ABSTRACT

Title of Dissertation: EFFECTS OF A MEXICAN CONDITIONAL CASH TRANSFER PROGRAM ON HEALTH AND DEMOGRAPHY

Soomin Ryu, Doctor of Philosophy, and 2022

Dissertation directed by: Dr. Susan W. Parker, School of Public Policy

Progresa, a Mexican conditional cash transfer program (CCT), was introduced in 1997 to alleviate poverty. The program provided cash payments to low-income households conditional on the children's regular attendance at school and household members' regularly visits to health clinics. Progresa also offered nutritional supplements, principally to young children and pregnant women. This anti-poverty program was one of the oldest and best-known CCT programs, supporting 7 million low-income families. However, in Spring 2019, the Mexican government officially dismantled Progresa.

This dissertation evaluated the impacts of implementing and terminating of Progresa on Mexican health and demographic outcomes using nationwide vital statistics. As vital events were frequently under-reported in rural areas of Mexico where Progresa was mainly implemented, the first chapter examined the validity of vital statistics using the Brass method. I found that births and child deaths were under-reported in Mexico, and under-reporting was more severe in poorer areas. However, for births, there was little evidence of under-reporting once late-registered births

were taken into account. The second chapter evaluated the effects of Progresa on fertility, child mortality, and maternal health. Using variations in the beneficiaries of Progresa across municipalities and time, I found that Progresa significantly reduced 0.4-0.5 births during a woman's lifetime, while adolescent pregnancy was decreased by 13-18%. The program reduced child mortality by 19%, but the effect was temporary. Progresa also enhanced maternal health: it significantly increased institutional deliveries and birth attendance by physician, while decreasing childbirth at home and birth attendance by nurse or midwife. The third chapter assessed the effects of the recent sudden termination of Progresa: it immediately increased in infant mortality due to infectious and parasitic diseases, whereas it reduced deliveries at private clinic and marginally increased deliveries with midwives' attendance.

This dissertation makes significant contributions to social policy and public health by estimating the effects of the CCT program on understudied demographic and health outcomes and the effects of its sudden termination on maternal and child health. This research has crucial public health and policy implications, particularly for several middle- and low-income countries where similar CCT programs are implemented.

EFFECTS OF A MEXICAN CONDITIONAL CASH TRANSFER PROGRAM ON HEALTH AND DEMOGRAPHY

by

Soomin Ryu

Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2022

Advisory Committee:
Professor Susan W. Parker, Chair
Professor Alok Bhargava
Associate Professor Michel Boudreaux
Assistant Professor Mónica Caudillo
Associate Professor Marie E. Thoma

Acknowledgements

I would like to express my gratitude and appreciation to my supervisor, Dr. Susan W. Parker, whose dedicated support, encouragement, and guidance have made my PhD journey an inspiring and fulfilling experience. This research has benefited greatly from several ongoing collaborations with her. I am thankful to Drs. Michel Boudreaux, Alok Bhargava, Mónica Caudillo, and Marie E. Thoma, each of whom provided me with guidance and feedback during this work. I also appreciate the Mexican National Institute of Statistics, Geography and Informatics (INEGI) for their help in using and interpreting the vital statistics, censuses, and survey data.

I am grateful to the professors, researchers, colleagues, and friends who have collaborated with and accompanied me throughout my graduate career. These collaborations and interactions have enriched and expanded my research experiences, while offering many invaluable moments and relationships.

Lastly, my sincere gratitude goes to my mother, Seonjoo Lee, and father, Jiwoong Ryu, for their unconditional support and love throughout my life. I would not even have been able to begin this journey without their encouragement. Thank you both for giving me the strength to explore new directions in life, overcome crises, and achieve this milestone.

Table Of Contents

List of Tables

List of Figures

Chapter 1: Under-reporting of Births and Child Deaths in Mexico

1.1 Introduction

Vital registration system is a key factor for understanding and improving public health and social, political, and economic system. It generates and provides legal identity for each person to be publicly recognized, securely registered and accessible for personal use (Szreter, 2007). Additionally, the official records of births, deaths, marriage, and divorce provide official statistics that are essential to analyze health status of countries and compare the degree of progress in social and economic development. Accurate vital statistics are also crucial prerequisite for implementing social and health policies and providing effective public goods and services.

