Title
The Impact of Adequate Prenatal Care in a Developing Country: testing the WHO recommendations

Author
Gajate Garrido, Gissele

Publication Date
2009-06-01

California Center for Population Research
University of California - Los Angeles

The Impact of Adequate Prenatal Care in a Developing Country: testing the WHO recommendations

Gissele Gajate Garrido

CCPR-2009-014

June 2009
Last Revised: June 2009

California Center for Population Research
On-Line Working Paper Series

The Impact of Adequate Prenatal Care in a Developing Country: testing the WHO recommendations

Gissele Gajate Garrido
University of California, Los Angeles

March, 2009

THE IMPACT OF ADEQUATE PRENATAL CARE IN A DEVELOPING COUNTRY: TESTING THE WHO RECOMMENDATIONS

Abstract

Deficient birth outcomes entail greater mortality risks, and higher probabilities of poor future health. This study is the first statistical examination of the effect of the World Health Organization's recommended number of prenatal care visits for developing countries on birth outcomes. This study accounts for the endogenous nature of prenatal care decisions by using an instrumental variables approach based on the accessibility of prenatal services. Using the CLHN Survey I construct a measure of prenatal care which involves both timing and intensity and that shows positive impacts for the combination of both. The results are highly robust to changes in measures of birth outcome but are only significant for urban areas. The lack of impact on rural areas could be due to the inferior quality of prenatal care services received there. This theory is corroborated when controlling directly for care quality.

I. Introduction

Over 20 million children worldwide are born with low birth weight (less than 2500 grams at birth). This represents 16% of all new born babies, of which 96% are born in developing countries. The percent of low birth weight deliveries in developing countries (17%) is more than double that in developed countries (7%)[1]. Low birth weight babies face greater mortality risk (Bahn et. al. 1985; Morris et. al. 1998) and are more likely to be neglected by caregivers (Zeskind & Ramey 1978; Zeskind & Lester 1981). The survivors have higher probabilities of retarded motor development, neurological impairment and chronic illness (Adair 1989, 1997; Barker 1995, 2007; Barker et. al. 1989; De Boo et. al 2006) and lower IQ, worse labor force and educational outcomes, and even pregnancy complications (Black et. al. 2007, Oreopoulos et. al. 2008, Royer 2009). Poor birth outcomes can therefore impose high health care costs on societies (Almond et al. 2005) and hinder a country's economic development due to the potential loss of human capital (Currie et. al. 1999; Glewwe et. al., 1995, 2001; Maluccio et. al. 2006; Walker 2005). Accordingly, one of the major goals in the Declaration of the Plan of Action adopted by the United Nations General Assembly Special Session on Children in 2002 is the reduction of low birth weight incidence by a third between 2000 and 2010.

Prenatal care is one of the most popular public health interventions aimed at improving birth outcomes. It has been extensively studied in industrialized countries (e.g. Warner 1995; Liu 1998; Rous et. al.; Smith Conway et. al. 2004; Lin 2004; Krueger and Scholl 2000). Nevertheless, there is no consensus about its impact on birth outcomes. Studies for developing countries have been scarce because of the lack of reliable data on birth outcomes,

[1] WHO. 2008. "World Health Statistics 2008." WHO

but these show inconsistent results as well. For example, Guilkey et. al. (1989) found both positive and negative effects on birth weight depending on geographical area, type of provider and facility where the care was supplied. Using data from Mexico, Deb and Sosa-Rubi (2005) found that early initiation of prenatal care had no impact on birth weight, while the number of visits (defined as the quality of care) had a large and positive effect.

This study is the first statistical examination of the effect on birth outcomes of the World Health Organization (WHO) recommended number of prenatal care visits for developing countries. By and large prenatal care has been analyzed from a developed country's perspective. This implies using as the standard the expected number of visits recommended by the American College of Obstetricians and Gynecologists (ACOG). This standard is not viable in a developing country context. A more realistic set of recommendations has been developed by the WHO (Berg 1995). By utilizing this definition of adequate care in a developing country setting this study is able to provide more suitable estimates of the impact of this type of care on birth outcomes.

One of the difficulties faced by researchers in estimating the impact of prenatal care is the endogenous nature of prenatal care practices. The utilization of prenatal care is determined by unobserved variables such as the mother's health or her preferences that may also affect birth outcomes. This will lead to biased estimates. The majority of studies have therefore employed instrumental variables techniques, in which the instruments are the availability of medical services in the mother's area of residence. This choice of instrument is controversial because mothers may migrate to certain regions because of their health or their preferences (Rosenzweig and Shultz 1982). Consequently, the availability of prenatal care services will be correlated with the mother's economic status and her personal endowment or preferences. These unobserved maternal preferences might influence birth outcomes. This is a particularly acute problem in developing countries where the availability of health services is highly correlated with the living standards in the mother's residence area.

This paper accounts for the endogenous nature of the mother's decision to seek prenatal care by using accumulated rainfall shocks during the mother's pregnancy as a source of exogenous variation. This instrument is not related to the availability of health services but to the opportunity cost and feasibility of accessing those services in a country where road conditions are poor. In addition, this paper will attempt to control for the quality of the service provided.

This study is based on the Cebu Longitudinal Health and Nutrition Survey (CLHNS). This survey is part of an ongoing study of a cohort of Filipino women who gave birth between 1983 and 1984. The incidence of low birth weight in the Philippines was and remains very high (20%), thus it is a very relevant country for this study. The CLHNS is a rich source of data with detailed information on the type of prenatal care, the birth outcome of the child and important maternal health markers in addition to demographic and socioeconomic indicators.

II. Determinants of Birth Weight

In the early stages of pregnancy growth is determined by the fetal genome. After the initial phase of embryonic development has taken place fetal growth will be restricted by maternal and environmental factors. Any factors that prevent normal circulation across the placenta or deprive the fetus of the necessary nutrients and level of oxygen will cause growth restrictions. Specifically, birth weight will depend on (i) fetal factors such as congenital anomalies and genetic features; (ii) maternal factors such as nutrition, chronic illnesses, infection, substance abuse, smoking and maternal fitness and size; and (iii) factors involving the placenta and uterus such as detachment. In developing countries higher levels of malnutrition before and during pregnancy, acute and chronic maternal infections, and poor maternal health are the primary causes of low birth weight (Moreira 2002).[2]

Intrauterine growth restriction leads not only to low birth weight but also to poor organ development and babies which are small for their gestational age (SGA). These babies are below the 10th percentile on the intrauterine growth chart[3] for a specific sex and gestational age. They will face higher mortality risks and could be found on a pathological state. The birth outcome variable I will focus on is birth weight, which could be caused by prematurity, not intrauterine growth restriction. However, as I will show later, I obtain similar conclusions when I examine the effect of prenatal care on the probability of being small for gestational age or of having a low birth weight (weighing less than 2500 grams at birth).

Prenatal care (defined as the medical attention received from the time of conception up to, but not including, labor and delivery) could positively influence birth outcomes through three main channels: 1) behavioral (elimination of harmful habits such as smoking); 2) nutritional (improvement of mother's nutritional intake); and 3) medical (reduction of morbidity risks) (Alexander and Korenbrot 1995). Prenatal care's goal according to Cynthia Berg's 1995 Report on Prenatal Care in Developing Countries consists of four basic components: (i) early detection of pregnant women at risk of any potential complications; (ii) action in order to prevent any future difficulties; (iii) diagnosis and treatment of preexisting medical conditions and (iv) prompt referral to the appropriate specialist when complications develop during pregnancy.

Basic prenatal care ensures adequate nutrition and vitamin intake, proper vaccination, exercise, negative behavioral modification and, when necessary, bed rest. Vitamins and minerals help repair and maintain cells and tissues. For example, iron tablets help prevent iron deficiency anemia which could make pregnant women feel weak, tired and dizzy. This

---

[2] In contrast, in developed countries the main factors restricting intrauterine growth are related to either preeclampsia or harmful maternal behaviors such as smoking and drug or alcohol abuse.

[3] For this study the standard used was the one found provided by the Public Health Agency of Canada. The Canadian Perinatal Surveillance System (CPSS) developed a population-based Canadian reference for birth weight for gestational age, which included data on all singleton infants born in Canada (with the exception of the province of Ontario) between 1994 and 1996 at 22 to 43 weeks gestation, comprising 347,570 males and 329,035 female infants.

deficiency could lead to increased risk of preterm delivery and infant low birth weight[4]. Iodine capsules are given to prevent cognitive damage from insufficient maternal thyroid hormone (Lamberg 1991). Receiving at least 400 micrograms of folic acid every day helps prevent many types of neural tube defects. Tetanus toxoid injections are given during pregnancy in order to prevent neonatal tetanus, a frequent cause of infant deaths in developing countries. This infection is acquired due to limited or absent clean delivery services (when sterile procedures are not observed in cutting the umbilical cord). According to the WHO once the disease is contracted the fatality rate can be as high as 100% without hospital care and between 10 to 60% with hospital care.

Prenatal care can detect serious conditions than can affect both the mother's and the baby's health. These include gestational diabetes, preeclampsia (also called toxemia of pregnancy) and Rh incompatibility. According to the American College of Obstetricians and Gynecologists (ACOG) women with uncomplicated pregnancies should visit their prenatal care provider every 4 weeks until the 28th week of pregnancy, then every 2 weeks until 36 weeks and then once a week until delivery.

The ACOG standard is not viable in a developing country context. A more realistic set of recommendations has been developed by the WHO in the recent past (Berg 1995). In 1995, the World Health Organization Technical Working Group on Antenatal Care established four as the minimum number of prenatal care visits for women without identified problems. These visits should be provided by skilled health personnel and completed at specified times during the pregnancy: one at 16 weeks, one at 24-28 weeks, one at 32 weeks and one at 36-38 weeks. During those visits physical examinations are performed. They should consist of the following procedures: collection of maternal medical history, anthropometric measurements, assessment of fetal heart sounds, a blood pressure check up, a pelvic exam, and blood and urine tests. Finally, a delivery plan should be formed especially if the birth is going to be a breech or transverse. The impact of prenatal care will then depend not just on the mere occurrence of a visit but on the quantity and quality of the procedures performed.

