the sixth month of pregnancy
- *month7*: exposed to Ramadan in the seventh month of pregnancy
- *month8*: exposed to Ramadan in the eighth month of pregnancy
- *month9*: exposed to Ramadan in the ninth month of pregnancy

Whereas the control group (excluded category) will be

- *notexposed*: not exposed to Ramadan in the utero

Moreover C, M & X are the vectors for *Child-specific*, *Mother-specific* and *Household-specific* controls respectively. *Child-specific* (C) controls includes the child's age in months, age squared, child's gender (dummy variable: male=1), birth year dummies, month of birth dummies, birth order , mother's age at child's birth, and mother's age at child birth squared. *Mother-specific* (M) controls include mother's education level. Whereas Household-specific (H) controls include household head's education level, region of household (dummy variable: urban=1), district dummies, wealth group (quintiles), land holding (dummy: own land=1), number of children in household and ethnic background [9]of household (categories).

The two different regression equations will be using different measures of health outcomes. Both these regression equations will have similar independent variables. The two measures of health outcomes used for the study include:

- Height: Height for age z-score
- Weight: Weight for age z-score

The aim of the study is analyse the impact of prenatal exposure to Ramadan on children health outcomes. Thus the main variables of interest will be the *month0 - month9* that represent various periods in which the foetus was exposed to Ramadan in utero. These variables will be compared with the control group of those children who were not prenatally

[9] Ethnicity and religion are not linked, because around 95 percent of population living in Pakistan are Muslims regardless of which ethnic group they belong to.

exposed to Ramadan. In order to separate out the impact of seasonality from the impact of exposure of Ramadan month of birth of children will be included in the equation. Moreover district and year interaction variable will be included in order to separate out the impact of any shock as floods or drought specific to a particular district.

After we present the OLS results, we estimate a model using household fixed effects that is represented by γ_f as indicated in the equations below (2a & 2b). This will allow filtering out any systematic between-family differences arising because of the impact of all time-invariant factors common to a household i.e. household-specific controls will be dropped out. Moreover results are also estimated using mother fixed effects that is mother and household specific controls will be dropped out of the model as indicated in the equations below (3a & 3b). It is possible that more than one family is living in a household. So household fixed effects will estimate the average variation across children living in a household (they might have different mothers). Whereas as mother fixed effect will estimate the average variation across children of same mother and filters out any between-mothers differences arising because of time-invariant factors related to a mother such as mother's education level.

Fixed Effects regression equations

Household Fixed effects

Child Health Outcomes (CHO) $= \beta_0 + \pi$ Exposure Variables + Child Controls +Mother Controls + γ_f + Error term ……………………………….. eq(2)

Height-for-Age: $HAZ_i = \beta_0 + \beta_1 month0_i + \beta_2 month1_i + \beta_3 month2_i + \beta_4 month3_i + \beta_5 month4_i + \beta_6 month5_i + \beta_7 month6_i + \beta_8 month7_i + \beta_9 month8_i + \beta_{10} month9_i + \boldsymbol{\gamma C_i} + \boldsymbol{\alpha M_i} + \gamma_f + \varepsilon_i$ ....eq(2a)

Weight-for-Age: $WAZ_i = \beta_0 + \beta_1 month0_i + \beta_2 month1_i + \beta_3 month2_i + \beta_4 month3_i + \beta_5 month4_i + \beta_6 month5_i + \beta_7 month6_i + \beta_8 month7_i + \beta_9 month8_i + \beta_{10} month9_i + \boldsymbol{\gamma C_i} + \boldsymbol{\alpha M_i} + \gamma_f + \varepsilon_i$ ...eq(2b)

Mother Fixed effects

Child Health Outcomes (CHO) $= \beta_0 + \pi$ Exposure Variables + Child Controls + γ_f + Error term ….. eq(3)

Height-for-Age: $HAZ_i = \beta_0 + \beta_1 month0_i + \beta_2 month1_i + \beta_3 month2_i + \beta_4 month3_i + \beta_5 month4_i + \beta_6 month5_i + \beta_7 month6_i + \beta_8 month7_i + \beta_9 month8_i + \beta_{10} month9_i + \boldsymbol{\gamma C_i} + \gamma_f + \varepsilon_i$ .... eq(3a)

Weight-for-Age: $WAZ_i = \beta_0 + \beta_1 month0_i + \beta_2 month1_i + \beta_3 month2_i + \beta_4 month3_i + \beta_5 month4_i + \beta_6 month5_i + \beta_7 month6_i + \beta_8 month7_i + \beta_9 month8_i + \beta_{10} month9_i + \boldsymbol{\gamma C_i} + \gamma_f + \varepsilon_i$ ....eq(3b)

Moreover the aim is also to compare the impact of prenatal exposure to month of fasting on child anthropometric outcomes across various factors including income groups, parental educational levels and ethnic groups. This will help in establishing a deeper analysis regarding how impact of prenatal exposure to fasting varies across households having different income groups, parental education and across households from various ethnic backgrounds.

4. Data

For the purpose of analysis, the Multiple Indicator Clustered Survey (MICS) dataset on Punjab 2008 and 2011 will be used for analysing the impact of prenatal exposure to Ramadan on child health. The dataset is pooled-cross section of all the households that were surveyed in 2008 and 2011. MICS is an international household survey program initiated by UNICEF. It aims to provide data on the situation of women and children in different countries in order to keep a check on their status regarding achievement of the Millennium Development Goals (MDGs). In Pakistan MICS Punjab was majorly carried out by the Bureau of Statistics, Government of Punjab and the technical expertise was provided by UNICEF and UNDP.

The MICS dataset includes all the important variables required for analysing the impact of prenatal exposure of fasting during Ramadan on child health outcomes. The data sets include day, month and year of birth for children that are required for generating the main variable of interest which is the exposure to Ramadan. Moreover MICS also has several variables on child health outcomes that are needed for our study. The sample of 137500 children under the age of five is available from MICS Punjab datasets of 2008, 2011. The descriptive statistics of our sample data has been provided in the appendix table 1.

For the purpose of our analysis two measures of child health outcomes will be considered as the dependent variables. These measures will capture both the long and short term health outcomes of children under the age of five. The measures include the Z-scores for height-for-age and weight-for-age for children under the age of five[10]. Z-score is a standardized way to measure anthropometric status because it compares sampled children

[10] According to Wealth Health Organization (WHO) Z-score or known as (SD-score) standard deviation score measures that difference between observed value and the average value of reference population in units of standard deviation.

with the international reference group of children of same gender and age. It is essential to analyse the impact on these two measures because height is long term whereas weight is a short term indicator of health outcome because weight can vary due to various factors such illness in that time period. Karimi (2015) also stated that height is a very important indicator because the foetus grows in length throughout the period of gestation whereas it gains weight mostly in the last trimester, which is the least important period for development compared to the first and second trimesters. We are using 10 measures for exposure variable in our study, as it will give us a clearer picture that which particular month within a trimester is important in terms of impact of exposure on foetal development[11]. Moreover we can also analyse how the impact of exposure shifted between months by using different estimation techniques. Almond and Mazumder (2011) & Almond et al. (2014) have also used 9 indicators for exposure measure[12].

[11] For robustness check we have also estimated our results using three dummies (for first, second and third trimester). (see appendix table 11a to 11c for results). In the OLS specifications: Exposure in first and second trimester negatively related to HAZ of children whereas exposure in third trimester is positively related to both child health outcomes. In the FE regressions: exposure to month of fasting in first two trimesters negatively impacts HAZ of children but no significant impact is seen for WAZ.

[12] Almond & Mazumder (2011) stated "Our simplest measure is an indicator for whether Ramadan overlapped with pregnancy. We also construct indicators for whether Ramadan occurred during the first, second, or third trimester. Although these basic measures are easy to interpret, they may not be suited to capture effects that occur during narrowly defined "critical windows" of fetal development."

5. Analysis

Impact of Exposure to Fasting on Child Health Outcomes

In order to analyse the linkage between prenatal exposure to the month of fasting and child health outcomes we first ran a simple OLS regression for establishing the correlation of prenatal exposure variables with respect to children's anthropometric status (see appendix table 2)[13]. For estimation of our main results we started off with the OLS regressions as it allows us to estimate average variation in health outcomes across all the children in our dataset. For our results estimation we controlled for child and mother specific factors and household specific demographic and socioeconomic factors that might be correlated to child health outcomes[14] in our regression.

For the case of height-for-age, we observe that, controlling for child, mother, and household characteristics in the first column of Table 1 that children who were prenatally exposed to fasting had on average lower HAZ scores if they were exposed in first two trimesters (1^{st} to 6^{th} month) as compared to the unexposed children. The largest impact occurs if exposure is in the fourth month, leading to a reduction in HAZ of 0.3 standard deviations. The reasons could be that, since early pregnancy is more critical to long-term development, nutritional disruptions are more detrimental in those key periods, and/or that

[13] Correlation of prenatal exposure to the month of fasting with child health outcomes reveals that exposure during the first and second trimesters i.e. between (months 0 to month 6) is mostly negatively correlated to child health outcomes. However exposure in the last three months is positively related (see appendix table 2). This is not completely at odds with the literature which suggest that exposure to fasting during early pregnancy has negative implications because by the end of the second trimester all of the foetus' organs have been developed and thus in the third trimester the foetus grows and matures. During the first trimester the foetus is undergoing the embryonic stage in which major organs of the foetus develop. Thus this stage is crucial because any shock, for example in terms of infectious diseases or radiation, may cause severe damage to the embryo. The medical literature also supports similar findings.

[14] Control variables such as child age, age squared, gender, month and year of birth, birth order, mother's age at child birth , mothers age squared at child's birth, mother and household head education level, urban , district , wealth quintile and ethnicity have been used as used in previous literature(Almond et al (2014), Almond and Mazumder (2008), Van Ewijk (2011) , Greve et al (2015))

women are more likely to be fasting in the earlier stages of pregnancy[15]. However children who were prenatally exposed in the ninth month (born during Ramadan) were on average taller compared to those who were not exposed. This could be the result of higher consumption of food, particularly meat, in celebrating Eid (the end of Ramadan). In the third trimester more generally, pregnancy is more visible and thus it is more likely that the woman is taken care of by her family members in terms of food intake, thus diminishing the impact of Ramadan. It could also be the case that compliance with fasting is lower in the third trimester. Moreover we observe that factors such maternal education and socio-economic status of household are also significant and bear the expected positive relationship with HAZ. We have also included other controls and all these factors bear expected signs e.g. higher birth order is negatively associated with HAZ and land holding is positively related to HAZ[16].

In the last two columns of Table 1, we see that the results for HAZ remain similar if we include a number of fixed effects, such as interactions of district*urban and district*year dummy variables.District and year interaction variables are included in order to separate out the impact of any shock, for example floods or droughts, that are specific to a particular district. Moreover month dummies are included to separate out the impact of seasonality.

Table 1 OLS Regression: Height-for-Age

VARIABLES	**HAZ**	**HAZ with district and urban interactions**	**HAZ with district and year interactions**
Month 9	0.0872***	0.0860***	0.0790***
	(0.0224)	(0.0224)	(0.0223)
Month 8	0.0396	0.0378	0.0314
	(0.0273)	(0.0273)	(0.0272)
Month 7	-0.0189	-0.0185	-0.0338
	(0.0324)	(0.0324)	(0.0323)
Month 6	-0.127***	-0.127***	-0.138***

[15] Observance of fasting might be highest during early Pregnancy so mothers might not be aware that they are pregnant because it is not visible in early stages Almond and Mazumder (2011).
[16] See appendix for complete results

	(0.0356)	(0.0356)	(0.0355)
Month 5	-0.216***	-0.214***	-0.220***
	(0.0350)	(0.0350)	(0.0349)
Month 4	-0.313***	-0.310***	-0.318***
	(0.0334)	(0.0334)	(0.0334)
Month 3	-0.232***	-0.231***	-0.236***
	(0.0316)	(0.0316)	(0.0316)
Month 2	-0.139***	-0.137***	-0.137***
	(0.0294)	(0.0294)	(0.0294)
Month 1	-0.0537**	-0.0505*	-0.0524*
	(0.0269)	(0.0269)	(0.0269)
Month 0	-0.0349	-0.0345	-0.0360
	(0.0226)	(0.0226)	(0.0225)
Constant	-2.374***	-2.389***	-2.473***
	(0.117)	(0.118)	(0.141)
Child controls	Yes	Yes	Yes
Mother controls	Yes	Yes	Yes
HH controls	Yes	Yes	Yes
Observations	102,734	102,734	102,734
R-squared	0.112	0.114	0.123
Robust standard errors in parentheses			
***** p<0.01, ** p<0.05, * p<0.1**			

In Table 2 the results for WAZ and prenatal exposure to month of fasting are presented where we control for child, mother, and household characteristics. The impact of prenatal exposure to fasting on WAZ is negative for exposure from the third to the fifth month, but bears a positive relationship for exposure in the ninth month. Similar results hold true if we include interactions of district dummies with an urban dummy and year variables.