To reach international standards set by the World Health Organization (WHO), Mexican government has been trying to enhance the coverage and quality of the vital registration system (Harbers, 2020; Hernandez, 2022). Established in 1985, Center for Disease Classification is responsible for monitoring the quality and standardization of the use of the 10th revision of the International Classification of Diseases (ICD-10) in all areas of the health system (Hernández et al., 2011). Moreover, the Mexican National Institute of Statistics and Geography (INEGI) manages the vital registration system in conjunction with the Ministry of Health and the Civil Registry offices. INEGI developed an automated mortality data system to automate the entry, classification, and retrieval of cause-of-death information reported on death certificates. With these efforts, Mexican civil registration and vital statistics system has been evaluated as having high quality data after 2000 (Mahapatra et al., 2007; Mathers et al., 2005; Mikkelsen et al., 2015;

Phillips et al., 2014). For example, the performance of civil registration and vital statistics can be measured by the vital statistics performance index (VSPI) using mortality data as a proxy for the quality and utility of all of the vital statistics. VSPI in Mexico has been higher than 0.85 since 2005, which indicates that the country has strong performing vital registration system (Mikkelsen et al., 2015).

Despite recent advances, there is evidence that births and child deaths may still be under-reported in poor and rural areas of Mexico (Braine, 2006; Gamlin & Osrin, 2020; Hernández-Prado et al., 2012; Tomé et al., 1997). Under the certification system, a birth or death should be reported to a health official who certifies birth or death, determines the cause of death, and gives the family a birth or death certificates (Braine, 2006). Under-registration of vital events occurs because of physical distance, cultural and language barriers, and lack of health care centers faced by Mexican indigenous communities (Farmer et al., 2006; Holmes, 2012). Although more than 90% of births in Mexico took place in medical establishments and were certified, some families did not register births at the civil registration office. In particular, births that occurred outside medical establishments were likely to be not registered. Moreover, there is a custom of burying or cremating children's deaths without receiving death certifications from hospitals or disposal permit from the civil registration authorities. One study suggested that the quality of the information provided in the certificate still needs improvement in rural areas of Mexico, particularly for death certificate (Hernández et al., 2011). Even in 2009, 93.2% of death certificates were filled out by physicians in rural areas, which was still lower compared to 99.9% in urban areas. Additionally, among registered deaths in 2009, only 44.4% of them occurred in health facilities, while 47.3% of them occurred at home and 8.3% in public areas. Issuance of certifications by physicians and the percentage of deaths at health facilities are essential for higher quality of vital registration system.

In modern societies, births certificates are important to receive education, health services and access protections under the law, property rights or entitlement (Harbers, 2020). Collection of death certificates is also crucial to understand the trends of death by cause of death and evaluate health policy and programs. As the second chapter of my dissertation examines the effects of a Mexican cash transfer program (Progresa) on fertility and child mortality using vital statistics, this chapter examines the validity of vital statistics by finding evidence of under-reported births and child deaths based on the Brass method, which is the most commonly used indirect estimation method. The Brass method allows comparing fertility and child mortality estimates from the vital statistics and those derived from the Brass method to identify under-reporting in the vital statistics. I found that births and child deaths were under-reported in Mexico, and the under-reporting was more severe in poor areas, where Progresa was mainly implemented. However, for births, there was little evidence of under-reporting once late-registered births were taken into account. For child deaths, under-reporting existed even when all late-registered deaths were considered. The paper fills the literature gap by finding nationwide evidence of under-reported births and child deaths in Mexico by using vital statistics and census.