This premise is supported by the historic trend of prenatal care and birth weights for the Philippines. The percentage of women aged 15-49 years examined at least once by a skilled health provider during pregnancy has been quite high and constant in recent years. In 1993, this number border 83%, rising to 86% in 1998, staying at that level during 2000 and increasing again in 2003 to 88%[5]. In contrast, the proportion of women who attended at least four antenatal visits provided by skilled health personnel has been decreasing during this period[6]. During the nineties adequate antenatal care coverage, as defined by the WHO, bordered on 77%. This percentage decline to 70% between 1999 and 2000 and for the year 2006 dropped to 59.5%[7]. The opposite trend has been experienced by birth weight in this time

---

[4] See Rasmussen and Stoltzfus (2003) and Scholl and Reilly (2000)

[5] Data collected from the Demographic and Health Surveys (Department of Health, National Statistics Office in the Philippines)

[6] UNICEF and WHO.(2004)

[7] This last statistic was obtained from the Field Health Services Information System Annual Report 2006 published by the National Epidemiology Center in the Philippines.

period. In 1993, 17.9% of infants were born with a low birth weight[8]. By the year 1998 this percentage was slightly reduced to 17.2%[9]. Yet between 1999 and 2006 this figure reached 20%[10]. While the level of standard prenatal care (defined as at least one visit to a care provider) has actually been increasing, both adequate prenatal care and adequate levels of birth weight have declined. This could indicate that birth weight can only be improved by providing women with an adequate level of care and not just by simply going once to a care provider during pregnancy.

The reasons women seek prenatal care are not always easy to observe and much less to measure, e.g. the health endowment of the mother and baby, chronic conditions, maternal moral values, childhood experiences, ability and personal motivation. These characteristics could be simultaneously determining the child's birth outcome (Rosenzweig et. al. 1982, 1983; Joyce 1994). Three different selection processes can bias the observed relationship between prenatal care use and birth outcome[11].

Favorable selection will occur if the women who exhibit all kinds of positive health behaviors (and are therefore at lower risk for a low birth weight) are also more likely to initiate prenatal care early and to maintain a regular schedule of visits. These health-conscious women will probably influence the impact of their prenatal care visits by selecting high quality providers and firmly adhering to their advice. Consequently, positive birth outcomes will be a function not only of prenatal care adequacy but in addition of these health-promoting behaviors and attitudes. This could potentially lead to a positive bias on estimates of prenatal care adequacy (Frick and Lantz 1996; Alexander and Korenbrot 1995).

Adverse selection will occur if women who are aware of their own poor health endowments (and have a higher probability of a negative birth outcome) are the more intensive users of prenatal care services. These women realize that their own negative health behaviors or their chronic health conditions will lead to a less healthy child and therefore seek prenatal care earlier and more frequently. This kind of selection will lead to underestimates of the impact of prenatal care on birth outcome. This selection process has been the most discussed in the literature (Frick and Lantz 1996; Grossman and Joyce 1990; Harris 1982).

The final selection mechanism, confidence selection, occurs when women who experience uneventful pregnancies consider themselves to be at a very low risk of having a poor birth outcome. These women may delay care and only have sporadic checkups. Nevertheless, they will probably experience positive birth outcomes. This type of selection will have the same effect as adverse selection since it will also bias the estimates of prenatal care services downwards (Frick and Lantz 1996).

---

[8] Blanc, Ann B; Wardlaw, Tessa "Monitoring Low Birth Weight: an evaluation of international estimates and an updated estimation procedure" 2005 Bulletin of the World Health Organization, 83(3)
[9] Idem
[10] UNICEF "The State of the World's Children 2008" 2008 UNICEF.
[11] This classification follows Frick and Lantz (1996) study.

III. Modeling and Estimation

1. The Theoretical Model

I focus on the effect of prenatal care practices on birth outcomes using a microeconomic approach. I base my analysis on the framework provided by Rosenzweig and Schultz 1982. I consider the level of utilization of prenatal care to be a choice that results from the household's efforts to maximize its utility, which is based in part on its child's birth outcome. The parents are assumed to choose leisure *L*, and consumption *C* of goods and services, in order to maximize their utility. *C* is desired for its own sake and has no impact on the child's birth outcome. Birth outcome is determined by health inputs, which do not provide any direct utility to the household. The H^{th} household preferences are represented by the following additive utility function:

$$U_t^H(\cdot) = E_0\left[\sum_{t=0}^{T} \beta^t U^H\left(C_t^F, L_t^F, C_t^M, L_t^M, B_t^c\right)\right]$$

where B_t^c is the child's birth outcome, C_t is parents' personal consumption and L_t is parent's leisure time. The child's birth outcome has the following production function:

$$B_t^c = F\left(P_t, T_t^{nM}, V_t^n, X_t^{\ c}, X_t^F, X_t^M, X_t^{\ A}, \mu_t\right)$$

Birth outcome is a result of the prenatal care choice (P_t), the time the mother invested to produce a better outcome (T_t^{nM} e.g. time used to boil water), the goods purchased to produce a better outcome (V_t^n e.g. vitamins), fetal characteristics such as gender (X_t^c), parental characteristics (X_t^F and X_t^M) such as mother's height, community characteristics (X_t^A) including access to health and sanitary facilities and unobserved attributes related to both the mother and the fetus (μ_t). These include maternal health endowment, initiative and preferences for child health as well as fetal congenital anomalies.

The decision maker maximizes household welfare, subject to a financial constraint, and the parents' time-constraints. Assuming negligible savings we have:

$$p_t\left(C_t^F + C_t^M\right) + p_t^n V_t^n + p_t^P V_t^P = \left(T_t^{LF}\right)w_t^F + \left(T_t^{LM}\right)w_t^M + Y_t^H$$

This financial constraint shows that the parental expenditure on consumption goods, health inputs and prenatal care services depends on their prices (p_t, p_t^n, p_t^p, respectively) as well as on the household earnings. These earnings are determined by the amount of parental time spent working in the labor market (T_t^{LF} and T_t^{LM}), the wage paid to the parents (w_t^F and w_t^M) and the amount of unearned income hold by the household. As well, the parent's are constrained by the amount of time available to them.

$$T_t^F = T_t^{LF} + L_t^F$$
$$T_t^M = T_t^{LM} + T_t^{nM} + L_t^M$$

Maximizing household welfare subject to these constraints implies that the child's birth outcome depends on the price for the consumption good, health inputs and prenatal care services, as well as on wage rates for parents, unearned income, fetal characteristics, parents-specific characteristics, community-specific characteristics, and a vector summarizing all unobservable characteristics.

$$B_t^c = \Phi\left(p_t, p_t^n, p_t^P, w_t^F, w_t^M, Y_t^H, X_t^c, X_t^F, X_t^M, X_t^A, \mu_t\right)$$

Similarly, the decision to seek prenatal care will depend on all these variables.

$$P_t^{type} = \Psi\left(p_t, p_t^n, p_t^P, w_t^F, w_t^M, Y_t^H, X_t^c, X_t^F, X_t^M, X_t^A, \mu_t\right)$$

This model takes account of the fact that prenatal care utilization will fall as its price rises. Large distances to providers, waiting times, transportation problems and so on, can all be interpreted as things that raise the "price" of prenatal care utilization.

The observed relationship between the birth outcome B_t^c and the choice of prenatal care choice P_t in a heterogeneous (in μ_t) population is:

$$\frac{dB_t^c}{dP_t} = F_p + F_\mu \frac{d\mu_t}{dP_t}$$

That is, what is observed in the population is not the real technical relationship between prenatal care and birth outcome. There is an additional component ($F_\mu * d\mu_t/dP_t$) which will differ from zero if prenatal care is correlated in any way with the unobserved maternal or fetal characteristics. Because many different selection processes that could be biasing this relation, the sign of this bias is not known a priori to the researcher.

2. Empirical approach

The goal of this paper is to obtain unbiased estimates of the effect of prenatal care adequacy on the child's birth outcome. I therefore use an instrumental variables strategy where my instrument is the accumulated abnormal levels of rainfall during the mother's pregnancy until the point of the interview. The timing of the pregnancy generates the instrument's variability. Women who were pregnant at different points in time will have different levels of accumulated rainfall shocks. Because of poor road conditions in Cebu, rainfall affects the mother's time availability to seek prenatal care by raising her commuting time. However, this variable arguably does not directly affect birth outcomes.

In order to avoid conditional endogeneity issues in the estimation of the impact of prenatal care on the child's birth outcome it is necessary to include a set covariates that are likely to be correlated with both prenatal care and child's birth outcome. This set of covariates include: mother's height and childbearing history[12] as well as child's gender. Similarly, factors shaping maternal behaviors such as age and education are included. Finally, maternal health and nutritional status, as well as time constraints, represented by having a job or an unemployed husband, are taken into account. In addition, there are controls for community of residence and elevation levels (See Appendix 1 for further detail). It must be noted that there are other endogenous variables in the birth outcome equation. These include gestation period, negative health behaviors such as smoking and number of live births. Nevertheless, in this study we will only instrumentalize for prenatal care adequacy. In this sense, all the other variables will be treated as exogenous.