It is worth noting that exposure in the ninth month is positively related to both the health outcome measures. Possible explanation for such results is that the ninth month is the last month of pregnancy and child birth is also expected and thus women are less likely to fast during this time but there is also an abundance of food to celebrate the end of the fasting period, that is, Eid. Moreover most of the development has already occurred in the first two trimesters and in the third trimester the foetus is mainly gaining weight.

Results from OLS regressions indicate that prenatal exposure to fasting does have an impact on child health outcomes especially during mid pregnancy months.However this technique is unable to control for the unobservable variables that might result in an omitted variable bias. Thus in order to solve for such biases we further estimated the results using fixed effects regression.

Table 2 OLS Regression: Weight-for-Age

VARIABLES	WAZ	WAZ with district and urban interactions	WAZ with district and year interactions
Month 9	0.0604***	0.0588***	0.0574***
	(0.0165)	(0.0164)	(0.0165)
Month 8	0.0122	0.0112	0.00601
	(0.0203)	(0.0203)	(0.0203)
Month 7	0.000140	-0.000906	-0.00977
	(0.0238)	(0.0237)	(0.0238)
Month 6	-0.00596	-0.00720	-0.0167
	(0.0258)	(0.0257)	(0.0258)
Month 5	-0.0475*	-0.0473*	-0.0552**
	(0.0254)	(0.0254)	(0.0254)
Month 4	-0.116***	-0.114***	-0.120***
	(0.0245)	(0.0245)	(0.0245)
Month 3	-0.0890***	-0.0874***	-0.0917***
	(0.0233)	(0.0233)	(0.0233)
Month 2	-0.0279	-0.0264	-0.0319
	(0.0218)	(0.0217)	(0.0218)
Month 1	-0.0234	-0.0217	-0.0279
	(0.0200)	(0.0200)	(0.0200)
Month 0	0.00164	0.00169	-0.00393
	(0.0168)	(0.0168)	(0.0168)
Constant	-1.469***	-1.471***	-1.421***
	(0.0880)	(0.0888)	(0.105)
Child controls	Yes	Yes	Yes
Mother controls	Yes	Yes	Yes
HH controls	Yes	Yes	Yes
Observations	105,096	105,096	105,096
R-squared	0.135	0.137	0.142
Robust standard errors in			

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

Fixed Effects Specifications

Moving towards our main analysis, the fixed effects approach shows how controlling for time-invariant unobservable variables within either the broader household (household fixed effect, HFE) or nuclear family (mother fixed effect, or MFE) affects the estimates[17]. In order to separate out any systematic within family differences household-fixed effects estimates has been used. Moreover mother-fixed effects estimates compare children having the same mother and thus they are not sensitive to any systematic within mother differences in terms of mother's health as stated by van Ewijk (2011).

Fixed effects regression controls for omitted variables within the household that are time invariant and thus allows us to get better estimates about the impact of exposure on child health outcomes. Table 3 presents both household and mother fixed effects estimates of exposure to Ramadan on height and results indicate that prenatal exposure to fasting between 1st to 7th months negatively impacts the HAZ of children compared to the unexposed children. However the estimates for weight (WAZ) depict that children who were prenatally exposed to fasting between 5th to 8th months were on average more underweight compared to those who were not exposed at all as shown in Table 4. The possible reason for this negative impact on weight-for-age could be because in the third trimester foetus is mainly gaining weight thus exposure to month of fasting during this stage might negatively impact the weight of the baby.[18] It is important to note that height-for-age is a measure of long-term health whereas

[17] (van Ewijk, 2011)

[18] In both OLS and FE, WAZ positively affected by exposure in the ninth month, but this result has lost statistical significance in the FE specifications. A reason is that since fixed effect regression relies only on the

weight-for-age is a measure of short-term health as the latter can be affected if a child is suffering from a disease like diarrhoea at that time. The pattern of the results even after controlling for time–invariant omitted variables are much stronger compared to the above OLS regressions especially for the case of height-for-age, which suggest that results are robust. In the case of the results for WAZ, the statistically significant impact of Ramadan moves from mid-pregnancy (in the OLS specifications) to later in the pregnancy (FE specifications). We have greater confidence in the FE results since they control better for unobserved heterogeneity and F-tests for the joint significance of the fixed effects suggest that they are indeed. The FE results for WAZ also coincide with what is medically known about the stages of foetal development. Here it is important to note that FE focuses on the variation between children having same mother (in case of MFE) and ignores the variation across all the children in the dataset that yield higher standard errors compared using OLS. Thus it can be said that results from FE specifications solves for the omitted variable bias but at the expense of greater variability in the sample and lower standard errors.

Table 3 Height-for-Age Fixed Effects (FE)

VARIABLES	Household Fixed Effects HAZ	Mother Fixed Effects HAZ
Month 9	0.0471	0.0469
	(0.0314)	(0.0332)
Month 8	-0.0113	-0.00715
	(0.0389)	(0.0413)
Month 7	-0.117**	-0.102**
	(0.0460)	(0.0486)
Month 6	-0.165***	-0.165***
	(0.0493)	(0.0521)
Month 5	-0.274***	-0.279***
	(0.0482)	(0.0509)
Month 4	-0.307***	-0.317***
	(0.0462)	(0.0486)
Month 3	-0.226***	-0.247***
	(0.0442)	(0.0465)
Month 2	-0.154***	-0.163***

variation between children from same household or having same mother, sample variability decreases and standard errors increase.

	(0.0415)	(0.0437)
Month 1	-0.0766**	-0.0833**
	(0.0377)	(0.0397)
Month 0	0.00449	0.0109
	(0.0319)	(0.0337)
Constant	-6.367***	-7.796***
	(0.783)	(1.398)
Child controls	Yes	Yes
Mother controls	Yes	No
HH controls	No	No
Observations	102,734	102,734
R-squared	0.104	0.115
Number of MFE		69,506
Number of HFE	64,807	
Robust standard errors in parentheses		
***** p<0.01, ** p<0.05, * p<0.1**		

Table 4 Weight-for-Age Fixed Effects (FE)

VARIABLES	Household Fixed Effects WAZ	Mother Fixed Effects WAZ
Month 9	0.0104	0.0155
	(0.0230)	(0.0242)
Month 8	-0.0891***	-0.0841***
	(0.0284)	(0.0300)
Month 7	-0.106***	-0.106***
	(0.0336)	(0.0353)
Month 6	-0.102***	-0.100***
	(0.0359)	(0.0378)
Month 5	-0.0909***	-0.0894**
	(0.0352)	(0.0369)
Month 4	-0.0473	-0.0536
	(0.0337)	(0.0353)
Month 3	-0.0366	-0.0416
	(0.0322)	(0.0337)
Month 2	-0.00846	-0.00877
	(0.0303)	(0.0317)
Month 1	0.0224	0.0229
	(0.0275)	(0.0289)
Month 0	0.0223	0.0329
	(0.0234)	(0.0245)
Constant	-9.863***	-10.38***
	(0.571)	(1.018)
Child controls	Yes	Yes
Mother controls	Yes	No
HH controls	No	No
Observations	105,096	105,096

R-squared	0.133	0.145
Number of MFE		70,723
Number of HFE	65,898	
Robust standard errors in parentheses		
***** p<0.01, ** p<0.05, * p<0.1**		

Analysis within Sub-Groups

For deeper analysis of the linkage between prenatal exposure to month of fasting and child health outcomes we estimated the impact of exposure separately for a variety of sub-samples, to see whether the impact of exposure varied based on certain household attributes. Sub group analysis allows all parameters to differ across groups. For instance the impact of prenatal exposure to fasting on child health can differ across different ethnic or wealth quintile groups etc. Thus sub group analysis is done in order to check whether the effect differs across different groups. For example women from high wealth quintile households are less likely to fast or more likely compensate for the lost nutrients and thus it is perceived that children from high wealth quantile household are less likely to be impacted due to prenatal exposure to fasting compared to children belonging to low wealth quantile household. This exercise was carried out by dividing the full sample into sub-samples based on: i) quartiles of wealth, ii) level of mother's education and iii) levels of the household head's education, and iv) ethnic groups.

Subgroup analysis is done using OLS regressions by including all the control variables. These results estimate health outcome variation across all the children in the dataset rather than just the variation across children of same mother or belonging to same household. The results in table 5a) indicate that children who belong to families in the lowest wealth quintile through the 4th wealth quintile are on average shorter in height if they are prenatally exposed to month of fasting during first two trimesters. However HAZ score of children belonging to highest wealth quintile families are negatively impacted only if exposure to month of fasting is in the 4th month of pregnancy. The results in table 5b) for weight indicate that children who belonged to families in the lowest wealth quintile has on average lower WAZ score if they were exposed to month of fasting during the first two trimesters. However children belonging to highest wealth quintile families were not seen to be negatively impacted by exposure to the month of fasting.

Table 5a: Height-for-Age: wealth group regressions

VARIABLES	Lowest	Second	Middle	Fourth	Highest
Month 9	0.146***	0.166***	0.0449	0.0208	0.109**
	(0.0549)	(0.0503)	(0.0476)	(0.0468)	(0.0518)
Month 8	0.0970	0.105*	-0.0143	-0.0389	0.0918
	(0.0671)	(0.0631)	(0.0597)	(0.0567)	(0.0613)
Month 7	0.0510	0.0560	-0.0970	-0.139**	0.0898
	(0.0781)	(0.0757)	(0.0696)	(0.0673)	(0.0746)
Month 6	-0.144*	-0.0102	-0.201***	-0.168**	-0.0472
	(0.0843)	(0.0824)	(0.0763)	(0.0748)	(0.0835)
Month 5	-0.360***	-0.225***	-0.254***	-0.171**	-0.0537
	(0.0808)	(0.0800)	(0.0758)	(0.0745)	(0.0825)
Month 4	-0.410***	-0.238***	-0.370***	-0.311***	-0.191**
	(0.0771)	(0.0755)	(0.0728)	(0.0711)	(0.0798)
Month 3	-0.372***	-0.182***	-0.222***	-0.251***	-0.103
	(0.0696)	(0.0695)	(0.0706)	(0.0675)	(0.0795)
Month 2	-0.193***	-0.101	-0.132**	-0.166**	-0.0500
	(0.0647)	(0.0636)	(0.0646)	(0.0646)	(0.0732)
Month 1	-0.102*	-0.0115	-0.0930	-0.123**	0.105
	(0.0601)	(0.0577)	(0.0580)	(0.0600)	(0.0664)
Month 0	0.0398	-0.0385	-0.0490	-0.0776	-0.0184
	(0.0531)	(0.0497)	(0.0476)	(0.0492)	(0.0545)
Constant	-2.182***	-2.277***	-1.996***	-2.012***	-1.949***
	(0.284)	(0.267)	(0.253)	(0.260)	(0.318)
Observations	18,573	19,794	21,569	22,817	20,010
R-squared	0.082	0.091	0.080	0.074	0.058

Table 5b: Weight-for-Age: wealth group regressions					
VARIABLES	Lowest	Second	Middle	Fourth	Highest
Month 9	0.0965**	0.0969***	0.0601*	0.00625	0.0719*
	(0.0400)	(0.0359)	(0.0357)	(0.0349)	(0.0386)
Month 8	0.0515	0.0388	-0.0275	-0.00709	0.0411
	(0.0489)	(0.0465)	(0.0437)	(0.0430)	(0.0466)
Month 7	0.0223	0.0166	0.0192	-0.0273	0.000661
	(0.0571)	(0.0529)	(0.0511)	(0.0508)	(0.0554)
Month 6	-0.0351	0.0605	0.0316	-0.0472	0.0135
	(0.0601)	(0.0581)	(0.0556)	(0.0548)	(0.0613)
Month 5	-0.146**	-0.0548	0.0290	-0.0166	-0.0313
	(0.0580)	(0.0564)	(0.0559)	(0.0549)	(0.0607)
Month 4	-0.219***	-0.0805	-0.0847	-0.119**	-0.0419
	(0.0560)	(0.0545)	(0.0533)	(0.0531)	(0.0598)
Month 3	-0.225***	-0.114**	0.00150	-0.0739	-0.0183
	(0.0508)	(0.0498)	(0.0512)	(0.0515)	(0.0596)
Month 2	-0.0921*	-0.0392	-0.0228	-0.0103	0.0670
	(0.0474)	(0.0460)	(0.0475)	(0.0487)	(0.0551)
Month 1	-0.00152	-0.0180	-0.0406	-0.0595	0.0351
	(0.0436)	(0.0425)	(0.0436)	(0.0460)	(0.0495)
Month 0	0.0457	-0.00424	0.0106	-0.0229	-0.00271
	(0.0391)	(0.0364)	(0.0360)	(0.0364)	(0.0410)
Constant	-1.068***	-1.337***	-1.432***	-1.247***	-1.419***
	(0.214)	(0.193)	(0.193)	(0.194)	(0.245)
Observations	19,125	20,240	22,014	23,268	20,480
R-squared	0.102	0.102	0.089	0.096	0.071

Interesting estimates are observed across mothers having different education levels. The results in table 6a) indicate that mothers having less than or equal to secondary education level are more likely to have children who are negatively impacted due exposure to month of fasting during first two trimesters. Children of mothers having less than primary education are seen to be on average shorter if they are prenatally exposed to month of fasting in the first two trimesters compared to children who are not exposed. The results for the least educated women sub-sample are stronger than in the OLS regressions for the full sample, and are somewhat closer to the FE coefficients. A reason may be that the unobservables controlled for in the FE regressions were correlated with the mother's education. However children of mothers having the highest level of education are not seen to be negatively impacted due to prenatal exposure to month of fasting. Similar results are seen for weight-for-age z-score in table 6b). The possible reasons for such results could be that educated and wealthy women are more aware of health issues and thus are less likely to keep fast or even if they do fast they might take nutritional supplements in order counter the negative impact of fasting by fulfilling the nutritional needs of body.