1.2. Research Questions

Although recent studies have reported Mexico has well-performing vital statistics systems (Mahapatra et al., 2007; Mathers et al., 2005; Mikkelsen et al., 2015; Phillips et al., 2014), under-registration of child deaths and births is evident in rural areas of Mexico until the early 2000s, where and when the anti-poverty programs such as Progresa were mainly implemented (Braine, 2006; Gamlin & Osrin, 2020; Hernández-Prado et al., 2012; Tomé et al., 1997). Using a representative sample of 101 municipalities with very low human development index, Hernández-Prado et al. (2012) identified 68.1% of births as being under-reported in 2007 and 2008 as well as 22.6% in 2007. Tomé et al. (1997) employed verbal autopsy to identify under-reported infant deaths, where a trained interviewer used a questionnaire to collect information about a recently deceased person from an individual familiar with the deceased. Researchers found that infant deaths were under-reported by 68.9% on average between 1993 and 1994 in Guerrero state, which increased to 73.2% in communities of less than 500 inhabitants. Through a two-year ethnographic study of pregnancies and childbirth, Gamlin and Osrin (2020) also suggested that perinatal or infant deaths were not registered in the clinic of indigenous communities with the custom of burying children where they died. Previous studies used verbal autopsy, medical records review, and ethnographic approach to assess the quality of under-reported births or child deaths in vital statistics, which were restricted to only small sample size.

The goal of this chapter is to compare fertility and child mortality from nationwide vital statistics and those derived from the Brass method, which allows assessing the validity of vital statistics of Mexico. I postulated two hypotheses as follows:

Hypothesis 1. *Births are under-reported in the Mexican vital statistics, and under-reporting is more severe in poor areas than non-poor areas.*

Hypothesis 2. *Child deaths are under-reported in the Mexican vital statistics, and under-reporting is more severe in poor areas than non-poor areas.*

1.3. Data and Methods

1.3.1. Brass method

Indirect estimation of fertility and child mortality using a summary birth history (SBH) has been widely used in censuses and surveys in developing countries, where vital registration system is poor or nonexistent. Indirect estimated fertility uses the number of children ever born in SBH to adjust the estimates of period fertility derived from recent births (vital statistics), which tends to be underreported or misreported. Indirect estimation of mortality is derived from SBHs, the number of children ever born and the number of children dead (Verhulst, 2016). The classical Brass method (Brass, 1964) is the most commonly used one for indirect estimation.

As a few studies found under-reported births and child deaths in Mexico using only small samples (Gamlin & Osrin, 2020; Hernández-Prado et al., 2012; Tomé et al., 1997), I aim to assess the validity of overall Mexican vital statistics at the national level as well as at smaller geographic level classified by poverty. I employed the Brass method to indirectly estimate fertility and child mortality and to compare them with the estimates from nationwide vital statistics. The Brass method for fertility and child mortality uses information on SBHs (the number of children ever born and the number of children dead) aggregated by the age of the mother. By comparing the estimates from vital statistics and those from SBHs, this method allows identifying the under-reported births and deaths in the vital statistics. Data on births and child deaths were generated through a civil registration and vital statistics system that Mexico has been using since 1950 to reach international standards set by the WHO. The data for births and deaths are publicly available in the INEGI website since 1985 and 1990 respectively as INEGI is the principal government agency responsible for the population censuses and national surveys. Data on SBHs were drawn from Mexican census. It includes information on women's number of children ever born and the number of children dead, and maternal age.

Numerous recent studies in developing countries, including Latin American countries, have used the Brass method to estimate fertility and child mortality (Chen, 2016; Kamal, 2010; Moultrie & Dorrington, 2008; Mturi & Hinde, 2001; Palloni & Heligman, 1985; Sarma & Choudhury, 2014; Spoorenberg, 2015; Susuman, 2012; Vapattanawong et al., 2007; Wilson & Wakefield, 2020; Yimamu, 1990). The United Nations World Population Prospects also derives fertility and child mortality estimates, incorporating summary birth histories in population census and sample surveys to consider under-reporting and misreporting in developing countries (United Nations Inter-agency Group for Child Mortality Estimation, 2020; United Nations, 2019b). To estimate the Mexican national under-5 mortality rate (U5MR) in 1980-2006, Sepúlveda et al. (2006) applied the Brass method to correct the under-reported children's deaths using Mexican censuses in 1990, 2000, and 2005.