3. Specification

For my analysis I estimate a Two-Stage Least Squares model in which the endogenous variable is first regressed on the instrument (and all the other exogenous variables in the model). In the "second stage", the model of interest is estimated including the predicted value of the endogenous variable derived from the first stage and adjusting the standard errors appropriately. Given that the instrument is uncorrelated with the omitted variable (e.g. mother's health endowment) the predicted value of the endogenous variable will also be uncorrelated with them so that the estimation is purged of the bias that results from these omitted variables. Specifically I estimate the following model:

First Stage

$$P_t = \theta_0 + \theta_1 X_t^{\,c} + \theta_2 X_t^{\,F} + \theta_3 X_t^{\,M} + \theta_4 X_t^{\,A} + \theta_5 Z_t + \upsilon_t$$

where Z_t is the accumulated rainfall shocks, which represent the increase in the time and difficulty to access prenatal care services.

Second Stage

$$B_t^c = \beta_0 + \beta_1 P_t + \beta_2 X_t^{\,c} + \beta_3 X_t^{\,F} + \beta_4 X_t^{\,M} + \beta_5 X_t^{\,A} + \mu_t \qquad (1)$$

In this model, the dependent variable is birth outcome. The set of covariates used to estimate the child's nutritional level consist of subsets of variables: those that are child-specific; those that are parent—specific, those that are community specific. The independent variable of interest is prenatal care utilization choice. The error term captures the influence of all unobserved variables on birth outcome. Finally, it should be stated that I will be unable to separate maternal or household preferences from maternal technology since I am using a household production function to calculate these conditional demand functions.

[12] This includes number of previous miscarriages and a dummy equal to one for first time mothers.

IV. Data

1. The Design of the Cebu Study

The Cebu Longitudinal Health and Nutrition Survey (CLHNS) is part of an ongoing study of a cohort of Filipino women who gave birth between May 1, 1983 and April 30, 1984. A single stage cluster sampling procedure was used to randomly select 33 communities or Barangays (17 urban, 16 rural) from the Metropolitan Cebu area. In this study the analysis is divided between urban and rural Barangays due to the differences in prenatal care and birth outcomes between these two areas[13].

A baseline interview was conducted among 2,555 urban and 772 rural women during the 6th to 7th month of pregnancy so that all births could be identified. A subsequent survey took place immediately after birth. From the total sample 135 women were lost due to migration[14], 17 withdraw form the study, 16 were dropped due to erroneous information, 26 women had twin births and 53 suffered miscarriages[15] or had a stillbirth[16]. Where necessary, the questionnaires were supplemented by observations (e.g. of sanitary conditions). In addition community data were collected during the baseline survey. Data on birth weight, gestational age and the adequacy of prenatal care was available for around 2,300 babies in urban areas and 707 in rural ones. This is the number of observations used in the regressions. This sample size is further reduced to 1749 and 541 babies, respectively, if we only analyze full term pregnancies.

2. The birth outcome measure

Biologically speaking, birth weight is a function of both fetal growth rate and gestational age. This means that if we compare birth weights for babies with different amounts of time spent in the uterus we will be confounding fetal growth rate with gestation. A solution to this problem is to only analyze the birth weight of full term babies[17]. This is the first type of analysis performed. This is a valid comparison since during the last few weeks of gestation the fetus does not grow anymore. This time is used for the organs to mature.

In order to be able to compare fetal growth rates for babies with different gestation periods, gestational age has to be controlled for. This cannot simply be done by including gestational age as an additional explanatory variable in a linear regression of birth weight. Such linear

---

[13] See Section V: Results

[14] Following The Cebu Study Team (1991) it can be argued that mothers with certain characteristics are more likely to be lost to the sample than others. This means, the sample could be reduced in a non random way. In order to correct for this self-selection bias it is necessary to apply Heckman's two stage procedure. This introduces a "correction factor" (Mills' ratio) which increases as the probability of leaving the sample increases. This correction was performed but the mills ratio was found to be not significant so no correction was needed.

[15] The possible existence of a selection bias due to the absence of the mothers that suffered miscarriages will be discussed in the Robustness Checks section of this paper.

[16] Source: Cebu Longitudinal Health and Nutrition Survey (CLHNS)

[17] This implies the baby has been in the uterus more than 36 weeks (approximately nine months).

specification will fail to correct for the non linear biological-technical relationship between birth weight and gestation. The two additional methodologies employed in this paper to remove the systematic effect of gestation are the ones provided by Rosenzweig and Schultz (1982) and Warner (1998). Both methods entail estimating birth weight as a cubic function of gestation. However, Rosenzweig and Schultz standardize it by dividing observed birth weight by predicted birth weight. In contrast, Warner adds to the observed birth weight the difference between the predicted birth weight at 40 weeks and the predicted birth weight at the observed gestation[18].

3. The prenatal care services measure

Measuring the adequacy of prenatal care has been a challenge for researchers since the variables usually employed (e.g. number of visits, time of care initiation, provider type) are unable to simultaneously control for when the care begun, when it ended and exactly at what point of the pregnancy it took place. In order to address these issues I use the recommendations developed by the World Health Organization Technical Working Group on Antenatal Care as the standard for adequate prenatal care in a developing country. This measure is implicitly adjusted for the gestational age at initiation of care and at delivery. Given the characteristics of the data this measurement will be adjusted not for gestational age at delivery but for gestational age at interview. This means that the measurement used describes the adequacy of prenatal care services received during the time period after prenatal care started and until the interview took place. 58% of the sample women where interviewed between the beginning of their 6th and the end of their 7th month of pregnancy. Thus this dummy will be measuring the impact of the adequacy of prenatal care visits completed until the beginning of the 3rd trimester.

4. The instrument chosen: accumulated rainfall shocks

This variable was constructed using information from the Mactan- Cebu International Airport Weather Station, located in the heart of Metro Cebu. This is a highly relevant location since the sample used in this study comes from communities located at the Metropolitan Cebu area. Rainfall shocks, defined as the monthly level of rainfall level minus a ten year rainfall average for that month reflect the unexpected increase in rainfall levels. These shocks increase commuting times and so affect the mother's time availability to seek prenatal care[19]. Even to this day roads are made impassable by floodwaters during the peak of the monsoon season (see Appendix 2). Heavy rains in addition, generate landslides and car accidents which further complicate access. Rain is a particularly pertinent phenomenon in Cebu due to the quality of the roads and the types of transportation means available at the time.

---

[18] A shortcoming of this last method is that for extremely preterm babies the adjustment might be bigger than the actual birth weight. This is not a concern for this study since extremely preterm births account for less than 0.15% of the sample used.

[19] This is especially true for this sample where almost 99% of pregnant women left their home to attend their prenatal care appointments.

Road conditions in Cebu were poor in both rural and urban areas. In rural areas, only 2% of Barangays had concrete roads, almost 20% had asphalt roads, 18% had gravel roads and a predominant 75% had dirt roads. Furthermore, less than 1% of the total extent of roads was made of concrete, less than 9% were asphalted, 6% were gravel roads and almost 85% were dirt roads. On top of this, over 91% of the span of roads was in fair to poor condition. Even in urban areas a considerable percentage of total road surfaces were made of gravel or dirt. Eight percent of total road spans were made of concrete, over 56% were asphalted, 25% were gravel roads and 10% where dirt roads. Yet with the exception of concrete roads, all other surfaces were not maintained properly.

Sixty percent of urban and 52% or rural women walked the whole distance to the health facility where they received prenatal care, while 77% and 80%, respectively, walked at least a portion of this distance. Only 23% of urban households and 16% of rural homes owned some means of transportation. The type of transportation most of these households owned was either a bicycle (74% in urban areas and 47% in rural ones) or a boat (11% in urban areas and 31% in rural ones)[20]. Finally, tricycles were the predominant type of public transportation available in both areas. For all these transportation means rain will be most burdensome.

V. Results

1. Differences in quality of care between urban and rural areas

The sample is separated into urban and rural households due to practical differences in the nature of prenatal care as well as in behavior and outcomes between these areas. Table 1 illustrates these differences and shows how outcomes are modified when I only consider the sample of women that received adequate prenatal care.

Table 1
Descriptive Statistics

	Urban areas		**Rural Areas**	
Behavior	**Mean**	**S.D.**	**Mean**	**S.D.**
Percentage of women that attended a PCP	73%	44%	52%	50%
Percentage of women that attended a healer	47%	50%	58%	49%
Percentage of women that attended exclusively a healer	17%	37%	31%	46%
Woman took vitamins/minerals	62%	49%	45%	50%
Woman received an antitetanus injection	21%	41%	14%	34%
Percentage of women with APC	41%	49%	31%	46%

[20] Less than 4% of the sample owns a car or a tricycle.

	Urban areas		Rural Areas	
Birth outcome	**Mean**	**S.D.**	**Mean**	**S.D.**
Birth weight (in grams)	3,015	453	2,927	416
Probability of LBW	11%	31%	15%	36%
Probability of being SGA	17%	37%	20%	40%
Birth weight (in grams) if APC received	3,050	452	2,918	407
Probability of LBW if APC received	10%	30%	16%	36%
Probability of being SGA if APC received	14%	34%	20%	40%
Birth weight (in grams) if no APC received	2,986	452	2,931	420
Probability of LBW if no APC received	12%	32%	15%	35%
Probability of being SGA if no APC received	20%	40%	21%	41%

Note: PCP = Professional Care Provider and APC = Adequate Prenatal Care, SGA= Small for Gestational Age, LBW = low birth weight
Source: CLHNS

If we restrict the sample to the women that received adequate prenatal care birth, outcomes improve in urban areas and worsen in rural ones. This could be an indication of a strong adverse selection effect in rural areas. In addition, when adequate levels of prenatal care were sought in rural areas the variance in birth weight declines. The normal distribution of birth weight is much more compact and no outliers are found. When this is not the case this distribution expands and outliers appear at both extremes of the distribution. It appears that in rural areas the contribution of an adequate level of prenatal care will not be necessarily a higher birth weight, but may be just a reduction in its variability. The inexistent positive effect of prenatal care in rural areas could be due to a lack of quality in this service.