Similar results are seen across children for families having different household head education levels. However the results are less dramatic compared to those for the mother's education level.

Table 6a: Height-for-Age: Mother's education level

VARIABLES	None	Primary	Middle	Secondary	Higher
Month 9	0.139***	0.0329	0.0180	0.0397	0.0794
	(0.0325)	(0.0512)	(0.0696)	(0.0612)	(0.0704)
Month 8	0.0747*	-0.0277	-0.112	0.00224	0.149*
	(0.0402)	(0.0622)	(0.0855)	(0.0742)	(0.0833)
Month 7	0.0538	-0.184**	-0.226**	-0.0754	0.156
	(0.0471)	(0.0750)	(0.101)	(0.0900)	(0.100)
Month 6	-0.0752	-0.253***	-0.364***	-0.142	0.0589
	(0.0512)	(0.0829)	(0.111)	(0.102)	(0.111)
Month 5	-0.236***	-0.249***	-0.267**	-0.231**	0.00820
	(0.0495)	(0.0823)	(0.113)	(0.100)	(0.112)
Month 4	-0.325***	-0.334***	-0.366***	-0.276***	-0.172
	(0.0464)	(0.0806)	(0.107)	(0.0978)	(0.109)
Month 3	-0.293***	-0.251***	-0.204*	-0.0917	-0.0670
	(0.0429)	(0.0781)	(0.105)	(0.0958)	(0.105)
Month 2	-0.160***	-0.192***	-0.0988	-0.0194	-0.0759
	(0.0400)	(0.0724)	(0.0992)	(0.0872)	(0.100)
Month 1	-0.0637*	-0.0912	-0.0549	0.0223	-0.0201
	(0.0366)	(0.0655)	(0.0894)	(0.0821)	(0.0878)
Month 0	-0.0297	-0.101*	0.0343	0.0135	-0.0561
	(0.0318)	(0.0523)	(0.0714)	(0.0655)	(0.0750)
Constant	-2.498***	-1.730***	-2.112***	-2.253***	-3.043***
	(0.161)	(0.285)	(0.410)	(0.427)	(0.522)
Observations	51,094	18,219	9,710	13,088	10,623
R-squared	0.089	0.079	0.081	0.065	0.061

Table 6b: Weight-for-Age: Mother's education level					
VARIABLES	None	Primary	Middle	Secondary	Highest
Month 9	0.0989***	0.00462	0.0251	-0.0147	0.0794
	(0.0235)	(0.0376)	(0.0531)	(0.0461)	(0.0704)
Month 8	0.0256	0.0174	-0.120*	-0.0238	0.149*
	(0.0291)	(0.0480)	(0.0655)	(0.0566)	(0.0833)
Month 7	0.0438	-0.0394	-0.208***	-0.0411	0.156
	(0.0339)	(0.0556)	(0.0751)	(0.0668)	(0.100)
Month 6	0.0382	-0.0491	-0.215***	-0.0840	0.0589
	(0.0364)	(0.0613)	(0.0813)	(0.0728)	(0.111)
Month 5	-0.0228	-0.0320	-0.286***	-0.102	0.00820
	(0.0352)	(0.0610)	(0.0805)	(0.0734)	(0.112)
Month 4	-0.0998***	-0.116*	-0.278***	-0.164**	-0.172
	(0.0338)	(0.0601)	(0.0776)	(0.0702)	(0.109)
Month 3	-0.0978***	-0.0908	-0.223***	-0.0126	-0.0670
	(0.0313)	(0.0587)	(0.0753)	(0.0694)	(0.105)
Month 2	-0.0317	-0.0718	-0.115	0.0727	-0.0759
	(0.0291)	(0.0540)	(0.0717)	(0.0655)	(0.100)
Month 1	-0.00626	-0.0557	-0.0993	0.00260	-0.0201
	(0.0268)	(0.0492)	(0.0657)	(0.0611)	(0.0878)
Month 0	0.0122	-0.0212	-0.0136	0.0431	-0.0561
	(0.0236)	(0.0384)	(0.0544)	(0.0483)	(0.0750)
Constant	-1.412***	-1.195***	-0.964***	-1.673***	-3.043***
	(0.119)	(0.208)	(0.326)	(0.313)	(0.522)
Observations	52,389	18,567	9,878	13,384	10,623
R-squared	0.108	0.100	0.117	0.078	0.061

In estimates across ethnic groups it was observed that HAZ of children from both Punjabi and Saraiki backgrounds is negatively impacted by the exposure to month of fasting in the first two trimesters. However there was no impact due to prenatal exposure to month of fasting was seen among children from Urdu speaking families, but the reason could be that there were a very small number of observations in the data for Urdu speaking families (see appendix table 10).

In addition to running the regressions for the above sub-samples separately, we have also estimated regressions on the full sample similar to the earlier OLS regressions, but with the addition of exposure variables interacted with dummy variables for the above characteristics (for example, the five wealth quintile dummies interacted with the 10 exposure variables). The advantage of interaction effects is that it allows us to use the full sample in determining how demographics impact the exposure variables, and it allows us to tell if the differences in the treatment effects between different demographic groups are statistically significant. The results indicated in appendix table 6 indicate that children who belong to third wealth quintile and higher are on average shorter if they are exposed to month of fasting in 6th and (or) 7th month of pregnancy compared to children who belong to lowest wealth group families.

Selective Timing of Pregnancy

Estimates showing the impact on child health outcome due to prenatal exposure to fasting can be biased if the parents are selectively timing their pregnancy with respect to Ramadan. In order to check this concern we compared the parental characteristics as previously done by van Ewijk (2011). Furthermore we conducted a robustness check by testing how the impact of exposure to the month of fasting changes when we look at the families least likely to time their pregnancies, that is, the families not using modern methods of family planning. Moreover results were also estimated only for children who were first born. These techniques will help us in identifying whether there is a bias in the results due to selectivity problems. It is important to check the self-selection issue in order to ensure validity of the intent to treat analysis.

Comparing Parental Characteristics

Differences in parental characteristics may exist between parents who are selectively timing their pregnancy to avoid fasting (month of Ramadan) verses those who are not. Van Ewijk (2011) stated that more educated and health concerned families might be more likely to avoid pregnancy during Ramadan. If this is the case then the control group (not exposed) will have better health outcomes even in the absence of any effect of exposure to fasting. Table 7 shows some interesting results in terms of parental characteristics such as household head's and mother's education, wealth quintile groups and ethnicity. The results indicate children from households whose head is uneducated are more likely to be unexposed. However those whose head has attained primary and higher education are more likely to be exposed. Similarly children of uneducated mothers are more likely to be not exposed but for secondary and higher education level children are more likely to be exposed. Moreover children belonging to secondary wealth quintile households are more likely to be not exposed but children from highest wealth quintile households are more likely to be exposed. These results are opposite to what we expected if more educated parents were selectively timing their pregnancy to avoid Ramadan.

The possible explanation for the lower likelihood of exposure for children of uneducated household heads and mothers could be due to the culling effect as mentioned by Almond & Currie (2011). The culling effect might arise because weaker foetuses might be less likely to survive if exposed to exogenous shock. As the data only contains children who survived the shock, the proportion of such children might be less for uneducated and less wealthy families due to culling effect. The impact of exposure to fasting is underestimated if weaker foetuses are miscarried when exposed to shock.

Table 7: Parental Characteristic					
		Not exposed (%)	Exposed (%)	t-value	Pr(|T| > |t|)
HH head Education	None (Significant)	42.9	41.5	-3.9629	0.0001
	Primary (Significant)	16.2	16.9	2.6845	0.0073
	Middle (Insignificant)	12.6	12.8	0.8636	0.3878
	Secondary (Insignificant)	18.2	18.2	-0.2293	0.8187
	Higher (Significant)	9.8	10.3	2.6092	0.0091
Mother Education	None (Significant)	54.9	52.0	-8.0748	0.0000
	Primary (Insignificant)	16.8	17.2	1.3686	0.1711
	Middle (Insignificant)	8.7	9.1	1.5750	0.1153
	Secondary (Significant)	10.8	12.1	5.4660	0.0000
	Higher (Significant)	8.5	9.5	4.8456	0.0000
Wealth Quintiles	Lowest (Insignificant)	20.1	19.9	-0.8872	0.3750
	Secondary (Significant)	20.4	19.6	-2.9056	0.0037
	Middle (Insignificant)	20.9	20.5	-1.1182	0.2635
	Fourth (Insignificant 5%)	21	21.5	1.8907	0.0587
	Highest (Significant)	17.4	18.3	3.1679	0.0015
Ethnicity	Urdu (Significant)	4.5	4.8	1.9636	0.0496
	Punjabi (Insignificant)	69.2	69	-0.7456	0.4559
	Saraiki (Insignificant)	21.7	21.3	-1.4713	0.1412

In order to get a deeper understanding of selectivity we compared parental characteristics for exposure across trimesters. The findings are mostly consistent with the findings of table 7 discussed above but offer some additional insights. Results presented in table 8 reveal that mothers with less than primary education had children who were more likely to be “not exposed”, but if they were exposed to fasting, it was more likely to be in the first trimester of pregnancy. Moreover exposure in second and third trimester is positively related to mother’s education. Children from higher wealth household are more likely to be not exposed, or if exposed, it occurred in the third trimester.

Table 8: Parental Characteristics across Trimesters

VARIABLES	First trimester	Second trimester	Third trimester	Not exposed
Mother education				
Primary	-0.00699**	0.00860**	0.00695*	-0.0136***
	(0.00341)	(0.00362)	(0.00383)	(0.00323)
Middle	-0.0117***	0.0195***	0.00593	-0.0172***
	(0.00443)	(0.00481)	(0.00501)	(0.00427)
Secondary	-0.0137***	0.0125***	0.0203***	-0.0289***
	(0.00426)	(0.00460)	(0.00488)	(0.00403)
Higher	-0.0145***	0.0227***	0.0188***	-0.0301***
	(0.00500)	(0.00547)	(0.00574)	(0.00478)
Household Head Education				
Primary	0.0151***	-0.00236	-0.00672*	0.00921***
	(0.00340)	(0.00362)	(0.00379)	(0.00319)
Middle	0.0149***	-0.00509	-0.00845**	-0.00315
	(0.00378)	(0.00404)	(0.00425)	(0.00359)
Secondary	0.00872**	-0.00415	-0.00634	0.00358
	(0.00348)	(0.00374)	(0.00392)	(0.00337)
Higher	0.0103**	-0.00592	-0.00653	-7.51e-05
	(0.00453)	(0.00487)	(0.00519)	(0.00429)
Wealth Quintiles				
Second	-0.00166	-0.0111***	0.00324	0.00760**
	(0.00375)	(0.00396)	(0.00413)	(0.00355)
Middle	-0.00553	-0.00791*	0.00640	0.00825**
	(0.00384)	(0.00411)	(0.00427)	(0.00367)

Fourth	-0.00836**	-0.0116***	0.0160***	0.00699*
	(0.00405)	(0.00432)	(0.00453)	(0.00385)
Highest	-0.0134***	-0.0111**	0.0209***	0.0110**
	(0.00467)	(0.00502)	(0.00527)	(0.00444)
Constant	0.209***	0.250***	0.269***	0.190***
	(0.00273)	(0.00292)	(0.00300)	(0.00258)
Observations	127,607	127,607	127,607	127,607
R-squared	0.001	0.000	0.001	0.001
Robust standard errors in parentheses				
***** p<0.01, ** p<0.05, * p<0.1**				

Estimation of results for children belonging to families that have never used birth control (family planning) methods.

For robustness check we wanted to explore how exposure to fasting is related to families that have never opted for birth control methods (family planning)[19]. Through this technique we can explore the results for families who entirely avoid family planning. The table 9 shows two separate regressions for HAZ and WAZ for families who have not opted for family planning. The results seem interesting because they reveal that HAZ of children whose families never opted for family planning were negatively impacted if they were exposed to month of fasting in month 4 to month 8 of pregnancy. However, WAZ was negatively impacted if the children were prenatally exposed to fasting month 7 and 8 compared to the unexposed children. The magnitude of the coefficients is smaller for our given sub-sample as compared to the full sample. However if the magnitude of the

[19] We have categorized the data based on the question that whether the woman and/or her husband **ever** used family planning method. For robustness check we have used data where the women have responded to the above mentioned question as ‘’No’’ and thus the selected sample is perceived to include those families who have never used birth control methods. Whereas those whose response was “Yes’’ includes those families who have used birth control methods at any point in time.

coefficients had increased, that would suggest that people who are using family planning are different from the group who are not using family planning i.e. not timing their pregnancy.