1.3.2. Fertility

This paper employed the P/F ratio technique developed by Brass (1964), which suggested that period measures of age-specific fertility rate (ASFR) could be adjusted by leveraging information on cohort parity, the average number of children ever born to a woman of a given age (Baker et al., 2011; Brass, 1964). Figure 1.1 summarizes the procedure of the Brass P/F ratio method. Data on children ever born (step 1a) is usually derived from census, while the period measures of current fertility (step 2a-2b) can be computed from a survey question about births in the past year or date of the most recent birth from the vital statistics system. The assumptions are that misreporting of current fertility is constant across all age groups, and that under-reporting of recalling children ever born is different across age groups, with older women more likely to under-report. The final assumption is that the trends and patterns of fertility are constant over the last 15-20 years. However, this can be relaxed by deriving current fertility rates from registered births in the same year that the data on children ever born is derived (United Nations, 1990). As I constructed the current fertility rates (ASFR) and the number of children ever born using the data in the same year, the last assumption can be relaxed (Spoorenberg, 2015).[1]

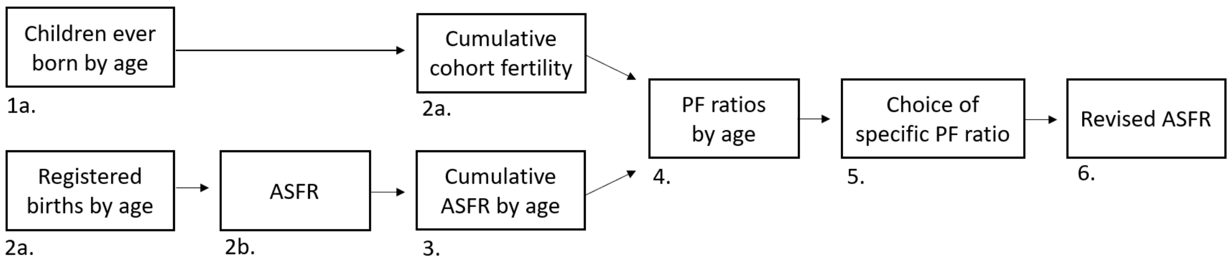


Figure 1.1. The procedure of the Brass P/F ratio method
Source: Author revised the flow of procedure presented in Baker et al. (2011)

Two data sources were drawn to use the Brass P/F ratio method: (1) data on the average number of children ever born by age group of women from Mexican census (1990, 2000, 2005) and (2) data on the sums of ASFRs from the vital statistics. The number of children ever born represents the estimates of the cumulative fertility of cohorts up to that age (cohort-specific fertility) (step 1b), while ASFRs are summed up to each age group to estimate cumulative fertility (period measure of fertility) (step 3). In the Brass P/F ratio, P is average parity, which represents the cohort-specific fertility, and F is closely related to the cumulated period measure of fertility (Moultrie et al., 2013). Using these two quantities, the average parity of women by age group (P_i) and the average parity equivalents for period by age group (F_i) is calculated to derive P_i / F_i ratio for each age group (step 4). With perfect data, the P/F ratio should be close to 1 and the same for all age groups. In practice, the method is still reliable if the ratios for 20-29 age groups are close to 1 (Spoorenberg, 2015). The ratio of 20-24 age group (P_2/F_2) is used as an

[1] Brass suggested that the P/F ratio method yielded good estimates even when fertility was declining (Brass, 1985).

adjustment factor because the number of children ever born reported by women at younger reproductive ages likely to be lower biased and less likely to be affected by the fertility decline (step 5) (Moultrie et al., 2013; United Nations, 1983). But P/F ratio of 15-19 age group is not recommendable because a greater proportion of women will not have experienced childbirth, which makes the P/F ratio unreliable estimate. The adjusted ASFR estimates are computed by multiplying original ASFRs by P_2/F_2 (step 6). Based on these adjusted ASFRs, adjusted total fertility rate (TFR) is derived.