The quality of care provided by health professionals[21] differs drastically between urban and rural regions. In their 1989 paper about prenatal care in Cebu Guilkey et. al. state the following: *"There may be important differences in the availability of supplies and midwives, for example, in urban and rural BHS's (Barangay Health Stations), which our data are not detailed enough to allow us to control. In theory, all BHS's are staffed by a full-time midwife, supervised and supplied by the Ministry of Health's rural health units or city health offices. From observation and discussion we know that urban BHS's often have better supplies and more equipment (e.g., they are more likely to have weighing scales) and are more likely to have their midwives available."*

The percentage of births attended by skilled health personnel is another proxy for the quality of services provided. In 2003, 79% of births in urban areas where attended by skilled health personnel, in contrast to 40.8% in rural areas (World Health Statistics 2008). It is reasonable to presume that at that time the differences were even more dramatic.

[21] Health professionals include doctors, nurses or registered midwives working in a public hospital or private clinic.

In rural areas women seek exclusively prenatal care from traditional care providers much more frequently (31% compared to 16% in urban areas). Moreover, of women seeking traditional care none exclusively, only 45% complement it with professional care in rural areas in contrast to 64% in urban ones. This may reflect a greater preference for traditional norms regarding prenatal care practices, or the lesser availability of professional health providers. The traditional "doctors" are the Mananambals and Mananabangs. The former is considered the local healer and the latter is the traditional birth attendant. Both use primarily herbs and incantations in their practice (Lieban 1995). Consequently, it is arguable that additional visits to these prenatal care providers would improve birth outcomes. Furthermore, when comparing the content of prenatal care visits between professional health providers and traditional healers the differences are striking. Of the women that sought professional prenatal care 25% received antitetanus injections in rural areas in contrast to 29% in urban ones, while over 89% were told that they should take vitamins and minerals in rural areas compared to 94% in urban communities. None of the women that exclusively visit a Mananambal or Mananabang received antitetanus injections.

According to the "National Demographic and Health Survey 1998"[22], women are receiving at least iron, iodine and tetanus immunizations during prenatal care visits. In this sample women that received adequate prenatal care as described by Berg (1995) have a higher probability of taking these vitamins during their pregnancy and of getting immunized. This is true for both urban and rural areas. Similarly, they have a higher probability of going to a hospital if they had complications during the delivery as it can see in Table 2. It could be possible that adequate prenatal care is impacting birth outcomes by improving the chances of a woman of receiving vitamins or of being immunized.

Table 2
Increase in the probability of the outcome for women that received the adequate number of prenatal care visits

Outcome	Urban areas	Rural Areas
Taking vitamins during the pregnancy	43.8%	57.3%
Receiving an antitetanus injection	17.8%	22.5%
Going to a hospital if there is a complication	24.1%	15.5%

Note: These results where obtained by running simple probit regressions that showed the increase in the probability of these events happening for women that seek adequate levels of prenatal care. They are all marginal effects and are significant at a 1% level with exception of the impact in rural areas of receiving adequate prenatal care on the probability of going to a hospital if there is a complication.

2. The First Stage regressions

The estimates obtained in the first stage regression for each set of birth outcomes chosen are presented in Table 3.

[22] National Statistics Office in the Philippines

Table 3
First Stage Regression, Dependent Variable: Adequacy of Prenatal Care Services Received

	URBAN SAMPLE			RURAL SAMPLE		
Second Stage Variable:	**Birth weight Full term babies**	**Adjusted Birth weight[1]**	**Prob. of being LBW or SGA[2]**	**Birth weight Full term babies**	**Adjusted Birth weight[1]**	**Prob. of being LBW or SGA[2]**
Gestational age	-0.021		-0.007	-0.014		-0.008
	(0.009)**		(0.004)*	(0.015)		(0.007)
Age	0.009	0.009	0.008	0.004	0.004	0.004
	(0.003)***	(0.002)***	(0.002)***	(0.005)	(0.004)	(0.004)
Mother's height (cm)	0.002	0.003	0.003	-0.003	0.000	0.000
	(0.002)	(0.002)	(0.002)	(0.004)	(0.003)	(0.003)
Arm circumference	0.011	0.012	0.013	0.003	0.000	0.000
	(0.005)**	(0.004)***	(0.004)***	(0.010)	(0.008)	(0.008)
Sick past week	0.010	0.003	0.002	-0.021	0.017	0.017
	(0.025)	(0.022)	(0.022)	(0.044)	(0.037)	(0.037)
Pregnant for the 1st time	0.031	0.052	0.050	-0.015	0.033	0.033
	(0.041)	(0.035)	(0.035)	(0.076)	(0.061)	(0.061)
Num of children	-0.060	-0.055	-0.053	-0.019	-0.013	-0.013
	(0.009)***	(0.008)***	(0.008)***	(0.015)	(0.012)	(0.012)
Cumulative Rainfall shocks	***-0.003***	***-0.003***	***-0.003***	***-0.001***	***-0.003***	***-0.003***
	(0.001)***	***(0.001)******	***(0.001)******	***(0.002)***	***(0.002)****	***(0.001)*****
Other controls[3]	YES	YES	YES	YES	YES	YES
Sample size	1749	2300	2300	541	706	707
Partial R^2 of excluded instruments	**0.0046**	**0.0060**	**0.0062**	**0.0014**	**0.0052**	**0.0056**

Standard errors in parentheses * Significant at 10%; ** Significant at 5%; *** Significant at 1%
[1] Both methods of adjusting birth weight (Warner's and Rosenzweig and Schultz's) give the same first stage results.
[2]The regressions for having a Low Birth Weight (LBW) or a Small for Gestational Age (SGA) baby have practically identical coefficients. An average is shown.
[3] Previous miscarriage, smoked while pregnant, education level, employed mother, jobless father, average elevation above sea level and community fixed effects

The results obtained for both methods of adjusting birth weight (Rosenzweig and Schultz's and Warner's) are identical. Hence they are condensed in one single column (column 2 for urban areas and column 5 for rural areas). Similarly, the first stage regression for both the probability of having a low birth weight or of having a small for gestational age baby are practically identical and so only one set of results is presented (column 3 for urban areas and column 6 for rural one.)

The instrument seems to perform more than adequately in urban areas. In all cases, it is significant at a 1% level and it displays a negative effect on the adequacy of received prenatal care visits. An increase of one standard deviation in the level of accumulated rainfall shocks (10.7 mm) will decrease the probability of having an adequate level of prenatal care by 3.4% on average. This is consistent with the line of reasoning presented in the Modeling and Estimation section of this paper. In rural areas, the instrument also displays a negative sign and has a similar impact but it is not significant for full term births. This is probably due to the reduction in the sample size. For the other regressions increasing the level of accumulated rainfall shocks by one standard deviation (10.8 mm) reduces the probability of having adequate care by 3.2% on average. The coefficients are significant at least at a 10% level.

3. Conditional Demand Estimates

The estimates for conditional demand functions for birth weight can be found in Tables 4 and 5. I performed three types of estimations, one for each definition of birth weight: (i) birth weight of full term babies, (ii) Warner (1998) standardized measure of birth weight and (iii) Rosenzweig and Schultz (1982) standardized measure of birth weight. All three estimations are performed using the instrument (accumulated rain shocks) for one endogenous regressor (adequacy of prenatal care services). Controls for mothers with previous miscarriages, working mothers, unemployed fathers, maternal educational level, Barangay's elevation above sea level and community fixed effects were included.

The odd columns in Table 4 present the OLS estimates for urban areas, while the even columns show the IV results. According to the OLS regressions, for all definitions of birth weight, the adequacy of prenatal care services received during visits appears to have a positive effect on the outcome. In the case of full term babies going from not having the adequate level of prenatal care for a developing country to doing so will increase the baby's birth weight by 23 grams. Yet this coefficient is not significant. This result could indicate that the mechanism of confidence selection could be present in the case of full term babies biasing the results downwards. According to Warner's measure, changing the actual number of prenatal care visits to the required number of visits will increase birth weight by 36 grams. This result is significant at a 10% level. When Rosenzweig and Schultz's measure is used, increasing the number of actual visits to the expected amount leads to an increase in the ratio of observed birth weight to predicted birth weight of 0.012 points. This is the strongest result with a 5% level of significance.