Table 9: Robustness checking using sample for to families not using birth control methods

VARIABLES	HAZ	WAZ
Month 9	-0.0436	-0.0388
	(0.0412)	(0.0318)
Month 8	-0.169***	-0.118***
	(0.0549)	(0.0433)
Month 7	-0.255***	-0.171***
	(0.0666)	(0.0524)
Month 6	-0.239***	-0.0957
	(0.0806)	(0.0619)
Month 5	-0.154*	-0.0341
	(0.0789)	(0.0607)
Month 4	-0.158**	-0.0734
	(0.0715)	(0.0550)
Month 3	-0.0752	-0.0190
	(0.0651)	(0.0499)
Month 2	-0.00800	0.0215
	(0.0599)	(0.0455)
Month 1	-0.0520	-0.00648
	(0.0525)	(0.0401)
Month 0	-0.0596	0.000502
	(0.0415)	(0.0315)
Constant	-2.292***	-5.483***
	(0.452)	(0.352)
Child controls	Yes	Yes
Mother controls	Yes	Yes
HH controls	Yes	Yes
Observations	31,705	32,007
R-squared	0.140	0.171
Robust standard errors in parentheses		
***** p<0.01, ** p<0.05, * p<0.1**		

After including the interaction term (between exposure to fasting and family planning variable) in the regression the results indicate (see table 8 in appendix) that there is no significant difference in WAZ seen between families who have used birth control methods compared to families who have not used such techniques.

First born children are unlikely to be timed because people like to have first baby soon after marriage. Couples are more likely to use birth control methods after their first child. Thus they less likely to time their pregnancy for first born child. This method is used as a robustness check to see how the impact of exposure to the month of fasting changes for first born. Table 9 in appendix displays results using the first born that indicates that children who are exposed in the fourth month are on average shorter in height compared to the unexposed children whereas those children who were prenatally exposed to fasting in the eighth month were slightly taller than the unexposed children. But no difference in weight was seen between exposed and unexposed first-born children.

Conclusion

This paper investigated the association of foetal exposure to fasting with child health outcomes in terms of height-for-age and weight-for-age Z-score. The study reveals that children who were prenatally exposed to the month of fasting during the first or second trimester were on average shorter. However children who experienced prenatal fasting between the third and fifth month of pregnancy were on average underweight compared to the unexposed children. When these results are tested using household and mother fixed effects, the negative impact on weight-for-age occurs with exposure in the fifth to eighth month of pregnancy. These results are in line with existing literature, which suggest that shocks during pregnancy may alter the programming of foetus and the impact might be visible later in life in terms of health outcomes. The reason for the negative impact on child health outcomes may not be only because of reduction in caloric intake but could be associated to indulgence in unhealthy eating habits, altered sleep patterns and altered timings of nutritional intake during the month of fasting. Thus it is important to understand that the results of this study should be interpreted as analysed the impact of all the activities associated with the observance of the month of fasting and thus results do not separate out a pure impact of fasting as also stated by Almond et al (2014). The results from our study highlight that maternal nutritional intake, particularly during early pregnancy, is crucial for long term development of the foetus. Thus it is essential to initialize prenatal interventions to provide not only prenatal health care services but also maternal nutritional supplementation and create awareness among women and their families regarding how nutritional deficiencies during early pregnancy can have negative implications on their child's health outcomes such as height and weight. Prenatal interventions are required in order to ensure that women fulfil their nutritional requirement during pregnancy by avoiding skipping of meals and/or by taking of nutritional supplements to fulfil the nutritional requirements of the body.

Moreover this study did not seem to find evidence that women were selectively timing their pregnancy to avoid month of fasting (Ramadan) by comparing the parental characteristics of exposed and the unexposed children and also through investigation of relationship between prenatal exposure to month of fasting and child health outcomes for families not opting for family planning.

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Appendix

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
HAZ	119967	-1.444247	1.645477	-5.99	5.99
WAZ	123051	-1.51382	1.243558	-5.99	5.98

Variable	Obs	Mean	Std. Dev.	Min	Max
month9	127888	.0977105	.296924	0	1
month8	127888	.0911501	.2878235	0	1
month7	127888	.0910171	.2876346	0	1
month6	127888	.0902665	.2865643	0	1
month5	127888	.0830649	.2759813	0	1
month4	127888	.0725009	.2593166	0	1
month3	127888	.065182	.2468478	0	1
month2	127888	.0671369	.2502599	0	1
month1	127888	.0738615	.2615464	0	1
month0	127888	.0840423	.2774523	0	1
notexposed	127888	.1854826	.3886901	0	1
childgender	125765	.5119707	.4998587	0	1
urban	127888	.350893	.4772514	0	1
hhchildren	127888	2.069014	1.056294	0	13
ownland	127836	.3277559	.4693972	0	1
childageM	127888	28.51777	17.9265	0	63
childageMsqu	127888	1134.62	1052.846	0	3969
ageatchild~h	109349	27.88558	5.859597	10	50
ageatchild~u	109349	811.94	346.7638	100	2500
melevel	127827	2.084395	1.389079	1	5
helevel	127654	2.383059	1.433371	1	5
AG1M	127888	6.57695	3.492464	1	12
AG1Y	127888	2007.06	2.280628	2003	2011
BO	127888	3.208253	1.441108	1	5
districtcode	127888	16.32625	10.3912	1	49
wealthgroup	127888	2.98103	1.391674	1	5
ETHNICITY	127691	2.261506	.6198215	1	4
datayear	127888	2009.537	1.499551	2008	2011

Table 2: Correlations

VARIABLES	(1) HAZ	(2) WAZ
month9	0.197***	0.106***
	(0.0187)	(0.0138)
month8	0.176***	0.108***
	(0.0191)	(0.0145)
month7	0.0953***	0.101***
	(0.0196)	(0.0145)
month6	0.0234	0.0657***
	(0.0203)	(0.0151)
month5	-0.0323	-0.0533***
	(0.0201)	(0.0150)
month4	-0.117***	-0.117***
	(0.0206)	(0.0155)
month3	-0.142***	-0.163***
	(0.0210)	(0.0157)
month2	-0.131***	-0.129***
	(0.0209)	(0.0155)
month1	-0.0315	-0.101***
	(0.0205)	(0.0151)
month0	0.0611***	-0.0257*
	(0.0194)	(0.0144)
Constant	-1.464***	-1.507***
	(0.0112)	(0.00825)
Observations	119,967	123,051
R-squared	0.004	0.005

Note: Clustered robust standard errors in parentheses.
Asterisks denote level of significance*** p<0.01, ** p<0.05, * p<0.1

Table 3: OLS Regressions

VARIABLES	OLS all controls HAZ	OLS all controls cl + D*U HAZ	OLS all controls + D*Y HAZ	OLS all controls WAZ	OLS all controls cl + D*U WAZ	OLS all controls + D*Y WAZ
month9	0.0872***	0.0860***	0.0790***	0.0604***	0.0588***	0.0574***
	(0.0224)	(0.0224)	(0.0223)	(0.0165)	(0.0164)	(0.0165)
month8	0.0396	0.0378	0.0314	0.0122	0.0112	0.00601
	(0.0273)	(0.0273)	(0.0272)	(0.0203)	(0.0203)	(0.0203)
month7	-0.0189	-0.0185	-0.0338	0.000140	-0.000906	-0.00977
	(0.0324)	(0.0324)	(0.0323)	(0.0238)	(0.0237)	(0.0238)
month6	-0.127***	-0.127***	-0.138***	-0.00596	-0.00720	-0.0167
	(0.0356)	(0.0356)	(0.0355)	(0.0258)	(0.0257)	(0.0258)
month5	-0.216***	-0.214***	-0.220***	-0.0475*	-0.0473*	-0.0552**
	(0.0350)	(0.0350)	(0.0349)	(0.0254)	(0.0254)	(0.0254)
month4	-0.313***	-0.310***	-0.318***	-0.116***	-0.114***	-0.120***
	(0.0334)	(0.0334)	(0.0334)	(0.0245)	(0.0245)	(0.0245)
month3	-0.232***	-0.231***	-0.236***	-0.0890***	-0.0874***	-0.0917***
	(0.0316)	(0.0316)	(0.0316)	(0.0233)	(0.0233)	(0.0233)
month2	-0.139***	-0.137***	-0.137***	-0.0279	-0.0264	-0.0319
	(0.0294)	(0.0294)	(0.0294)	(0.0218)	(0.0217)	(0.0218)
month1	-0.0537**	-0.0505*	-0.0524*	-0.0234	-0.0217	-0.0279
	(0.0269)	(0.0269)	(0.0269)	(0.0200)	(0.0200)	(0.0200)
month0	-0.0349	-0.0345	-0.0360	0.00164	0.00169	-0.00393
	(0.0226)	(0.0226)	(0.0225)	(0.0168)	(0.0168)	(0.0168)
childgender	-0.0320***	-0.0325***	-0.0326***	-0.0383***	-0.0388***	-0.0380***
	(0.00967)	(0.00966)	(0.00964)	(0.00714)	(0.00714)	(0.00713)
Urban	-0.0806***	-0.0448	-0.0792***	-0.0163	-0.0512	-0.0149
	(0.0148)	(0.0539)	(0.0148)	(0.0112)	(0.0429)	(0.0112)
hhchildren	0.00757	0.00780	0.00700	-0.00479	-0.00454	-0.00502
	(0.00587)	(0.00588)	(0.00585)	(0.00444)	(0.00444)	(0.00445)
ownland	0.121***	0.123***	0.121***	0.128***	0.128***	0.127***
	(0.0124)	(0.0125)	(0.0124)	(0.00932)	(0.00933)	(0.00931)
childageM	-0.0388***	-0.0388***	-0.0385***	-0.0537***	-0.0538***	-0.0537***
	(0.00207)	(0.00207)	(0.00210)	(0.00146)	(0.00146)	(0.00149)
childageMsqu	0.000560***	0.000561***	0.000556***	0.000712***	0.000714***	0.000710***
	(3.29e-05)	(3.29e-05)	(3.35e-05)	(2.34e-05)	(2.34e-05)	(2.38e-05)
ageatchildbirth	0.0398***	0.0398***	0.0404***	0.0217***	0.0214***	0.0208***

	(0.00722)	(0.00722)	(0.00718)	(0.00536)	(0.00536)	(0.00535)
Ageatchildbirthsqu	-0.000471***	-0.000470***	-0.000476***	-0.000254***	-0.000249***	-0.000238***
	(0.000122)	(0.000122)	(0.000121)	(9.03e-05)	(9.02e-05)	(9.01e-05)
2.melevel	0.101***	0.100***	0.105***	0.0751***	0.0756***	0.0754***
	(0.0156)	(0.0156)	(0.0156)	(0.0117)	(0.0117)	(0.0117)
3.melevel	0.134***	0.132***	0.136***	0.118***	0.119***	0.117***
	(0.0199)	(0.0199)	(0.0199)	(0.0152)	(0.0152)	(0.0152)
4.melevel	0.241***	0.240***	0.244***	0.183***	0.185***	0.182***
	(0.0197)	(0.0197)	(0.0196)	(0.0149)	(0.0149)	(0.0149)
5.melevel	0.409***	0.407***	0.412***	0.377***	0.379***	0.374***
	(0.0235)	(0.0236)	(0.0234)	(0.0180)	(0.0181)	(0.0180)
2.helevel	0.0315**	0.0334**	0.0315**	0.0204*	0.0220*	0.0215*
	(0.0157)	(0.0157)	(0.0156)	(0.0118)	(0.0118)	(0.0117)
3.helevel	0.0679***	0.0671***	0.0658***	0.0476***	0.0479***	0.0470***
	(0.0171)	(0.0171)	(0.0171)	(0.0129)	(0.0129)	(0.0128)
4.helevel	0.103***	0.103***	0.1000***	0.0657***	0.0667***	0.0661***
	(0.0162)	(0.0162)	(0.0162)	(0.0122)	(0.0122)	(0.0121)
5.helevel	0.185***	0.183***	0.185***	0.133***	0.133***	0.133***
	(0.0215)	(0.0216)	(0.0215)	(0.0163)	(0.0162)	(0.0162)
2.BO	-0.0921***	-0.0912***	-0.0950***	-0.0794***	-0.0794***	-0.0797***
	(0.0150)	(0.0150)	(0.0149)	(0.0111)	(0.0111)	(0.0111)
3.BO	-0.164***	-0.163***	-0.167***	-0.104***	-0.105***	-0.107***
	(0.0164)	(0.0164)	(0.0164)	(0.0122)	(0.0122)	(0.0122)
4.BO	-0.169***	-0.167***	-0.172***	-0.114***	-0.114***	-0.116***
	(0.0177)	(0.0177)	(0.0176)	(0.0132)	(0.0132)	(0.0131)
5.BO	-0.248***	-0.245***	-0.250***	-0.176***	-0.176***	-0.179***
	(0.0179)	(0.0179)	(0.0179)	(0.0133)	(0.0133)	(0.0133)
2.wealthgroup	0.174***	0.158***	0.172***	0.126***	0.117***	0.126***
	(0.0183)	(0.0186)	(0.0182)	(0.0135)	(0.0137)	(0.0135)
3.wealthgroup	0.299***	0.277***	0.297***	0.229***	0.216***	0.230***