To examine whether births were under-reported, I compared adjusted TFR using the Brass P/F ratio and unadjusted TFR only using vital statistics. The application of the Brass P/F ratio method was conducted in poor and non-poor areas separately to see whether under-reporting was more severe in poor areas compared to non-poor areas. I expected that the adjustment factor (P_2/F_2) and the differences of adjusted and unadjusted TFR would be larger in poor areas than non-poor areas, which indicates that higher proportion of births were under-reported in vital statistics of poor areas.

1.3.3. Child mortality

To identify under-reporting of child deaths in vital statistics, this paper used the Brass method that employs the age of the mother as a proxy to calculate the children's mean length of exposure to the risk of dying (Brass, 1975). The Brass method estimates child mortality from aggregated information on the number of children ever born and the number of children dead by mother's age group. A key assumption is that any changes in child mortality in the recent past have been gradual and unidirectional. Another assumption is that the mortality of children does not vary by 5-year grouping of mothers. Violation of this assumption can result in overestimated recent mortality reported by women aged 15-19 and 20-24, since mortality risks for children borne by young mothers are higher (United Nations, 1990).

The proportions of dead children born to mothers classified by 5-year age group (i.e., 15-19, 20-24, … 45-49) reflect the cohort-specific probabilities of dying. The basic relationship between the proportion of children dead by age group of mothers and the probability of dying in childhood can be explained by a simple example. If all women are supposed to have children at age 20, the children of women at age 25 will be exposed to the risk of dying for 5 years and the proportion dead will be the probability of dying by age 5. Thus, the age of women in relation to the time of child-bearing determines the children's duration of exposure to the risk of dying (United Nations, 1990). Young mothers have relatively young children, who have been exposed to the risk of dying for short and recent periods; thus, the proportion of dead children of young mothers represents child mortality risks at an early age (Moultrie, et al., 2013). On the other hand, older mothers have a mix of young and older children exposed to the risk of death for longer periods in the past. Using different mothers' age, the proportions of dead are converted into probabilities of dying by exact ages (n) of childhood, ${}_nq_0$. A common index recommended as a reliable estimate is U5MR (${}_5q_0$) (Susuman, 2012). The use of infant mortality is not recommended because the estimates (${}_1q_0$) obtained from the conversion are very sensitive to the mortality pattern underlying the different models (United Nations, 1990). The necessary pieces of information are available in the census: the number of children ever born, the number of children ever born who have died by mother's age group, and female population of reproductive age (15 to 49) by age group.

There are two versions to use the Brass method to indirectly estimate child mortality: Trussell version and Palloni and Heligman version. Both are variants of the Brass method to provide the probability of dying from birth to age n ($_nq_0$). The Trussell version uses the Coale-Demeny model life table system (United Nations, 1983), while the Palloni-Heligman uses the United Nations model system (Palloni & Heligman, 1985). This paper adopted the Palloni and Heligman (1985) version of the Brass method, which is possible to take account for age patterns of mortality in Latin America. Figure 1.2 summarizes the procedure. First, average parity, P(i), is computed as the average number of children ever born by women in a given 5-year age group (step 1). Parity values are needed only for age groups 15-19, 20-24, and 25-29, which are presented as P(1), P(2), and P(3). In step 2, the proportion of dead, D(i), is calculated for all age groups (i) from 15-19 to 45-49 as the ratio of the total number of dead children to the total number of children ever born. The mean age at maternity, M, is estimated by multiplying the midpoint of each age group by the number of births to women in that age group, and then dividing the sum of the products by total number of births (step 3). Multiplier, k(i), is calculated in step 4 using the following equation:

$$k(i) = a(i) + b(i)\frac{P(1)}{P(2)} + c(i)\frac{P(2)}{P(3)} + d(i)\,M$$

where a(i), b(i), c(i), and d(i) are coefficients based on the United Nations mortality models life table[2]. In step 5, the probability of dying, q(x) for ages x of 1, 2, 3, 5, 10, 15 and 20, is calculated for each age group (i) of mothers, by multiplying k(i) by D(i). Then time reference, t(i) is calculated using coefficients and parity ratios in similar way that k(i) is computed (step 6):