Table 4
Urban Areas
Conditional Demand Function for Birth Weight

Dependent variable:	**Birth weight Full term babies**		**Adjusted Birth weight Warner 1998**		**Adjusted Birth weight Ros. and Sch. 1982**	
Explanatory variables	**OLS**	**IV[1]**	**OLS**	**IV[1]**	**OLS**	**IV[1]**
Adeq. # of Prenatal care visits	***23.415***	***1,018.59***	***35.725***	***1,011.09***	***0.012***	***0.334***
for a Developing Country	***(20.860)***	***(464.135)*****	***(18.497)****	***(354.116)******	***(0.006)*****	***(0.117)******
Gestational age	40.486	59.742				
	(7.560)***	(14.511)***				
Male	69.3	41.426	58.596	13.227	0.019	0.004
	(19.757)***	(32.531)	(17.559)***	(30.757)	(0.006)***	(0.010)
Age	1.178	-7.869	0.543	-7.932	0	-0.003
	(2.474)	(5.629)	(2.196)	(4.471)*	(0.001)	(0.001)*
Mother's height (cm)	15.107	13.333	15.048	12.207	0.005	0.004
	(1.974)***	(3.093)***	(1.776)***	(2.824)***	(0.001)***	(0.001)***
Arm circumference	19.283	6.776	24.483	10.994	0.008	0.004
	(4.204)***	(8.613)	(3.782)***	(7.431)	(0.001)***	(0.002)
Sick past week	-28.104	-30.312	-44.338	-39.094	-0.015	-0.014
	(21.869)	(33.038)	(19.429)**	(28.837)	(0.006)**	(0.010)
Mother smoked while pregnant	-48.635	7.805	-52.375	-13.408	-0.017	-0.005
	(31.998)	(54.994)	(27.889)*	(43.645)	(0.009)*	(0.014)
Pregnant for the 1st time	-73.506	-102.524	-117.127	-166.629	-0.04	-0.056
	(35.183)**	(54.816)*	(31.226)***	(49.596)***	(0.010)***	(0.016)***
Num of children	7.439	67.635	5.505	58.759	0.002	0.019
	(8.072)	(30.546)**	(7.126)	(21.977)***	(0.002)	(0.007)***
Other controls[2]	YES	YES	YES	YES	YES	YES
R-squared[3]	0.1456		0.1300		0.1296	
F-test for weak identification		**7.92**		**13.63**		**13.63**
Stock-Yogo weak ID test critical values[4]						
Actual size of 5% test > 10%		16.38		16.38		16.38
Actual size of 5% test > 15%		8.96		8.96		8.96
Actual size of 5% test > 20%		6.66		6.66		6.66

Standard errors in parentheses * Significant at 10%; ** Significant at 5%; *** Significant at 1%
[1] IV: accumulated abnormal levels of rainfall from conception to interview date.
[2] Previous miscarriage, education level, employed mother, jobless father and average elevation above sea level
[3] Stata's ivreg command suppresses the printing of an R2 on 2SLS/IV if the R2 is negative, which is to say, if the model sum of squares is negative.
[4] The critical value is a function of the number of instrumental variables and the desired maximal percentage we allow the actual size of the nominal 5% TSLS t test to exceed.

Table 5
Rural Areas
Conditional Demand Function for Birth Weight

Dependent variable:	**Birth weight Full term babies**		**Adjusted Birth weight Warner 1998**		**Adjusted Birth weight Ros. and Sch. 1982**	
Explanatory variables	**OLS**	**IV[1]**	**OLS**	**IV[1]**	**OLS**	**IV[1]**
Adeq. # of Prenatal care visits	***11.791***	***613.591***	***7.418***	***192.05***	***0.003***	***0.064***
for a Developing Country	***(38.360)***	***(1196.834)***	***(33.630)***	***(463.766)***	***(0.012)***	***(0.159)***
Gestational age	26.118	34.462				
	(12.583)**	(22.258)				
Male	57.725	30.57	66.897	62.886	0.023	0.021
	(33.539)*	(66.919)	(29.362)**	(30.979)**	(0.010)**	(0.011)**
Age	-3.202	-5.775	-4.149	-4.876	-0.001	-0.002
	(4.430)	(7.311)	(3.751)	(4.163)	(0.001)	(0.001)
Mother's height (cm)	8.475	10.258	8.512	8.534	0.003	0.003
	(3.463)**	(5.407)*	(2.961)***	(2.956)***	(0.001)***	(0.001)***
Arm circumference	40.817	38.196	38.29	37.973	0.013	0.013
	(8.153)***	(10.939)***	(7.348)***	(7.376)***	(0.003)***	(0.003)***
Sick past week	-50.047	-34.653	-62.104	-63.528	-0.022	-0.022
	(37.421)	(53.715)	(32.796)*	(32.923)*	(0.011)*	(0.011)**
Mother smoked while pregnant	-39.488	8.58	-25.807	-9.864	-0.008	-0.003
	(48.894)	(111.594)	(40.311)	(56.691)	(0.014)	(0.019)
Pregnant for the 1st time	-89.551	-80.975	-97.269	-103.181	-0.033	-0.035
	(65.566)	(79.214)	(54.995)*	(56.847)*	(0.019)*	(0.019)*
Num of children	8.823	20.364	17.861	20.433	0.007	0.007
	(13.211)	(27.732)	(10.934)	(12.673)	(0.004)*	(0.004)*
Other controls[2]	YES	YES	YES	YES	YES	YES
R-squared[3]	0.1478		0.1443		0.1447	
F-test for weak identification		**0.73**		**3.54**		**3.54**
Stock-Yogo weak ID test critical values[4]						
Actual size of 5% test > 10%		16.38		16.38		16.38
Actual size of 5% test > 15%		8.96		8.96		8.96
Actual size of 5% test > 20%		6.66		6.66		6.66

Standard errors in parentheses * Significant at 10%; ** Significant at 5%; *** Significant at 1%

[1] IV: accumulated abnormal levels of rainfall from conception to interview date.

[2] Previous miscarriage, education level, employed mother, jobless father and average elevation above sea level

[3] Stata's ivreg command suppresses the printing of an R2 on 2SLS/IV if the R2 is negative, which is to say, if the model sum of squares is negative.

[4] The critical value is a function of the number of instrumental variables and the desired maximal percentage we allow the actual size of the nominal 5% TSLS t test to exceed.

For all definitions of birth weight, receiving an adequate level of prenatal care in a rural area appears to have no statistically significant effect on this outcome. As it can be seen in Table 5, all the OLS coefficients appear to be much smaller in dimension, though they still display a positive sign. As OLS estimates are probably misleading due to the endogeneity of prenatal care practices two-stage least squares (2SLS) regressions are presented.

In urban areas the IV regressions show that an adequate level of prenatal care has a positive and statistically significant effect on all birth weight outcomes. This effect is much larger and much more significant than before. For full term babies, going from not having the adequate number of prenatal care visits to doing so increases the baby's birth weight by 1,019 grams. This represents one third of the average birth weight of these babies. Using Warner's measure the effect is very similar (1,011 grams). When employing Schultz's technique increasing the actual visits to the expected level leads to a raise in the ratio of observed birth weight to predicted birth weight of 0.334 points. In rural areas prenatal care appears not to matter at all. IV regressions show that having an adequate level of prenatal care has a positive effect. Coefficients are larger than OLS ones, but none of them are statistically significant. As previously pointed out these results could be related to the quality level of this service in rural areas.

A very important step in assessing the reliability of an instrumental variable is to test for its strength. Estimators can perform poorly when instruments are weak resulting in non-normal sampling distributions of IV statistics and unreliable standard IV point estimates, hypothesis tests, and confidence intervals[23]. . In Tables 4 through 7 statistical tests were performed using the first-stage F statistic. The null hypothesis is that the instruments are weak. For the estimations using adjusted birth weight as the dependent variable the F statistic ensures that a 5% hypothesis test rejects no more than 15% of the time in urban areas (Table 4). This fits the definition of a strong instrument according to Stock, Wright and Yogo (2002). For the model using birth weight for full term births a 5% hypothesis test rejects no more than 20% of the time. In rural areas, none of the specifications is able to ensure that a 5% hypothesis test rejects no more than even 25% of the time (Table 5).

4. Probit models for deficient Birth outcomes

Tables 6 and 7 contain Probit models for deficient birth outcomes: (i) being small for gestational age (SGA) or (ii) having a low birth weight. These regressions provide an appropriate robustness check for the previous results. All estimations are performed using accumulated rainfall shocks as an instrument and all the controls mentioned before. Odd columns show Probit estimates, while the even ones contain marginal effects for IVPROBIT estimations.

---

[23] A set of instruments is defined as being weak if the concentration parameter is small enough that inferences based on conventional normal approximating distributions are misleading. The concentration parameter is a unit less measure of the strength of the instruments (Stock, Wright and Yogo, 2002). One measure of whether a set of instruments is strong is whether the concentration parameter is sufficiently large.

Table 6
Urban Areas
Probit models for deficient Birth outcomes: Marginal effects

Dependent variable:	**Probability of being a SGA baby**		**Probability of being a LBW baby**	
Explanatory variables	**PROBIT**	**IVPROBIT[1]**	**PROBIT**	**IVPROBIT[1]**
Adeq. # of Prenatal care visits for a Developing Country	***-0.015***	***-0.485***	***-0.017***	***-0.344***
	(0.012)	***(0.117)****	***(0.013)***	***(0.181)****
Gestational age	0.065	0.065	-0.019	-0.023
	(0.003)***	(0.010)***	(0.002)***	(0.003)***
Male	0.035	0.061	-0.01	0.004
	(0.011)***	(0.016)***	(0.012)	(0.018)
Age	-0.001	0.003	0.001	0.004
	(0.001)	(0.002)	(0.002)	(0.003)*
Mother's height (cm)	-0.006	-0.005	-0.008	-0.008
	(0.001)***	(0.002)**	(0.001)***	(0.002)**
Arm circumference	-0.008	-0.001	-0.014	-0.0104
	(0.003)***	(0.005)	(0.003)***	(0.005)
Sick past week	0.001	-0.002	0.017	0.0168
	(0.013)	(0.018)	(0.014)	(0.017)
Mother smoked while pregnant	0.027	0.005	0.015	0.0016
	(0.021)	(0.027)	(0.020)	(0.025)
Pregnant for the 1st time	0.048	0.073	0.073	0.094
	(0.025)*	(0.031)**	(0.028)***	(0.033)***
Num of children	0.003	-0.025	-0.001	-0.020
	(0.005)	(0.011)***	(0.005)	(0.013)**
Other controls[2]	YES	YES	YES	YES
Pseudo R-squared	0.2345		0.1332	
F-test for weak identification		**14.07**		**14.07**
Stock-Yogo weak ID test critical values[3]				
Actual size of 5% test > 10%		16.38		16.38
Actual size of 5% test > 15%		8.96		8.96
Actual size of 5% test > 20%		6.66		6.66

Standard errors in parentheses * Significant at 10%; ** Significant at 5%; *** Significant at 1%
SGA: Small for Gestational Age, LBW: Low Birth Weight
[1] IV: accumulated abnormal levels of rainfall from conception to interview date.
[2] Previous miscarriage, education level, employed mother, jobless father and average elevation above sea level
[3] The critical value is a function of the number of instrumental variables and the desired maximal percentage we allow the actual size of the nominal 5% TSLS t test to exceed.