	(0.0196)	(0.0201)	(0.0195)	(0.0146)	(0.0149)	(0.0146)
4.wealthgroup	0.463***	0.442***	0.459***	0.348***	0.336***	0.348***
	(0.0221)	(0.0225)	(0.0220)	(0.0165)	(0.0168)	(0.0165)
5.wealthgroup	0.683***	0.669***	0.681***	0.530***	0.520***	0.530***
	(0.0273)	(0.0274)	(0.0272)	(0.0205)	(0.0206)	(0.0205)
2.ETHNICITY	-0.0241	-0.0150	-0.0211	0.00638	0.0159	0.00862
	(0.0275)	(0.0278)	(0.0276)	(0.0207)	(0.0209)	(0.0207)
3.ETHNICITY	-0.172***	-0.146***	-0.162***	0.0140	0.0425*	0.0129
	(0.0307)	(0.0312)	(0.0307)	(0.0228)	(0.0232)	(0.0228)
4.ETHNICITY	-0.0403	-0.0263	-0.0220	0.0821***	0.0957***	0.0703**
	(0.0371)	(0.0375)	(0.0374)	(0.0280)	(0.0283)	(0.0281)
Constant	-2.374***	-2.389***	-2.473***	-1.469***	-1.471***	-1.421***
	(0.117)	(0.118)	(0.141)	(0.0880)	(0.0888)	(0.105)
Month of birth Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
district*urban interaction	No	Yes	No	No	Yes	No
district*year interaction	No	No	Yes	No	No	yes
Observations	102,734	102,734	102,734	105,096	105,096	105,096
R-squared	0.112	0.114	0.123	0.135	0.137	0.142
Note: Clustered robust standard errors in parentheses.						
Asterisks denote level of significance* p<0.01, ** p<0.05, * p<0.1**						

Table 4: HAZ Fixed Effects

	(1)	(2)	(3)
VARIABLES	OLS	HH FE	MFE
month9	0.0872***	0.0471	0.0469
	(0.0224)	(0.0314)	(0.0332)
month8	0.0396	-0.0113	-0.00715
	(0.0273)	(0.0389)	(0.0413)
month7	-0.0189	-0.117**	-0.102**
	(0.0324)	(0.0460)	(0.0486)
month6	-0.127***	-0.165***	-0.165***
	(0.0356)	(0.0493)	(0.0521)
month5	-0.216***	-0.274***	-0.279***
	(0.0350)	(0.0482)	(0.0509)
month4	-0.313***	-0.307***	-0.317***
	(0.0334)	(0.0462)	(0.0486)
month3	-0.232***	-0.226***	-0.247***
	(0.0316)	(0.0442)	(0.0465)
month2	-0.139***	-0.154***	-0.163***
	(0.0294)	(0.0415)	(0.0437)
month1	-0.0537**	-0.0766**	-0.0833**
	(0.0269)	(0.0377)	(0.0397)
month0	-0.0349	0.00449	0.0109
	(0.0226)	(0.0319)	(0.0337)
childgender	-0.0320***	-0.0346***	-0.0340**
	(0.00967)	(0.0132)	(0.0140)
Urban	-0.0806***		
	(0.0148)		
hhchildren	0.00757		
	(0.00587)		
ownland	0.121***		
	(0.0124)		
childageM	-0.0388***	-0.0153*	-0.0121
	(0.00207)	(0.00884)	(0.00941)
childageMsqu	0.000560***	0.000854***	0.000904***
	(3.29e-05)	(4.08e-05)	(4.28e-05)
ageatchildbirth	0.0398***	0.125***	0.218***
	(0.00722)	(0.0178)	(0.0529)
ageatchildbirthsqu	-0.000471***	-0.00200***	-0.00404***
	(0.000122)	(0.000306)	(0.000414)
2.melevel	0.101***	0.0690	
	(0.0156)	(0.0553)	
3.melevel	0.134***	0.0918	

	(0.0199)	(0.0674)	
4.melevel	0.241***	0.263***	
	(0.0197)	(0.0663)	
5.melevel	0.409***	0.339***	
	(0.0235)	(0.0773)	
2.helevel	0.0315**		
	(0.0157)		
3.helevel	0.0679***		
	(0.0171)		
4.helevel	0.103***		
	(0.0162)		
5.helevel	0.185***		
	(0.0215)		
2.BO	-0.0921***	-0.469***	-0.536***
	(0.0150)	(0.0232)	(0.0246)
3.BO	-0.164***	-0.874***	-1.000***
	(0.0164)	(0.0347)	(0.0378)
4.BO	-0.169***	-1.178***	-1.370***
	(0.0177)	(0.0460)	(0.0506)
5.BO	-0.248***	-1.531***	-1.795***
	(0.0179)	(0.0586)	(0.0649)
2.wealthgroup	0.174***		
	(0.0183)		
3.wealthgroup	0.299***		
	(0.0196)		
4.wealthgroup	0.463***		
	(0.0221)		
5.wealthgroup	0.683***		
	(0.0273)		
2.ETHNICITY	-0.0241		
	(0.0275)		
3.ETHNICITY	-0.172***		
	(0.0307)		
4.ETHNICITY	-0.0403		
	(0.0371)		
Constant	-2.374***	-6.367***	-7.796***
	(0.117)	(0.783)	(1.398)
Month of birth Fixed effects	Yes	Yes	Yes
Year of birth Fixed effects	Yes	Yes	Yes
District Fixed Effects	Yes	No	No
Observations	102,734	102,734	102,734
R-squared	0.112	0.104	0.115
Number of HHID		64,807	
Number of MOMIDfinal			69,506
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1			

Table 5: WAZ Fixed Effects

	(1)	(2)	(3)
VARIABLES	OLS	HH FE	MFE
month9	0.0604***	0.0471	0.0155
	(0.0165)	(0.0314)	(0.0242)
month8	0.0122	-0.0113	-0.0841***
	(0.0203)	(0.0389)	(0.0300)
month7	0.000140	-0.117**	-0.106***
	(0.0238)	(0.0460)	(0.0353)
month6	-0.00596	-0.165***	-0.100***
	(0.0258)	(0.0493)	(0.0378)
month5	-0.0475*	-0.274***	-0.0894**
	(0.0254)	(0.0482)	(0.0369)
month4	-0.116***	-0.307***	-0.0536
	(0.0245)	(0.0462)	(0.0353)
month3	-0.0890***	-0.226***	-0.0416
	(0.0233)	(0.0442)	(0.0337)
month2	-0.0279	-0.154***	-0.00877
	(0.0218)	(0.0415)	(0.0317)
month1	-0.0234	-0.0766**	0.0229
	(0.0200)	(0.0377)	(0.0289)
month0	0.00164	0.00449	0.0329
	(0.0168)	(0.0319)	(0.0245)
childgender	-0.0383***	-0.0346***	-0.0416***
	(0.00714)	(0.0132)	(0.0102)
urban	-0.0163		
	(0.0112)		
hhchildren	-0.00479		
	(0.00444)		
ownland	0.128***		
	(0.00932)		
childageM	-0.0537***	-0.0153*	0.0379***
	(0.00146)	(0.00884)	(0.00685)
childageMsqu	0.000712***	0.000854***	0.000917***
	(2.34e-05)	(4.08e-05)	(3.12e-05)
ageatchildbirth	0.0217***	0.125***	0.111***
	(0.00536)	(0.0178)	(0.0385)
ageatchildbirthsqu	-0.000254***	-0.00200***	-0.00254***
	(9.03e-05)	(0.000306)	(0.000301)

2.melevel	0.0751***	0.0690	
	(0.0117)	(0.0553)	
3.melevel	0.118***	0.0918	
	(0.0152)	(0.0674)	
4.melevel	0.183***	0.263***	
	(0.0149)	(0.0663)	
5.melevel	0.377***	0.339***	
	(0.0180)	(0.0773)	
2.helevel	0.0204*		
	(0.0118)		
3.helevel	0.0476***		
	(0.0129)		
4.helevel	0.0657***		
	(0.0122)		
5.helevel	0.133***		
	(0.0163)		
2.BO	-0.0794***	-0.469***	-0.329***
	(0.0111)	(0.0232)	(0.0179)
3.BO	-0.104***	-0.874***	-0.584***
	(0.0122)	(0.0347)	(0.0275)
4.BO	-0.114***	-1.178***	-0.819***
	(0.0132)	(0.0460)	(0.0368)
5.BO	-0.176***	-1.531***	-1.088***
	(0.0133)	(0.0586)	(0.0472)
2.wealthgroup	0.126***		
	(0.0135)		
3.wealthgroup	0.229***		
	(0.0146)		
4.wealthgroup	0.348***		
	(0.0165)		
5.wealthgroup	0.530***		
	(0.0205)		
2.ETHNICITY	0.00638		
	(0.0207)		
3.ETHNICITY	0.0140		
	(0.0228)		
4.ETHNICITY	0.0821***		
	(0.0280)		
Constant	-1.469***	-6.367***	-10.38***
	(0.0880)	(0.783)	(1.018)
Month of birth Fixed effects	Yes	Yes	Yes
Year of birth Fixed effects	Yes	Yes	Yes
District Fixed Effects	Yes	No	No
Observations	105,096	102,734	105,096
R-squared	0.135	0.104	0.145
Number of HHID		64,807	
Number of MOMIDfinal			70,723

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 6: OLS regression for HAZ using various factors interaction with exposure

	(1)	(2)	(3)	(4)
VARIABLES	HAZ Wealth*exp	HAZ ethnicity*exp	HAZ melevel*exp	HAZ helevel*exp
_Iwealthgro_2	0.213***	0.174***	0.184***	0.185***
	(0.0370)	(0.0183)	(0.0183)	(0.0183)
_Iwealthgro_3	0.350***	0.300***	0.314***	0.314***
	(0.0370)	(0.0196)	(0.0195)	(0.0195)
_Iwealthgro_4	0.527***	0.464***	0.480***	0.480***
	(0.0386)	(0.0221)	(0.0219)	(0.0219)
_Iwealthgro_5	0.721***	0.684***	0.699***	0.699***
	(0.0431)	(0.0272)	(0.0271)	(0.0271)
_Iexposure_2	0.0433	-0.113	-0.0229	-0.0593*
	(0.0480)	(0.0949)	(0.0301)	(0.0332)
_Iexposure_3	-0.0427	-0.121	-0.0390	-0.0475
	(0.0504)	(0.0990)	(0.0331)	(0.0367)
_Iexposure_4	-0.0977*	-0.226**	-0.142***	-0.164***
	(0.0524)	(0.105)	(0.0362)	(0.0388)
_Iexposure_5	-0.231***	-0.316***	-0.262***	-0.305***
	(0.0537)	(0.0986)	(0.0385)	(0.0415)
_Iexposure_6	-0.262***	-0.367***	-0.296***	-0.305***
	(0.0547)	(0.102)	(0.0396)	(0.0420)
_Iexposure_7	-0.220***	-0.140	-0.223***	-0.231***
	(0.0551)	(0.101)	(0.0411)	(0.0433)
_Iexposure_8	-0.0485	-0.232**	-0.0617	-0.100**
	(0.0588)	(0.109)	(0.0425)	(0.0445)
_Iexposure_9	0.0687	0.0149	0.0370	-0.00634
	(0.0564)	(0.0929)	(0.0392)	(0.0418)
_Iexposure_10	0.0997*	0.0871	0.0516	0.0189
	(0.0519)	(0.0921)	(0.0349)	(0.0371)
_Iexposure_11	0.140***	-0.00731	0.122***	0.0711**
	(0.0478)	(0.0927)	(0.0300)	(0.0323)
_IweaXexp_2_2	-0.0647			
	(0.0637)			
_IweaXexp_2_3	0.0150			
	(0.0647)			
_IweaXexp_2_4	-0.0833			
	(0.0667)			
_IweaXexp_2_5	-0.0679			
	(0.0676)			
_IweaXexp_2_6	-0.0813			
	(0.0669)			
_IweaXexp_2_7	-0.0858			
	(0.0662)			
_IweaXexp_2_8	-0.0144			
	(0.0711)			