$$t(i) = e(i) + f(i)\frac{P(1)}{P(2)} + g(i)\frac{P(2)}{P(3)}$$

[2] The life tables provide description of age-specific death rates, and demographers derived suitable life tables in developing countries after applying variety of adjustment techniques due to incomplete civil registration and vital statistics system or errors in reporting. The United Nations model life tables for developing countries constructed five families of models by geographical area: Latin American, Chilean, South Asian, Far Eastern and a General. Latin American model was used.

where e(i), f(i), and g(i) are suggested coefficients for the time reference based on the life tables (United Nations, 1982). Once t(i) values are computed, reference dates (year) are generated for each age group. Based on q(10) and suggested values in the United Nations mortality models life table, q(5), U5MR is calculated (step 7).

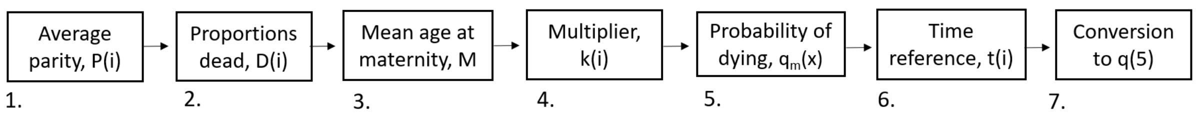


Figure 1.2. The procedure of estimating under-5 mortality rate using Palloni and Heligman version of the Brass method
Source: Author constructed the flow of procedure based on United Nations (1990).

I computed the indirect estimates of U5MR using the Brass method and compare them with the estimates derived from vital statistics at the national level. Then, I compared two U5MR estimates in poor and non-poor areas separately to see whether under-reporting was more severe in poor areas than non-poor areas. I expected that the differences between U5MR from the Brass method and that from vital statistics would be larger in poor areas than non-poor areas, which indicates that higher proportion of child deaths were under-reported in vital statistics of poor areas.

1.4. Results

1.4.1. Under-reported fertility

Table 1.1 reports the results of applying the Brass P/F ratio to all areas of Mexico in 1990. The 5-year age groups (i) presented in column 1 are as follows: i = 1 = 15-19 years, i = 2 = 20-24 years, …, i = 7 = 45-49 years. The column 2 presents the total number of Mexican women by age groups in 1990. Thus, the column 3 presents the number of births that occurred and were registered in 1990, excluding late-registered births to avoid distortion in the age pattern of fertility (United Nations, 1983). ASFR, indicated as f_i in column 4, was the number of births (column 3) divided by the number of women (column 2) for each age group. TFR was 2.34 in 1990, calculated based on ASFRs. Φ_i in column 5 indicates the cumulative period fertility (ASFR) up to each age group. P_i in column 6 represents the cumulative fertility of cohorts (average parity), the number of children ever born to each age group of mothers. F_i in column 7 represents the average parity equivalents for a period and was estimated by interpolation using period fertility (f_i) and cumulative period fertility (Φ_i)[3]. P/F ratio was calculated by dividing P_i by F_i for each age group. Under-reporting in vital statistics is suggested when P is larger than F. The ratio of 20-24 age group (P_2/F_2) is usually used as an adjustment factor for the ASFRs because it is less likely to be affected by the fertility decline compared to the ratios of older age groups. Adjusted fertility for each age group was obtained by multiplying f_i by P_2/F_2. TFR based on the adjusted ASFRs was 3.76, which was higher than the TFR based on the unadjusted ASFRs (2.34). Given that the TFR was estimated at 3.47 in 1990 by the World Population Prospects of United Nations (United Nations, 2019a)[4], the Brass P/F ratio method could correct for the under-reported births to some extent.