Table 7
Rural Areas
Probit models for deficient Birth outcomes: Marginal effects

Dependent variable:	**Probability of being a SGA baby**		**Probability of being a LBW baby**	
Explanatory variables	**PROBIT**	**IVPROBIT[1]**	**PROBIT**	**IVPROBIT[1]**
Adeq. # of Prenatal care visits for a	***-0.012***	***0.128***	***-0.011***	***0.162***
Developing Country	***(0.024)***	***(0.440)***	***(0.024)***	***(0.523)***
Gestational age	0.082	0.086	-0.019	-0.022
	(0.008)***	(0.018)***	(0.004)***	(0.005)***
Male	0.019	0.017	0.002	-0.002
	(0.021)	(0.023)	(0.021)	(0.027)
Age	-0.001	-0.001	0.004	0.004
	(0.003)	(0.003)	(0.003)	(0.003)
Mother's height (cm)	-0.005	-0.006	-0.007	-0.008
	(0.002)**	(0.003)*	(0.002)***	(0.003)***
Arm circumference	-0.021	-0.022	-0.021	-0.027
	(0.006)***	(0.007)***	(0.006)***	(0.009)***
Sick past week	0.041	0.041	0.047	0.052
	(0.027)	(0.028)	(0.027)*	(0.031)*
Mother smoked while pregnant	0.012	0.024	0.019	0.042
	(0.032)	(0.049)	(0.030)	(0.063)
Pregnant for the 1st time	0.061	0.056	0.014	0.014
	(0.053)	(0.054)	(0.041)	(0.050)
Num of children	0.006	0.008	-0.016	-0.018
	(0.008)	(0.011)	(0.009)*	(0.011)*
Other controls[2]	YES	YES	YES	YES
Pseudo R-squared	0.3137		0.1867	
F-test for weak identification		**3.77**		**3.77**
Stock-Yogo weak ID test critical values[3]				
Actual size of 5% test > 10%		16.38		16.38
Actual size of 5% test > 15%		8.96		8.96
Actual size of 5% test > 20%		6.66		6.66

Standard errors in parentheses * Significant at 10%; ** Significant at 5%; *** Significant at 1%
SGA: Small for Gestational Age, LBW: Low Birth Weight
[1] IV: accumulated abnormal levels of rainfall from conception to interview date.
[2] Previous miscarriage, education level, employed mother, jobless father and average elevation above sea level
[3] The critical value is a function of the number of instrumental variables and the desired maximal percentage we allow the actual size of the nominal 5% TSLS t test to exceed.

When running a Probit regression, in both urban and rural areas, an adequate level of prenatal care services appears to have a negative but not statistically significant effect on both deficient birth outcomes. Seeking an adequate number of prenatal care visits decreases the probability of these outcomes between 1.2 and 1.7 percentage points.

After controlling for endogeneity, receiving an adequate number of prenatal care visits has a negative and highly statistically significant effect on the probability of both outcomes in urban areas. The probability of being SGA is reduced by 49% while the probability of being born weighing less than 2,500 grams goes down by 34%. These results do not hold for rural areas. There again prenatal care displays no statistically significant impact. As before, the instrument appears to be strong in urban areas and not in rural ones. In rural areas (Table 7) neither of the specifications is able to ensure that a 5% hypothesis test rejects no more than even 25% of the time.

5. Controlling for quality of prenatal care

The results obtained could be indicating a lack of impact on rural areas due to the inferior quality of the prenatal care services received there. Providing pregnant women with antitetanus injections could be considered as an indication of a higher level of quality of care. Immunization itself has absolutely no biological effect on birth weight. Tetanus toxoid injections are given during pregnancy only to prevent neonatal tetanus. Nevertheless, it could be conjectured that the prenatal care providers that make sure women get vaccinated are the ones that have a higher quality of service in general terms.

In order to test this hypothesis I ran two new sets of regressions, each with a new definition of the prenatal care variable. In the first case, this variable becomes a dummy equal to one for women who simultaneously had adequate prenatal care and received an antitetanus injection. This results in larger and more significant coefficients for all birth weight specifications, but smaller coefficients in absolute levels for deficient birth outcomes. In the second case the prenatal care variable is a dummy equal to one for women which had adequate prenatal care but did not receive an antitetanus injection. For all the estimations related to birth weight prenatal care appeared to have no effect. For the models measuring the probability of having a SGA or LBW baby the coefficients were bigger and stronger. This could indicate that having the adequate number of prenatal care visits even though you did not receive an antitetanus injection decreases the probability of deficient birth outcomes but will not boost birth weight. In this sense, quality of service as defined here could be a more important determinant of cumulative measures as increasing birth weight, but not of more drastic categories such as being SGA or having a LBW[24]. The estimations shown are only for urban areas, since prenatal care still has no effect in rural areas, regardless of the specification. The summarized results are presented in Table 8.

[24] It should be noted that for the regressions when prenatal care includes immunization the instrument was strong. This was not the case for the second specification.

Table 8
IV regressions using as the prenatal care measure either visits where women received antitetanus injections or where they did not

Dependent variable:	**Birth weight FT babies**	**Adj. BW Warner 1998**	**Adj. BW R. & S. 1982**	**Pr. of being a SGA baby**	**Pr. of being a LBW baby**
Adeq. # of PNC visits for a DC + antitetanus injection	1,027.12 (412.568)**	1,209.99 (402.078)***	0.399 (0.133)***	-0.308 (0.088)***	-0.218 (0.101)**
Adeq. # of PNC visits for a DC + **no** antitetanus injection	122,630 (4'866,779)	6,151 (9518)	2.031 (3.143)	-0.666 (0.067)***	-0.642 (0.122)***

Standard errors in parentheses * Significant at 10%; ** Significant at 5%; *** Significant at 1%
FT: Full time, BW: Birth Weight, SGA: Small for Gestational Age, LBW: Low Birth Weight, PNC: Prenatal Care, DC: Developing Country

VI. Robustness checks

1. The validity of the exogeneity assumption

Accumulated rainfall shock could not only affect the mothers commuting costs but also other variables such as the price of basic food staples (e.g. rice[25]), the prevalence of pathogens in the area and maternal stress levels. These variables could affect birth weight through the nutritional level of the mother as well as her physical and mental health status. If this is the case the instrument will be correlated with the error term and will not be valid.

The impact of unexpected rainfall on rice prices depends on the timing and the direction of the rainfall shock. If there is a positive shock during harvesting this could delay the harvest and increase prices. Similarly, a negative rainfall shock during flowering might hurt production and raise prices. Yet, a positive shock during flowering will not affect production since rice is cultivated by flooding the fields. If the unexpected rainfall comes about between these two stages the effect is negligible. To test this correlation I collected rainfall shocks data for 22 years[26] and ran regressions using rice price as the dependent variable. If rainfall shocks are the only covariate used, the coefficient obtained (18) is less than half the standard error (37), showing no significant impact. If rainfall levels, consumption levels and a time trend are added, rainfall shocks continue to have no significant impact on rice prices[27].

[25] This is one of the Philippines food staples.
[26] I obtained rice prices and consumption data for the Philippines for 1960-2006 (source: International Rice Research Institute) and rainfall data for 1972-2004 (source: Mactan- Cebu International Airport Weather Station).
[27] The coefficient was 71 and the standard error was around 60

I tested the effect of accumulated rainfall shocks on maternal health running two models. The first measures the impact of accumulated unexpected rainfall levels on the probability of being sick one week prior to the interview[28]. An increase of 1 standard deviation in the level of accumulated unexpected rainfall will increase the probability of being sick only by 4.5%. The second model computes the effect of accumulated rainfall shocks on arm circumference[29], a proxy for the nutritional level of the mother[30]. An increase of 1 standard deviation in the level of rainfall shocks will decrease the average woman's arm circumference by a meager 0.9%. Both coefficients are significant at a 1% level, yet there are small. By controlling directly for these health outcomes as well as by long term health status (using maternal height) I attempt to fulfill the exogeneity assumption.

Maternal stress has been argued to impact birth outcomes negatively and thus could affect prenatal care estimates. In birth outcome studies it has been classified as being a measure of life events, state anxiety or trait anxiety. According to Lobel (1994), life events are episodes that entail foremost adjustments in a person's life. These events can be positive, like getting a job promotion or negative like losing a loved one. In this sense, life events face a person with a potentially stressful situation or environmental condition. On the other hand, state anxiety is a response to a stimuli such as a situation considered perilous, hostile or plain stressful. Following Lobel (1994) "state anxiety is the emotional state characterized by feeling tension, apprehension, nervousness, and worry." Finally, train anxiety can be described as an individual's predisposition to perceive certain stimuli as perilous or hostile.

Rainfall shocks could be characterized as a daily hassle. They can at most generate state anxiety in the expecting mother, but they are definitely not life events. Birth weight can be negatively affected by life events, but there is no conclusive evidence of prenatal state anxiety on poor birth outcomes (Lobel 1994). Furthermore, when optimism is accounted for, prenatal maternal stress does not affect birth outcomes at all (Lobel et. al. 2000).

2. Selection due to termination of pregnancy

An additional concern in terms of the validity of this study is the effect of selection due to fetal loss. It is reasonable to assume that the initial sample of fetuses will be very heterogenous in its health characteristics. This heterogeneity is echoed in the child's probability of survival in utero. Women who give birth to alive children are those who face the lowest risk of termination of pregnancy and in this sense belong to a selected sample (Harris 1982). Hence it is not certain that the birth weight conditional demand function estimated using this selected sample would be an unbiased representative of the total population (Liu 1998). This is not an important concern in this study since miscarriages

---

[28] Controls include: mother's age, height and arm circumference, previous miscarriage, first time mother, parity, mother smoked while pregnant, education level, employed mother and community fixed effects.