_IweaXexp_2_9	-0.0637			
	(0.0700)			
_IweaXexp_2_10	-0.0481			
	(0.0663)			
_IweaXexp_2_11	-0.00344			
	(0.0626)			
_IweaXexp_3_2	-0.0744			
	(0.0621)			
_IweaXexp_3_3	-0.0228			
	(0.0656)			
_IweaXexp_3_4	-0.0285			
	(0.0660)			
_IweaXexp_3_5	0.0260			
	(0.0660)			
_IweaXexp_3_6	-0.0698			
	(0.0651)			
_IweaXexp_3_7	0.00149			
	(0.0643)			
_IweaXexp_3_8	-0.125*			
	(0.0677)			
_IweaXexp_3_9	-0.137**			
	(0.0658)			
_IweaXexp_3_10	-0.0885			
	(0.0640)			
_IweaXexp_3_11	-0.0803			
	(0.0611)			
_IweaXexp_4_2	-0.122*			
	(0.0623)			
_IweaXexp_4_3	-0.0680			
	(0.0654)			
_IweaXexp_4_4	-0.0588			
	(0.0655)			
_IweaXexp_4_5	-0.00806			
	(0.0646)			
_IweaXexp_4_6	-0.0511			
	(0.0642)			
_IweaXexp_4_7	0.0303			
	(0.0639)			
_IweaXexp_4_8	-0.119*			
	(0.0682)			
_IweaXexp_4_9	-0.158**			
	(0.0656)			
_IweaXexp_4_10	-0.0992			
	(0.0630)			
_IweaXexp_4_11	-0.103*			
	(0.0611)			
_IweaXexp_5_2	-0.122*			
	(0.0662)			
_IweaXexp_5_3	0.0376			
	(0.0693)			
_IweaXexp_5_4	-0.0455			
	(0.0701)			

_IweaXexp_5_5	0.0370			
	(0.0709)			
_IweaXexp_5_6	-0.0658			
	(0.0668)			
_IweaXexp_5_7	0.0505			
	(0.0665)			
_IweaXexp_5_8	-0.133*			
	(0.0712)			
_IweaXexp_5_9	-0.0658			
	(0.0687)			
_IweaXexp_5_10	-0.0559			
	(0.0646)			
_IweaXexp_5_11	-0.0638			
	(0.0637)			
childgender	-0.0317***	-0.0318***	-0.0322***	-0.0323***
	(0.00967)	(0.00967)	(0.00967)	(0.00967)
urban	-0.0811***	-0.0807***	-0.0756***	-0.0759***
	(0.0148)	(0.0148)	(0.0147)	(0.0147)
hhchildren	0.00766	0.00767	0.00844	0.00810
	(0.00587)	(0.00587)	(0.00586)	(0.00586)
ownland	0.121***	0.122***	0.119***	0.119***
	(0.0125)	(0.0124)	(0.0124)	(0.0124)
childageM	-0.0388***	-0.0388***	-0.0387***	-0.0386***
	(0.00207)	(0.00207)	(0.00207)	(0.00207)
childageMsqu	0.000561***	0.000562***	0.000560***	0.000558***
	(3.29e-05)	(3.29e-05)	(3.29e-05)	(3.29e-05)
ageatchildbirth	0.0403***	0.0397***	0.0417***	0.0416***
	(0.00722)	(0.00723)	(0.00722)	(0.00722)
ageatchildbirthsqu	- 0.000480***	-0.000468***	-0.000496***	-0.000494***
	(0.000122)	(0.000122)	(0.000122)	(0.000122)
_Imelevel_2	0.101***	0.101***	0.131***	0.108***
	(0.0156)	(0.0156)	(0.0312)	(0.0156)
_Imelevel_3	0.134***	0.133***	0.188***	0.144***
	(0.0199)	(0.0199)	(0.0392)	(0.0199)
_Imelevel_4	0.242***	0.240***	0.297***	0.251***
	(0.0197)	(0.0197)	(0.0380)	(0.0196)
_Imelevel_5	0.409***	0.409***	0.443***	0.419***
	(0.0235)	(0.0235)	(0.0428)	(0.0235)
_Ihelevel_2	0.0311**	0.0313**	0.0315**	0.0241
	(0.0157)	(0.0157)	(0.0157)	(0.0321)
_Ihelevel_3	0.0680***	0.0675***	0.0701***	0.0661*
	(0.0171)	(0.0171)	(0.0171)	(0.0356)
_Ihelevel_4	0.103***	0.103***	0.106***	0.0822***
	(0.0162)	(0.0162)	(0.0162)	(0.0317)
_Ihelevel_5	0.184***	0.185***	0.185***	0.170***
	(0.0216)	(0.0216)	(0.0215)	(0.0425)
o._Iwealthgro_2	-			
o._Iwealthgro_3	-			
o._Iwealthgro_4	-			

o._Iwealthgro_5	-			
_IETHNICITY_2	-0.0235	-0.0738		
	(0.0275)	(0.0569)		
_IETHNICITY_3	-0.172***	-0.140**		
	(0.0307)	(0.0616)		
_IETHNICITY_4	-0.0395	-0.0887		
	(0.0371)	(0.0775)		
_IETHXexp_2_2		0.110		
		(0.0970)		
_IETHXexp_2_3		0.0806		
		(0.101)		
_IETHXexp_2_4		0.104		
		(0.106)		
_IETHXexp_2_5		0.120		
		(0.0983)		
_IETHXexp_2_6		0.0838		
		(0.101)		
_IETHXexp_2_7		-0.0456		
		(0.0992)		
_IETHXexp_2_8		0.142		
		(0.108)		
_IETHXexp_2_9		-0.0287		
		(0.0926)		
_IETHXexp_2_10		-0.0320		
		(0.0928)		
_IETHXexp_2_11		0.106		
		(0.0945)		
_IETHXexp_3_2		0.00513		
		(0.104)		
_IETHXexp_3_3		0.0377		
		(0.108)		
_IETHXexp_3_4		0.0481		
		(0.113)		
_IETHXexp_3_5		-0.0236		
		(0.106)		
_IETHXexp_3_6		-0.0333		
		(0.108)		
_IETHXexp_3_7		-0.210**		
		(0.107)		
_IETHXexp_3_8		-0.0514		
		(0.116)		
_IETHXexp_3_9		-0.0706		
		(0.102)		
_IETHXexp_3_10		-0.130		
		(0.101)		
_IETHXexp_3_11		0.0378		
		(0.102)		
_IETHXexp_4_2		0.0468		
		(0.133)		
_IETHXexp_4_3		0.133		

		(0.140)		
_IETHXexp_4_4		0.124		
		(0.136)		
_IETHXexp_4_5		0.176		
		(0.134)		
_IETHXexp_4_6		0.0675		
		(0.133)		
_IETHXexp_4_7		-0.0865		
		(0.132)		
_IETHXexp_4_8		0.141		
		(0.148)		
_IETHXexp_4_9		-0.0668		
		(0.128)		
_IETHXexp_4_10		-0.108		
		(0.129)		
_IETHXexp_4_11		0.192		
		(0.128)		
_ImelXexp_2_2			-0.0340	
			(0.0524)	
_ImelXexp_2_3			0.00155	
			(0.0572)	
_ImelXexp_2_4			-0.000735	
			(0.0569)	
_ImelXexp_2_5			0.0433	
			(0.0564)	
_ImelXexp_2_6			-0.00527	
			(0.0554)	
_ImelXexp_2_7			0.0407	
			(0.0537)	
_ImelXexp_2_8			-0.0883	
			(0.0574)	
_ImelXexp_2_9			-0.114**	
			(0.0554)	
_ImelXexp_2_10			-0.0150	
			(0.0531)	
_ImelXexp_2_11			-0.0719	
			(0.0517)	
_ImelXexp_3_2			0.0701	
			(0.0671)	
_ImelXexp_3_3			-0.0285	
			(0.0726)	
_ImelXexp_3_4			0.0324	
			(0.0729)	
_ImelXexp_3_5			0.0541	
			(0.0724)	
_ImelXexp_3_6			-0.0559	
			(0.0712)	
_ImelXexp_3_7			-0.0201	
			(0.0702)	
_ImelXexp_3_8			-0.243***	
			(0.0705)	
_ImelXexp_3_9			-0.152**	

			(0.0696)	
_ImelXexp_3_10			-0.0645	
			(0.0663)	
_ImelXexp_3_11			-0.0719	
			(0.0640)	
_ImelXexp_4_2			-0.0338	
			(0.0611)	
_ImelXexp_4_3			-0.0553	
			(0.0675)	
_ImelXexp_4_4			0.00472	
			(0.0661)	
_ImelXexp_4_5			0.0907	
			(0.0672)	
_ImelXexp_4_6			-0.0146	
			(0.0638)	
_ImelXexp_4_7			-0.0438	
			(0.0636)	
_ImelXexp_4_8			-0.158**	
			(0.0673)	
_ImelXexp_4_9			-0.164***	
			(0.0621)	
_ImelXexp_4_10			-0.0524	
			(0.0603)	
_ImelXexp_4_11			-0.0667	
			(0.0596)	
_ImelXexp_5_2			-0.0843	
			(0.0704)	
_ImelXexp_5_3			-0.0592	
			(0.0732)	
_ImelXexp_5_4			-0.0393	
			(0.0760)	
_ImelXexp_5_5			0.0425	
			(0.0749)	
_ImelXexp_5_6			-0.0851	
			(0.0711)	
_ImelXexp_5_7			0.0496	
			(0.0719)	
_ImelXexp_5_8			-0.0619	
			(0.0728)	
_ImelXexp_5_9			0.00200	
			(0.0699)	
_ImelXexp_5_10			0.0169	
			(0.0660)	
_ImelXexp_5_11			-0.0776	
			(0.0661)	
o._Imelevel_2			-	
o._Imelevel_3			-	
o._Imelevel_4			-	
o._Imelevel_5			-	

_IhelXexp_2_2				0.0437
				(0.0547)
_IhelXexp_2_3				0.0252
				(0.0596)
_IhelXexp_2_4				0.00727
				(0.0599)
_IhelXexp_2_5				0.0891
				(0.0595)
_IhelXexp_2_6				-0.0434
				(0.0587)
_IhelXexp_2_7				-0.0234
				(0.0565)
_IhelXexp_2_8				-0.0465
				(0.0614)
_IhelXexp_2_9				-0.0249
				(0.0585)
_IhelXexp_2_10				0.0674
				(0.0565)
_IhelXexp_2_11				0.0113
				(0.0540)
_IhelXexp_3_2				0.0727
				(0.0602)
_IhelXexp_3_3				-0.0837
				(0.0631)
_IhelXexp_3_4				0.00981
				(0.0639)
_IhelXexp_3_5				0.143**
				(0.0645)
_IhelXexp_3_6				0.00710
				(0.0636)
_IhelXexp_3_7				-0.0318
				(0.0646)
_IhelXexp_3_8				-0.0570
				(0.0663)
_IhelXexp_3_9				-0.0598
				(0.0640)
_IhelXexp_3_10				-0.00595
				(0.0599)
_IhelXexp_3_11				0.0681
				(0.0587)
_IhelXexp_4_2				0.0479
				(0.0548)
_IhelXexp_4_3				0.0526
				(0.0581)
_IhelXexp_4_4				0.0572
				(0.0588)
_IhelXexp_4_5				0.122**
				(0.0589)
_IhelXexp_4_6				-0.0422
				(0.0566)
_IhelXexp_4_7				0.0497

				(0.0566)
_IhelXexp_4_8				-0.0481
				(0.0588)
_IhelXexp_4_9				0.000481
				(0.0557)
_IhelXexp_4_10				0.0350
				(0.0537)
_IhelXexp_4_11				0.0389
				(0.0529)
_IhelXexp_5_2				-0.00822
				(0.0704)
_IhelXexp_5_3				-0.0674
				(0.0737)
_IhelXexp_5_4				0.0955
				(0.0763)
_IhelXexp_5_5				0.129*
				(0.0753)
_IhelXexp_5_6				0.0521
				(0.0721)
_IhelXexp_5_7				0.111
				(0.0728)
_IhelXexp_5_8				-0.0411
				(0.0741)
_IhelXexp_5_9				-0.0192
				(0.0704)
_IhelXexp_5_10				0.0207
				(0.0682)
_IhelXexp_5_11				-0.0300
				(0.0669)
o._Ihelevel_2				-
o._Ihelevel_3				-
o._Ihelevel_4				-
o._Ihelevel_5				-
Constant	-2.420***	-2.338***	-2.544***	-2.514***
	(0.120)	(0.127)	(0.114)	(0.114)
Month of birth Fixed effects	Yes	Yes	Yes	Yes
Year of birth Fixed effects	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes
Observations	102,734	102,734	102,879	102,879
R-squared	0.113	0.113	0.112	0.112
Robust standard errors in parentheses				
***** p<0.01, ** p<0.05, * p<0.1**				

Note: the following are the base categories for the regressions in the table above; lowest wealth quintile household, Urdu speaking ethnic background, less than primary mother's education and less than primary education household education respectively.