[3] F(i) is obtained using the following equation: $F(i) = \Phi(i-1) + a\,f(i) + b\,f(i+1)$ where a and b are constants which is different for each age group. Coale and Trussell suggested a and b as coefficients for interpolation between cumulative fertility rates to estimate parity equivalents. Deriving F is complicated because the Brass method considers the fact that cumulative ASFR reflects the fertility experience of all women up until that age, but the average parities reflect experiences of women aged at the midpoint of that age group.

[4] The World Population Prospects calculate total fertility rate based on: (a) official estimates of age-specific fertility rates through 2011; (b) registered births classified by age of mother and the underlying female population by age through 2016; (c) adjusted for under-registration; (d) birth-histories data from the 1976-1977 WFS and 1987 DHS; (e) births in the household in the preceding 12 (or 24) months classified by age of mother from the 1970, 1990, 2000, 2010 censuses and 1978, 1979 ENPUMA and 1982 Survey and 1992, 2006, 2009, 2014 ENADID and 1995 ENPF and 2015 Intercensal Survey; (f) adjusted fertility using Brass P/F ratio method (or variants) with data on children ever born and births in the preceding 12 (or 24/36) months, both classified by age of mother, from the 1970, 1990, 2000, 2010 censuses and 1978, 1979 ENPUMA and 2015 Intercensal Survey; (g) indirect estimates obtained from the application of the own-children method of fertility estimation to the 1970 census and 1979 ENPUMA; (h) International estimates considered up to 2017.

Table 1.1. Application of the Brass P/F ratio, Mexico, all areas (1990)

(1) Age group*	**(2)** Number of women	**(3)** Registered births	**(4)** f_i (ASFR)	**(5)** Φ_i (Cumulative f_i)	**(6)** P_i	**(7)** F_i	**(8)** PF ratio	**(9)** Adjusted fertility
1	4904511	252,332	0.0514	0.2572	0.1426	0.0866	1.647	0.083
2	4091035	533,041	0.1303	0.9087	0.9110	0.5674	**1.606**	0.209
3	3353917	431,710	0.1287	1.5523	2.0026	1.2430	1.611	0.207
4	2808883	246,564	0.0878	1.9912	3.0166	1.7899	1.685	0.141
5	2368551	113,390	0.0479	2.2306	3.9160	2.1225	1.845	0.077
6	1792757	32,996	0.0184	2.3226	4.6869	2.2831	2.053	0.030
7	1519287	5,214	0.0034	2.3398	5.4203	2.3341	2.322	0.006
Total	20,838,941		0.4680					0.751
TFR			**2.34**					**3.76**

*Age group of mothers was defined as 1 for 15-19, 2 for 20-24, 3 for 25-29, 4 for 30-34, 5 for 35-39, 6 for 40-44, and 7 for 45-49.

Source: Mexican Institute of Statistics Geography and Informatics (INEGI) and Mexican census (1990)

Figure 1.3 compares the trend of TFRs using different data sources. 'Vital 1' was unadjusted TFR derived from vital statistics excluding late-registered births. 'Vital 2' was unadjusted TFR from vital statistics including late-registered births. 'Brass' was adjusted TFR, employing the Brass P/F method using both census and vital statistics excluding late-registered births (Vital 1). 'United Nations' was the TFR estimated by the World Population Prospects of United Nations (United Nations, 2019a). 'Survey' was the TFR based on Mexican survey data, Encuesta Nacional de la Dinámica Demográfica (ENADID). The figure shows that the TFR based on the Brass method was very similar to the unadjusted TFR including late-registered births ('Vital 2'). Also, both estimates were close to the estimates suggested by the United Nations or Mexican survey, which implies that there was little evidence of under-reporting of births at the national level once late-registered births were taken into account.