[29] Glewwe et. al. argued in their 2001 paper that: "A good indicator of maternal health is middle upper arm circumference, which indicates both energy (fat) and protein (muscle) reserves".

[30] Controls include: mother's age and height, previous miscarriage, parity, mother smoked while pregnant, education level and community fixed effects.

represent less than 0.4% of the sample, while still births amount to 1.2%. In addition, no abortions where recorded in the sample, which means no bias due to self-selection.

3. Sensitivity to interview date

The results obtained in this study could be sensitive to the point in the pregnancy when the woman was interviewed. However, this is not the case. When the sample is restricted to women interviewed 6 months or later into their pregnancy the coefficients increase by very little and are still significant at a 1% level. For women interviewed at least at 28 weeks of gestation the results are very similar.

4. Sensitivity to the quality of care

It is difficult to measure all the inputs that enter human health production functions or their quality. Prenatal care is a very complex intervention. Its effect might depend on a very wide range of factors. The timing of initiation of care, the specific type of provider, the facility where the service is provided and the specific tests offered just to mention a few. Certainly, the inability of this study to fully control for the content, quality, continuity and comprehensiveness of the service provided is a shortcoming. Thus this study does not allow the reader to distinguish the mechanisms through which the "adequate" prenatal care can positively impact birth outcomes (Frick et. al. 1996). Yet, by lacking controls for quality it provides conservative estimates of the impact of this type of care. If mothers are aware of the quality of the services provided, they might choose to go less times to the doctor if they believe that they can achieve the same result with a smaller number of visits. Hence the estimates of prenatal care practices could be biased downwards. The estimates obtained when using immunization as a control for quality support this conclusion. In this sense this paper could be providing lower bounds of the impact of an adequate level of prenatal care.

VII. Discussion

This paper approximates the impact of an adequate level of prenatal care on birth outcomes in a developing country context. It constitutes a significant improvement on previous studies for several reasons. First, the results are highly robust to changes in measures of birth outcome. In contrast with Deb and Sosa-Rubi (2005) and Guilkey's et. al. (1989) papers, the measure of prenatal care chosen in this study involves both timing and number of visits and shows positive impacts for the combination of both. Furthermore, the results presented are relevant for policy decision making since the prenatal care measure used is the one recommend by the World Health Organization (WHO) for developing countries.

The data collected for this study comes for a large survey specifically designed to capture maternal behaviors and child outcomes. In comparison, the majority of previous studies carried out for the US have been performed using birth certificate data. These studies like the ones performed in developing countries have conflicting results for the impact of the intensity of care. Warner (1995) showed that the number of prenatal care visits appeared to have no statistically significant effect on birth weight. In contrast, Jeffrey Rous et. al. (2003) and Lin (2004) predicted a positive effect of additional visits on birth weight. More consensuses have been attained on the effect of the onset of prenatal care. Warner (1995), Liu (1998) and Smith Conway et. al. (2004) showed that early prenatal care initiation has a positive impact on birth weight. Although the latter stated that this result did not hold for high risk pregnancies. Finally, Krueger and Scholl (2000) used indexes of adequacy of prenatal care to show that the combination of both an inadequate number of visits and a later initiation date increased the risk of preterm delivery but had no impact on the occurrence of small-for-gestational-age babies. The inconsistent results found in prior research could be due to the use of instrumental variables related to the availability of medical services in the areas where the mothers reside. These variables are possibly correlated with preferences and therefore with birth outcomes.

This paper has tried to overcome this shortcoming by choosing an instrument not related to the availability of health services but to the opportunity cost and feasibility of accessing those services. By using accumulated unexpected rainfall as a source of exogenous variation this study has attempted to obtain estimates which are independently distributed with regard to heterogeneous maternal characteristics. When the instrumental variable is used to control for endogeneity, the positive impact of adequate prenatal care appears to be much larger than in the OLS estimations. Yet this effect is only statistically significant in urban areas. There, regardless of the measure of birth weight chosen, receiving an adequate number of prenatal care visits increases a baby’s birth weight by about one third of the average birth weight. The results show that having the desirable number of visits is also an important determinant of poor birth outcomes such as being small for gestational age or having a low birth weight.

An unexpected finding from this paper is that prenatal care appears to have no statistically significant impact in rural areas. This could be an indication of the importance of quality in service when providing prenatal care. Descriptive evidence was provided to indicate the existence of a quality gap between the services provided in urban areas and rural ones. This difference could be what determines if prenatal care, even when sought at an adequate level, can have a positive effect on the child’s birth outcome.

This theory is corroborated when controlling for the quality of care using tetanus vaccination. When assuming that having an adequate level of prenatal care involves in addition receiving an antitetanus injection larger and more significant coefficient are obtained for all specifications related to birth weight. When the definition of adequate care is restricted to women who did not get vaccinated, prenatal care appeared to have no effect for all these estimations. This indicates that future research efforts should be focused on the quality of prenatal care interventions.

References

Adair, Linda S. 1989. "Low Birth Weight and Intrauterine Growth Retardation in Filipino Infants." *Pediatrics*. 84: 613-622.

Adair, L.S. and Guilkey, D.K. 1997. "Age-Specific Determinants of Stunting in Filipino Children." *Journal of Nutrition*. 127:314-320.

Alexander, Greg R. and Korenbrot, Carol C. 1995. "The Role of Prenatal Care in Preventing Low Birth Weight." *The Future of Children*. 5(1): 103-120.

Almond, Douglas; Chay, Kenneth Y and Lee, David S. 2005. "The Costs of Low Birth Weight." *Quarterly Journal of Economics.* 120: 1031–1083.

Barker, DJP; Osmond C. and Law CM. 1989. "The intrauterine and early postnatal origins of cardiovascular disease and chronic bronchitis." *Journal of Epidemiology.* 43: 237–40.

Barker, DJP 1995. "Fetal origins of coronary heart disease." *British Medical Journal.* 311: 171–4

Barker, DJP. 2007. "The origins of the developmental origins theory." *Journal of Internal Medicine.* 261: 412–417

Berg, Cynthia J. 1995. "Prenatal care in developing countries: the World Health Organization Technical Working Group on Antenatal Care." *Journal of the American Medical Women's Association.* 50(5): 182-186.

Black, Sandra E; Devereux, Paul J. and Salvanes, Kjell G. 2007. "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes." *The Quarterly Journal of Economics.* 122(1): 409-439

Blanc, Ann B. and Wardlaw, Tessa 2005. "Monitoring Low Birth Weight: an evaluation of international estimates and an updated estimation procedure." *Bulletin of the World Health Organization*, 83(3)

Cebu Study Team. 1992. "A Child Health Production Function Estimated from Longitudinal Data." *Journal of Development Economics*. 38:323-351.

Cebu Study Team. 1991. "Underlying and Proximate Determinants of Child Health: The Cebu Longitudinal Health and Nutrition Study." *American Journal of Epidemiology*. 133(2):185-201.

Currie, Janet and Hyson, Rosemary. 1999. "Is the Impact of Health Shocks Cushioned by Socioeconomic Status? The Case of Low Birthweight." *AEA papers and proceedings: Child Welfare*. 89(2): 245-250.

Deb, Partha and Sosa-Rubi, Sandra G. 2005. "Does onset or quality of prenatal care matter more for infant health?" *HEDG Working Paper*. 5(11)

De Boo, Hendrina A. and Harding, Jane E. 2006. "The developmental origins of adult disease (Barker) hypothesis." *The Royal Australian and New Zealand College of Obstetricians and Gynaecologists*. 46: 4–14

Department of Health. 2006 "Field Health Services Information System Annual Report 2006." *National Epidemiology Center in the Philippines.*

Department of Health. 1998. "National Demographic and Health Survey 1998." *National Statistics Office in the Philippines*.

Frankenberg E. and Mason W. 1995. "Maternal Education and Health-Related Behaviors: A Preliminary Analysis of the 1993 Indonesian Family Life and Survey." *Journal of Population*. 1(1): 21-44.

Frick, Kevin D. and Lantz, Paula M. 1996. "Selection Bias in Prenatal Care Utilization: An Interdisciplinary Framework and Review of the Literature." *Medical Care Research and Review*. 53(4): 371-396

Glewwe P, Jacoby HG, and King EM. 2001 "Early childhood nutrition and academic achievement: a longitudinal analysis." *Journal of Public Economics*. 81: 345–368.

Glewwe, Paul and Jacoby, Hanan G. 1995. "An Economic Analysis of Delayed Primary School Enrollment in a Low Income Country: The Role of Early Childhood Nutrition." *The Review of Economics and Statistics*. 77(1): 156-169.

Guilkey, D.K., B.M. Popkin, J.S. Akin, and E. Wong. 1989. "Prenatal Care and Pregnancy Outcome in the Philippines". *Journal of Development Economics*. 30:241-272.

Grossman, M., and Joyce, T. 1990. "Unobservables, Pregnancy Resolutions, and Birth Weight Production Functions in New York City." *Journal of Political Economy* 98(5): 983-1007.

Harris JE. 1982. "Prenatal medical care and infant Mortality." *Economic Aspects of Health. Victor Fuchs, ed., University of Chicago Press*: 15–52.

Joyce T. 1994. "Self-selection, prenatal care, and birthweight among Blacks, Whites, and Hispanics in New York City." *The Journal of Human Resources.* 29 (3): 762–794.

Krueger, Paul M. and Scholl, Theresa O. 2000. "Adequacy of prenatal care and pregnancy outcome." *JAOA*. 100(8): 485-492.