Table 7: OLS regression for WAZ using various factors interaction with exposure

	(1)	(2)	(3)	(4)
VARIABLES	WAZ wealth*exp	WAZ ethnicity*exp	WAZ melevel*exp	WAZ helevel*exp
_Iwealthgro_2	0.136***	0.126***	0.125***	0.125***
	(0.0272)	(0.0135)	(0.0134)	(0.0134)
_Iwealthgro_3	0.218***	0.229***	0.227***	0.227***
	(0.0274)	(0.0146)	(0.0145)	(0.0145)
_Iwealthgro_4	0.341***	0.348***	0.347***	0.346***
	(0.0289)	(0.0165)	(0.0164)	(0.0164)
o._Iwealthgro_5	-			
_Iexposure_2	0.00535	-0.0561	-0.00603	-0.0201
	(0.0355)	(0.0679)	(0.0223)	(0.0245)
_Iexposure_3	-0.00461	-0.0413	-0.0176	-0.0291
	(0.0367)	(0.0704)	(0.0243)	(0.0275)
_Iexposure_4	-0.0534	-0.0917	-0.0452*	-0.0877***
	(0.0393)	(0.0756)	(0.0266)	(0.0287)
_Iexposure_5	-0.136***	-0.0975	-0.103***	-0.149***
	(0.0398)	(0.0737)	(0.0284)	(0.0310)
_Iexposure_6	-0.122***	-0.206***	-0.113***	-0.137***
	(0.0405)	(0.0734)	(0.0292)	(0.0310)
_Iexposure_7	-0.0671*	-0.000671	-0.0508*	-0.0695**
	(0.0400)	(0.0770)	(0.0296)	(0.0313)
_Iexposure_8	-0.00450	-0.0823	0.0128	-0.00162
	(0.0423)	(0.0784)	(0.0305)	(0.0318)
_Iexposure_9	-0.0166	0.0248	0.0141	-0.00659
	(0.0415)	(0.0729)	(0.0285)	(0.0304)
_Iexposure_10	1.77e-05	0.0382	-0.00643	-0.0289
	(0.0382)	(0.0703)	(0.0254)	(0.0272)
_Iexposure_11	0.0472	-0.00272	0.0777***	0.0552**
	(0.0350)	(0.0644)	(0.0218)	(0.0234)
_IweaXexp_2_2	-0.0243			
	(0.0467)			
_IweaXexp_2_3	-0.0294			
	(0.0474)			
_IweaXexp_2_4	-0.0275			
	(0.0500)			
_IweaXexp_2_5	-0.0295			
	(0.0496)			
_IweaXexp_2_6	-0.0158			
	(0.0493)			
_IweaXexp_2_7	-0.0494			
	(0.0477)			
_IweaXexp_2_8	0.0106			
	(0.0504)			

_IweaXexp_2_9	-0.00617			
	(0.0498)			
_IweaXexp_2_10	0.0101			
	(0.0490)			
_IweaXexp_2_11	0.0319			
	(0.0458)			
_IweaXexp_3_2	0.0254			
	(0.0459)			
_IweaXexp_3_3	-0.0215			
	(0.0483)			
_IweaXexp_3_4	0.0192			
	(0.0500)			
_IweaXexp_3_5	0.106**			
	(0.0496)			
_IweaXexp_3_6	-0.000531			
	(0.0491)			
_IweaXexp_3_7	0.0499			
	(0.0477)			
_IweaXexp_3_8	-0.00793			
	(0.0490)			
_IweaXexp_3_9	0.0133			
	(0.0485)			
_IweaXexp_3_10	-0.0428			
	(0.0468)			
_IweaXexp_3_11	0.00825			
	(0.0452)			
_IweaXexp_4_2	-0.00291			
	(0.0462)			
_IweaXexp_4_3	-0.0246			
	(0.0490)			
_IweaXexp_4_4	0.0656			
	(0.0500)			
_IweaXexp_4_5	0.0762			
	(0.0487)			
_IweaXexp_4_6	-0.00127			
	(0.0480)			
_IweaXexp_4_7	0.0389			
	(0.0474)			
_IweaXexp_4_8	-0.0375			
	(0.0494)			
_IweaXexp_4_9	0.0192			
	(0.0485)			
_IweaXexp_4_10	0.0139			
	(0.0469)			
_IweaXexp_4_11	-0.0240			
	(0.0453)			
_IweaXexp_5_2	-0.00759			
	(0.0495)			
_IweaXexp_5_3	0.00326			
	(0.0506)			
_IweaXexp_5_4	0.0914*			
	(0.0528)			

_IweaXexp_5_5	0.0970*			
	(0.0535)			
_IweaXexp_5_6	0.0599			
	(0.0512)			
_IweaXexp_5_7	0.0597			
	(0.0496)			
_IweaXexp_5_8	0.0413			
	(0.0520)			
_IweaXexp_5_9	0.0595			
	(0.0507)			
_IweaXexp_5_10	0.0810*			
	(0.0490)			
_IweaXexp_5_11	0.0565			
	(0.0469)			
Childgender	-0.0380***	-0.0384***	-0.0379***	-0.0379***
	(0.00714)	(0.00714)	(0.00714)	(0.00714)
Urban	-0.0164	-0.0161	-0.0163	-0.0164
	(0.0112)	(0.0112)	(0.0111)	(0.0111)
Hhchildren	-0.00473	-0.00479	-0.00417	-0.00427
	(0.00445)	(0.00444)	(0.00445)	(0.00445)
Ownland	0.128***	0.128***	0.129***	0.129***
	(0.00933)	(0.00932)	(0.00933)	(0.00933)
childageM	-0.0537***	-0.0537***	-0.0536***	-0.0536***
	(0.00146)	(0.00146)	(0.00146)	(0.00146)
childageMsqu	0.000713***	0.000713***	0.000711***	0.000712***
	(2.34e-05)	(2.34e-05)	(2.34e-05)	(2.34e-05)
ageatchildbirth	0.0218***	0.0215***	0.0214***	0.0214***
	(0.00536)	(0.00536)	(0.00536)	(0.00535)
ageatchildbirthsqu	-0.000256***	-0.000252***	-0.000250***	-0.000249***
	(9.03e-05)	(9.03e-05)	(9.02e-05)	(9.01e-05)
_Imelevel_2	0.0749***	0.0750***	0.0871***	0.0740***
	(0.0117)	(0.0117)	(0.0230)	(0.0116)
_Imelevel_3	0.118***	0.118***	0.132***	0.118***
	(0.0152)	(0.0152)	(0.0296)	(0.0152)
_Imelevel_4	0.183***	0.183***	0.173***	0.182***
	(0.0149)	(0.0149)	(0.0293)	(0.0149)
_Imelevel_5	0.377***	0.377***	0.338***	0.374***
	(0.0180)	(0.0180)	(0.0327)	(0.0180)
_Ihelevel_2	0.0202*	0.0203*	0.0196*	0.0394
	(0.0118)	(0.0118)	(0.0118)	(0.0240)
_Ihelevel_3	0.0478***	0.0475***	0.0468***	0.00953
	(0.0129)	(0.0129)	(0.0129)	(0.0275)
_Ihelevel_4	0.0658***	0.0658***	0.0657***	0.0255
	(0.0122)	(0.0122)	(0.0122)	(0.0236)
_Ihelevel_5	0.134***	0.134***	0.133***	0.0382
	(0.0163)	(0.0163)	(0.0163)	(0.0318)
o._Iwealthgro_2	-			
o._Iwealthgro_3	-			
o._Iwealthgro_4	-			

_Iwealthgro_5	0.486***	0.530***	0.527***	0.527***
	(0.0328)	(0.0205)	(0.0204)	(0.0204)
_IETHNICITY_2	0.00739	-0.0246		
	(0.0207)	(0.0434)		
_IETHNICITY_3	0.0148	0.0204		
	(0.0228)	(0.0463)		
_IETHNICITY_4	0.0834***	0.00699		
	(0.0280)	(0.0579)		
_IETHXexp_2_2		0.0733		
		(0.0696)		
_IETHXexp_2_3		0.0139		
		(0.0716)		
_IETHXexp_2_4		0.0625		
		(0.0762)		
_IETHXexp_2_5		0.0249		
		(0.0736)		
_IETHXexp_2_6		0.113		
		(0.0730)		
_IETHXexp_2_7		-0.0402		
		(0.0761)		
_IETHXexp_2_8		0.100		
		(0.0776)		
_IETHXexp_2_9		-0.0182		
		(0.0726)		
_IETHXexp_2_10		-0.0158		
		(0.0708)		
_IETHXexp_2_11		0.0738		
		(0.0660)		
_IETHXexp_3_2		0.0217		
		(0.0750)		
_IETHXexp_3_3		0.0548		
		(0.0767)		
_IETHXexp_3_4		0.0736		
		(0.0817)		
_IETHXexp_3_5		-0.0411		
		(0.0793)		
_IETHXexp_3_6		0.0505		
		(0.0787)		
_IETHXexp_3_7		-0.0785		
		(0.0816)		
_IETHXexp_3_8		-0.0166		
		(0.0839)		
_IETHXexp_3_9		-0.0496		
		(0.0791)		
_IETHXexp_3_10		-0.0922		
		(0.0762)		
_IETHXexp_3_11		0.00616		
		(0.0717)		
_IETHXexp_4_2		0.0607		
		(0.0956)		
_IETHXexp_4_3		-0.0207		
		(0.0993)		

_IETHXexp_4_4		0.167*		
		(0.101)		
_IETHXexp_4_5		0.128		
		(0.0987)		
_IETHXexp_4_6		0.118		
		(0.0994)		
_IETHXexp_4_7		0.0282		
		(0.100)		
_IETHXexp_4_8		0.202*		
		(0.111)		
_IETHXexp_4_9		-0.0124		
		(0.0991)		
_IETHXexp_4_10		0.0569		
		(0.0970)		
_IETHXexp_4_11		0.199**		
		(0.0936)		
_ImelXexp_2_2			0.00196	
			(0.0383)	
_ImelXexp_2_3			0.00433	
			(0.0427)	
_ImelXexp_2_4			0.0207	
			(0.0431)	
_ImelXexp_2_5			0.0281	
			(0.0429)	
_ImelXexp_2_6			-0.00590	
			(0.0416)	
_ImelXexp_2_7			0.0202	
			(0.0396)	
_ImelXexp_2_8			-0.0596	
			(0.0418)	
_ImelXexp_2_9			-0.0624	
			(0.0398)	
_ImelXexp_2_10			0.00487	
			(0.0398)	
_ImelXexp_2_11			-0.0846**	
			(0.0379)	
_ImelXexp_3_2			0.0496	
			(0.0513)	
_ImelXexp_3_3			-0.00781	
			(0.0537)	
_ImelXexp_3_4			0.0188	
			(0.0552)	
_ImelXexp_3_5			-0.0228	
			(0.0539)	
_ImelXexp_3_6			-0.0236	
			(0.0551)	
_ImelXexp_3_7			-0.0710	
			(0.0507)	
_ImelXexp_3_8			-0.0407	
			(0.0524)	
_ImelXexp_3_9			-0.0532	
			(0.0508)	

_ImelXexp_3_10			-0.00142	
			(0.0512)	
_ImelXexp_3_11			-0.0103	
			(0.0495)	
_ImelXexp_4_2			0.0414	
			(0.0458)	
_ImelXexp_4_3			-0.0278	
			(0.0512)	
_ImelXexp_4_4			0.0657	
			(0.0509)	
_ImelXexp_4_5			0.0887*	
			(0.0509)	
_ImelXexp_4_6			0.00534	
			(0.0477)	
_ImelXexp_4_7			0.0224	
			(0.0491)	
_ImelXexp_4_8			-0.0590	
			(0.0476)	
_ImelXexp_4_9			-0.00972	
			(0.0467)	
_ImelXexp_4_10			0.0407	
			(0.0457)	
_ImelXexp_4_11			-0.0376	
			(0.0445)	
_ImelXexp_5_2			-0.00859	
			(0.0535)	
_ImelXexp_5_3			0.00123	
			(0.0568)	
_ImelXexp_5_4			0.0649	
			(0.0595)	
_ImelXexp_5_5			0.0446	
			(0.0579)	
_ImelXexp_5_6			0.0292	
			(0.0559)	
_ImelXexp_5_7			0.0554	
			(0.0569)	
_ImelXexp_5_8			0.0458	
			(0.0550)	
_ImelXexp_5_9			0.0457	
			(0.0535)	
_ImelXexp_5_10			0.105**	
			(0.0510)	
_ImelXexp_5_11			0.0376	
			(0.0494)	
o._Imelevel_2			-	
o._Imelevel_3			-	
o._Imelevel_4			-	
o._Imelevel_5			-	

_IhelXexp_2_2				-0.0312
				(0.0404)
_IhelXexp_2_3				-0.0279
				(0.0435)
_IhelXexp_2_4				0.0351
				(0.0450)
_IhelXexp_2_5				0.0300
				(0.0450)
_IhelXexp_2_6				-0.0502
				(0.0443)
_IhelXexp_2_7				0.00641
				(0.0416)
_IhelXexp_2_8				-0.0678
				(0.0447)
_IhelXexp_2_9				-0.0488
				(0.0428)
_IhelXexp_2_10				0.0148
				(0.0426)
_IhelXexp_2_11				-0.0728*
				(0.0401)
_IhelXexp_3_2				0.105**
				(0.0458)
_IhelXexp_3_3				0.0408
				(0.0473)
_IhelXexp_3_4				0.0918*
				(0.0492)
_IhelXexp_3_5				0.124**
				(0.0489)
_IhelXexp_3_6				0.0614
				(0.0484)
_IhelXexp_3_7				-0.0191
				(0.0486)
_IhelXexp_3_8				-0.0107
				(0.0485)
_IhelXexp_3_9				0.00638
				(0.0467)
_IhelXexp_3_10				0.0125
				(0.0458)
_IhelXexp_3_11				0.0681
				(0.0445)
_IhelXexp_4_2				0.0351
				(0.0409)
_IhelXexp_4_3				0.0285
				(0.0437)
_IhelXexp_4_4				0.106**
				(0.0441)
_IhelXexp_4_5				0.142***
				(0.0440)
_IhelXexp_4_6				0.0510
				(0.0426)
_IhelXexp_4_7				0.0496
				(0.0423)