Lamberg BA. 1991. "Endemic Goiter-Iodine Deficiency Disorders." *Annals of Medicine.* 23: 367-372.

Lieban, Richard W. 1995. "The 'Psychic Surgeon': A 'Medicodrama'" *Culture, Medicine and Psychiatry*. 20:291-311.

Lin, Shin-Jong. 2004 "Assessing the effect of prenatal care on birth outcome in Taiwan." *The Social Science Journal*. 4: 493–501

Liu, Gordon G. 1998. "Birth Outcomes and the Effectiveness of Prenatal Care". *Health Services Research*. 32(6): 805-823.

Lobel Marci. 1994. "Conceptualizations, Measurement, and Effects of Prenatal Maternal Stress on Birth Outcomes." *Journal of Behavioral Medicine*. 17(3): 225-272.

Lobel, Marci; DeVincent, Carla J.; Kaminer, Anita and Meyer, Bruce A. 2000. "The Impact of Prenatal Maternal Stress and Optimistic Disposition on Birth Outcomes in Medically High-Risk Women" *Health Psychology.* 9(6): 544-553.

Maluccio, John A.; Hoddinott, John; Behrman, Jere R.; Martorell, Reynaldo; Quisumbing, Agnes R. and Stein. Aryeh D. 2006. "The Impact of Nutrition during Early Childhood on Education among Guatemalan Adults." *PSC Working Paper Series.* 06(04).

Moreira, Andrea. 2002. "A review of the UNICEF low birth weight prevention initiative in the Philippines". Project paper (M.P.S. (Int. Dev.)) *Cornell University*

Morris , Saul S.; Victora, Cesar G.; Barros, Fernando C.; Halpern, Ricardo; Menezes, Ana MB.; Cesar, Juraci A.; Horta, Bernardo L. and Tomasi, Elaine. 1998. "Length and ponderal index at birth: associations with mortality, hospitalizations, development and post-natal growth in Brazilian infants." *International Journal of Epidemiology*, 27:242-247.

Oreopoulos, Philip; Stabile, Mark; Walld, Randy; Roos, Leslie 2008. "Short, Medium, and Long Term Consequences of Poor Infant Health: An Analysis Using Siblings and Twins." *The Journal of Human Resources*. 43(1): 88-138.

Pollack, Robert A. 1969. "Conditional Demand Functions and Consumption Theory". *The Quarterly Journal of Economics*. 83(1): 60-78.

Rasmussen, KM and Stoltzfus, RJ. 2003. "New evidence that iron supplementation during pregnancy improves birth weight: new scientific questions" *American Journal of Clinical Nutrition*. 78:673–674.

Rosenzweig, Mark and Schultz, Paul. 1982. "The Behavior of Mothers as Inputs to Child Health: The Determinants of Birthweight, Gestation, and Rate of Fetal Growth." Economic Aspects of Health, Victor Fuchs, ed., *University of Chicago Press:* 53-92.

Rosenzweig, Mark and Schultz, Paul. 1983. "Estimating a Household Production Function: Heterogeneity, the Demand for Health Inputs, and Their Effects on Birthweight." *Journal of Political Economy*. 91(5).

Rous JJ; Jewell RT and Brown RW. 2003. "The effect of prenatal care on birthweight: a full-information maximum likelihood approach". *Health Economics*. 13: 251-264

Royer, Heather. "Separated at Birth: Estimating the Long-Run and Intergenerational Effects of Birthweight Using Twins" *American Economic Journal - Applied Economics*. Forthcoming.

Scholl, Theresa T. and Reilly, T. 2000. "Anemia, Iron and Pregnancy Outcome" *Journal of Nutrition*. 130(2): 443–447.

Scrimshaw, Nevin S. and Schürch, Beat. 1998. "Causes and Consequences of Intrauterine Growth Retardation" *European Journal of Clinical Nutrition*. 52(1).

Smith Conway, Karen and Partha, Deb. 2004. "Is Prenatal Care Really Ineffective? Or, is the 'Devil' in the Distribution?" *Hunter College Department of Economics Working Papers*. 02(2).

Stock, J. H. and Yogo, M. 2002. "Testing for Weak Instruments in Linear IV Regression." *NBER Technical Working Paper.* 284.

Stock, J. H., Wright, J. and Yogo, M. 2002. "A Survey of Weak Instruments and Weak Identification in Generalized Method of Moments." *Journal of Business & Economic Statistics*. 20(4): 518-529.

Strauss J. and Thomas D. 1998. "Health, Nutrition, and Economic Development." *Journal of Economic Literature*. 36(2): 766-817.

UNICEF and WHO. 2004. "Low Birthweight: Country, Regional and Global Estimates". *UNICEF*

UNICEF. 1998. "The State of the World's Children: 1988." *UNICEF*.

UNICEF. 2008. "The State of the World's Children: 2008." *UNICEF*.

United Nations. 2000 "4th Report on the World Nutrition Situation. Nutrition throughout the Life Cycle." *ACC/SCN United Nations and IFPRI*

Walker S.P., Chang S.M., Powell C.A., Grantham-McGregor S.M. 2005. "Effects of early childhood psychosocial stimulation and nutritional supplementation on cognition and education in growth-stunted Jamaican children: prospective cohort study." *Lancet*. 366: 1804–07.

Warner, Geoffrey. 1995. "Prenatal Care Demand and Birthweight Production of Black Mothers." *The American Economic Review*. 85(2): 132-137.

Warner, Geoffrey. 1998. "Birthweight Productivity of Prenatal Care." *Southern Economic Journal.* 65(1): 42-63.

WHO. 2008. "World Health Statistics 2008." *WHO*.

Zeitlin M., Ghassemi H. and Mansour M. 1990. "Positive Deviance in Child Nutrition with emphasis on Psychosocial and Behavioural Aspects and Implications for Development." *WHO/UNICEF Joint Nutrition Support Programme, United Nations University Press.* Food and Nutrition Bulletin Supplement 14.

Zeskind, P. S., & Lester, B. M. 1981. "Analysis of cry features in newborns with differential fetal growth". *Child Development*. 52: 207-212.

Zeskind, P. S., & Ramey, C. T. 1978. "Fetal malnutrition: An experimental study of its consequences on infant development in two caregiving environments". *Child Development*. 49: 1155-1162.

Appendix

Appendix 1: Other determinants of birth outcome

Birth outcome is the result of the interaction of biological processes and environmental factors that affect the absorption of nutrients in uterus. Birth weight is determined by variables such as maternal height, sex and gestational age. It must be noted that mother's height is considered the best available proxy for genetic factors and additionally in developing countries can be seen as an indicator of her nutritional history.

Another factor shaping maternal behaviors and subsequent child outcomes is education. Formal education greatly increases receptivity to health and nutritional information. Women that go to school may learn about the biological processes that determine a positive birth outcome and so deliberately practice habits that diminish exposure to pathogens and susceptibility to disease (Frankenberg et. al. 1995). Similarly, the mother's education, formal and child care specific, as well as her exposure to modernization influence her ability and her motivation[31]. Likewise, a mother's age and childbearing history could affect her knowledge, attitudes, and behavior toward seeking prenatal care. An older mother might take better care of herself because of her experience (Zeitlin et. al. 1990). Similarly, we should consider a mother's health and nutritional status. This will for sure determine the child's weight at birth.

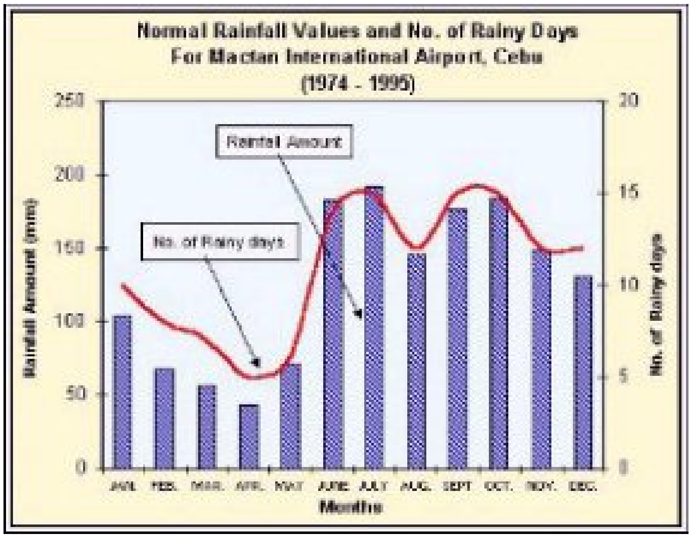
On the other hand, the urgency of other agendas that compete with child care influences a mother's everyday motivation to seek for prenatal care. In this sense, a woman that faces many different kinds of time constraints could be prevented from seeking adequate care. Clear examples are if the mother has a job and the number of young children living in the household. In addition, an unemployed husband also imposes restrictions on the woman's time availability.

Appendix 2: Cebu's geographic and climatic characteristics

The Philippinesis an island nation located in Southeast Asia, with Manila as its capital city. The city of Cebu is located along the coastal and the eastern belt of the Province of Cebu.

[31] The relationship between maternal education and the behaviors of interest might be confounded since we cannot control for their level of initiative or determination. If a particular characteristic motivates certain women to obtain education and carries over to other aspects of their lives, it may be this level of motivation that affects the decision to provide certain care practice rather than education (Frankenberg et. al. 1995).

As per records of the Weather Bureau, the average temperature in Cebu City is 27.4 ^{0}C or 81.3 ^{0}F. The summer heat, which generally comes in March, reaches its peak in April and May. Humidity is approximately 77%, decreasing during the summer months and increasing during the rainy days by a few percent.



In comparison to other areas in the Philippines, the Cebu Metropolitan Area does not have very pronounced seasons. Nevertheless, it is evidently dryer from November to April, while there is more rainfall during the southeast monsoon seasons especially in the month of September.