_IhelXexp_4_8				-0.0157
				(0.0423)
_IhelXexp_4_9				0.0198
				(0.0409)
_IhelXexp_4_10				0.0944**
				(0.0404)
_IhelXexp_4_11				0.0173
				(0.0392)
_IhelXexp_5_2				0.0867*
				(0.0524)
_IhelXexp_5_3				0.0344
				(0.0551)
_IhelXexp_5_4				0.243***
				(0.0592)
_IhelXexp_5_5				0.157***
				(0.0567)
_IhelXexp_5_6				0.137**
				(0.0557)
_IhelXexp_5_7				0.141**
				(0.0548)
_IhelXexp_5_8				0.106**
				(0.0541)
_IhelXexp_5_9				0.0964*
				(0.0523)
_IhelXexp_5_10				0.154***
				(0.0509)
_IhelXexp_5_11				0.0422
				(0.0492)
o._Ihelevel_2				-
o._Ihelevel_3				-
o._Ihelevel_4				-
o._Ihelevel_5				-
Constant	-1.461***	-1.443***	-1.458***	-1.438***
	(0.0895)	(0.0949)	(0.0855)	(0.0855)
Month of birth Fixed effects	Yes	Yes	Yes	Yes
Year of birth Fixed effects	Yes	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes	Yes
Observations	105,096	105,096	105,246	105,246
R-squared	0.136	0.136	0.136	0.136
Robust standard errors in parentheses				
***** p<0.01, ** p<0.05, * p<0.1**				

Note: the following are the base categories for the regressions in the table above; lowest wealth quintile household, Urdu speaking ethnic background, less than primary mother's education and less than primary education household education respectively.

Table 8: Robustness check using family planning interaction with exposure

VARIABLES	HAZ exposure*famlyplanning	WAZ exposure*famlyplanning
_Iexposure_2	-0.0699*	-0.00359
	(0.0408)	(0.0310)
_Iexposure_3	-0.0702	-0.0133
	(0.0511)	(0.0392)
_Iexposure_4	-0.0321	0.0103
	(0.0578)	(0.0441)
_Iexposure_5	-0.0960	-0.0247
	(0.0628)	(0.0482)
_Iexposure_6	-0.166**	-0.0682
	(0.0689)	(0.0532)
_Iexposure_7	-0.149**	-0.0184
	(0.0758)	(0.0585)
_Iexposure_8	-0.217***	-0.0692
	(0.0777)	(0.0599)
_Iexposure_9	-0.218***	-0.135***
	(0.0645)	(0.0508)
_Iexposure_10	-0.142***	-0.0898**
	(0.0534)	(0.0422)
_Iexposure_11	-0.0299	-0.0241
	(0.0404)	(0.0313)
Familyplanning	0.0114	0.0330
	(0.0663)	(0.0556)
_IexpXfami_2	0.105	0.0426
	(0.103)	(0.0851)
_IexpXfami_3	0.158	0.0298
	(0.105)	(0.0877)
_IexpXfami_4	-0.0573	-0.000545
	(0.116)	(0.0901)
_IexpXfami_5	-0.0704	-0.00326
	(0.114)	(0.0907)
_IexpXfami_6	0.203*	0.0677
	(0.113)	(0.0852)
_IexpXfami_7	0.159	0.0468
	(0.106)	(0.0885)
_IexpXfami_8	0.0333	-0.0506
	(0.110)	(0.0882)
_IexpXfami_9	0.0988	0.0914
	(0.105)	(0.0904)

_IexpXfami_10	0.0880	0.0994
	(0.105)	(0.0923)
_IexpXfami_11	0.0543	-0.00606
	(0.108)	(0.0848)
Constant	-2.492***	-5.577***
	(0.432)	(0.336)
Child controls	Yes	Yes
Mother controls	Yes	Yes
HH controls	Yes	Yes
Observations	34,648	34,969
R-squared	0.140	0.170
Robust standard errors in parentheses		
***** p<0.01, ** p<0.05, * p<0.1**		

Table 9: Robustness check using first born child

	(1)	**(2)**
VARIABLES	HAZ	WAZ
Month 9	0.0793	0.0497
	(0.0536)	(0.0400)
Month 8	0.112*	0.0365
	(0.0655)	(0.0489)
Month 7	0.0280	0.0210
	(0.0770)	(0.0574)
Month 6	-0.0495	0.0457
	(0.0830)	(0.0618)
Month 5	-0.0407	0.0921

	(0.0836)	(0.0622)
Month 4	-0.140*	-0.0172
	(0.0817)	(0.0609)
Month 3	-0.0898	0.00396
	(0.0797)	(0.0593)
Month 2	-0.118	0.0477
	(0.0758)	(0.0564)
Month 1	-0.0501	0.0192
	(0.0681)	(0.0507)
Month 0	-0.0855	0.0115
	(0.0571)	(0.0425)
Constant	-2.373***	-1.889***
	(0.263)	(0.196)
Child controls	Yes	Yes
Mother controls	Yes	Yes
HH controls	Yes	Yes
Observations	16,793	17,144
R-squared	0.098	0.119
Standard errors in parentheses		
***** p<0.01, ** p<0.05, * p<0.1**		

Table 10

VARIABLES	**HAZ ETHNICITY(Urdu speaking)**	**HAZ ETHNICITY(Punjabi)**	**HAZ ETHNICITY (Siraiki)**
month9	0.0461	0.0939***	0.00116
	(0.110)	(0.0261)	(0.0522)
month8	0.186	0.0468	-0.0747
	(0.132)	(0.0320)	(0.0645)
month7	0.163	-0.0251	-0.0895
	(0.148)	(0.0385)	(0.0756)
month6	-0.0416	-0.110***	-0.297***
	(0.172)	(0.0421)	(0.0831)
month5	0.0331	-0.208***	-0.319***
	(0.166)	(0.0416)	(0.0810)
month4	-0.179	-0.296***	-0.383***
	(0.158)	(0.0399)	(0.0757)
month3	-0.129	-0.199***	-0.348***
	(0.151)	(0.0383)	(0.0676)
month2	-0.0984	-0.113***	-0.184***
	(0.144)	(0.0354)	(0.0640)

month1	-0.114	-0.0287	-0.0922
	(0.124)	(0.0322)	(0.0591)
month0	-0.156	0.00595	-0.106**
	(0.108)	(0.0267)	(0.0515)
controls variables	all	all	all
Observations	5,007	73,758	19,183
R-squared	0.132	0.102	0.117

Table 11a , 11b & 11c

Table 11a**: Regressions using three exposure (trimesters) measures in OLS with controls**		
VARIABLES	HAZ (OLS)	WAZ (OLS)
First trimester	-0.0578***	-0.0147
	(0.0201)	(0.0149)
Second trimester	-0.115***	-0.0161
	(0.0240)	(0.0178)
Third trimester	0.0616***	0.0308**
	(0.0197)	(0.0146)
2.melevel	0.108***	0.0735***
	(0.0144)	(0.0107)
3.melevel	0.144***	0.118***
	(0.0187)	(0.0139)
4.melevel	0.251***	0.181***
	(0.0180)	(0.0133)
5.melevel	0.419***	0.374***
	(0.0211)	(0.0157)
2.helevel	0.0310**	0.0194*
	(0.0142)	(0.0105)
3.helevel	0.0701***	0.0468***
	(0.0157)	(0.0117)
4.helevel	0.105***	0.0656***
	(0.0146)	(0.0109)
5.helevel	0.185***	0.133***
	(0.0191)	(0.0142)
2.BO	-0.0931***	-0.0797***
	(0.0163)	(0.0121)
3.BO	-0.167***	-0.105***

	(0.0167)	(0.0124)
4.BO	-0.172***	-0.115***
	(0.0176)	(0.0131)
5.BO	-0.251***	-0.176***
	(0.0173)	(0.0128)
childgender	-0.0329***	-0.0383***
	(0.00958)	(0.00710)
urban	-0.0759***	-0.0166*
	(0.0132)	(0.00981)
2.wealthgroup	0.185***	0.125***
	(0.0163)	(0.0121)
3.wealthgroup	0.314***	0.227***
	(0.0174)	(0.0129)
4.wealthgroup	0.480***	0.346***
	(0.0195)	(0.0145)
5.wealthgroup	0.699***	0.527***
	(0.0241)	(0.0179)
hhchildren	0.00849*	-0.00421
	(0.00480)	(0.00357)
ownland	0.119***	0.129***
	(0.0112)	(0.00833)
childageM	-0.0394***	-0.0539***
	(0.00181)	(0.00134)
childageMsqu	0.000570***	0.000716***
	(2.99e-05)	(2.21e-05)
ageatchildbirth	0.0415***	0.0214***
	(0.00656)	(0.00487)
ageatchildbirthsqu	-0.000493***	-0.000249***
	(0.000110)	(8.17e-05)
Constant	-2.551***	-1.463***
	(0.104)	(0.0773)
District Fixed Effects	YES	YES
Year Fixed Effects	YES	YES
Month Fixed effects	YES	YES
Observations	102,879	105,246
R-squared	0.111	0.135
Standard errors in parentheses		
***** p<0.01, ** p<0.05, * p<0.1**		

Table 11b: **Regressions using three exposure (trimesters) measures with household fixed effects**		
VARIABLES	HAZ (HFE)	WAZ (HFE)
First trimester	-0.0899***	-0.00154
	(0.0278)	(0.0203)
Second trimester	-0.142***	-0.0202
	(0.0335)	(0.0244)
Third trimester	-6.15e-05	-0.0164
	(0.0279)	(0.0204)
2.melevel	0.0692	0.0705*
	(0.0553)	(0.0407)
3.melevel	0.0905	0.106**
	(0.0674)	(0.0497)
4.melevel	0.263***	0.153***
	(0.0663)	(0.0487)
5.melevel	0.343***	0.270***
	(0.0773)	(0.0568)
2.BO	-0.470***	-0.283***
	(0.0232)	(0.0170)
3.BO	-0.877***	-0.502***
	(0.0347)	(0.0254)
4.BO	-1.181***	-0.692***
	(0.0459)	(0.0336)
5.BO	-1.535***	-0.907***
	(0.0586)	(0.0429)
childgender	-0.0346***	-0.0437***
	(0.0132)	(0.00968)
childageM	-0.0129	0.0275***
	(0.00853)	(0.00624)
childageMsqu	0.000856***	0.000879***
	(4.03e-05)	(2.94e-05)
ageatchildbirth	0.124***	0.0774***
	(0.0178)	(0.0130)
ageatchildbirthsqu	-0.00199***	-0.00127***
	(0.000306)	(0.000224)
Constant	-6.630***	-9.394***
	(0.754)	(0.550)
Year Fixed Effects	YES	YES
Month Fixed Effects	YES	YES
Observations	102,879	105,246
R-squared	0.103	0.133

Number of HHID	64,897	65,990
Standard errors in parentheses		
***** p<0.01, ** p<0.05, * p<0.1**		

Table 11c**: Regressions using three exposure (trimesters) measures with mother fixed effects**

VARIABLES	HAZ (MFE)	WAZ (MFE)
First trimester	-0.105***	-0.00524
	(0.0293)	(0.0213)
Second trimester	-0.153***	-0.0220
	(0.0353)	(0.0257)
Third trimester	0.00109	-0.0151
	(0.0295)	(0.0215)
2.BO	-0.537***	-0.329***
	(0.0246)	(0.0179)
3.BO	-1.002***	-0.585***
	(0.0378)	(0.0275)
4.BO	-1.373***	-0.820***
	(0.0506)	(0.0368)
5.BO	-1.799***	-1.089***
	(0.0648)	(0.0472)
childgender	-0.0344**	-0.0414***
	(0.0140)	(0.0102)
childageM	-0.00915	0.0328***
	(0.00911)	(0.00663)
childageMsqu	0.000907***	0.000902***
	(4.23e-05)	(3.08e-05)
ageatchildbirth	0.216***	0.112***
	(0.0529)	(0.0385)
ageatchildbirthsqu	-0.00401***	-0.00254***
	(0.000414)	(0.000301)
Constant	-8.076***	-9.940***
	(1.382)	(1.006)
Year Fixed Effects	YES	YES
Month Fixed Effects	YES	YES
Observations	102,879	105,246

R-squared	0.114	0.144
Number of MOMIDfinal	69,604	70,823
Standard errors in parentheses		
***** p<0.01, ** p<0.05, * p<0.1**		