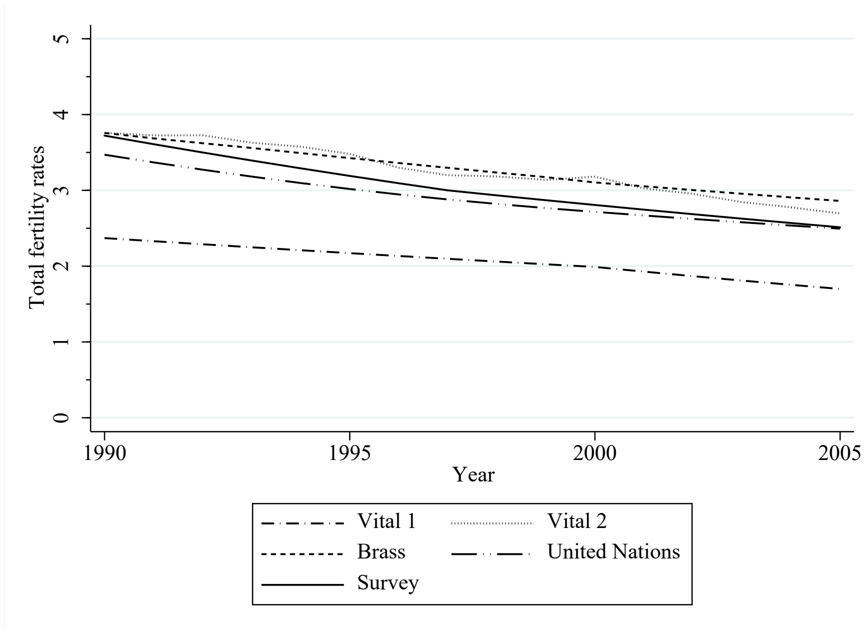


Figure 1.3. Comparison of total fertility rate (TFR), Mexico, all areas (1990-2005)
Notes: 'Vital 1' indicated unadjusted TFR derived from vital statistics excluding late-registered births. 'Vital 2' was unadjusted TFR from vital statistics including late-registered births. 'Brass' was adjusted TFR based on the Brass P/F method using census and vital statistics, excluding late-registered births. 'United Nations' was the TFR, estimated by the World Population Prospects of United Nations. 'Survey' was the TFR based on Mexican survey data, Encuesta Nacional de la Dinámica Demográfica (ENADID).
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican censuses (1990, 2000, 2005, 2010) and the United Nations

Table 1.2 reports unadjusted TFR without late-reported births and adjusted TFR using the Brass P/F ratio method in two areas by the marginality level in 1990, 2000, and 2005. Adjusted TFR was calculated using the Brass P/F ratio method based on both vital statistics and census, and the vital statistics included only births occurred and reported in the same year. Unadjusted TFR was derived from vital statistics without late-reported births to better compare it with the adjusted TFR because the Brass P/F ratio method did not take account of late-reported births. It was not able to include analysis using census in 1995 because it does not have information on the number of children ever born. The level of marginality was based on the Margination Index constructed by the Mexican Population Council (CONAPO).[5] According to this index, all municipalities were classified into five categories, ranging from 'very low poverty' to 'very high poverty'. Marginalized areas are municipalities with high and very high margination index, while non-marginalized areas are municipalities with medium, low, and very low margination index. In marginalized areas, the adjusted TFR was 5.53 (unadjusted TFR: 2.40) in 1990, which decreased to 3.52 (unadjusted TFR: 1.44) in 2005. In non-marginalized areas, TFR was 3.73 (unadjusted TFR: 2.36) in 1990 and it decreased to 2.81 (unadjusted TFR: 1.70) in 2005. The differences of adjusted and unadjusted TFRs were much larger in marginalized areas compared to non-marginalized areas.

Table 1.2. Application of the Brass P/F ratio in non-marginalized and marginalized areas, Mexico (1990-2005)

Year	Non-marginalized areas		Marginalized areas	
	Unadjusted TFR	Adjusted TFR	Unadjusted TFR	Adjusted TFR
1990	2.36	3.73	2.40	5.53
2000	1.88	3.31	1.68	4.18
2005	1.70	2.81	1.44	3.52

Notes: Unadjusted TFR was based on vital statistics, only including births occurred and reported in the same year because the Brass method did not consider late-reporting. Adjusted TFR was based on both vital statistics and census, and the vital statistics included only births occurred and reported in the same year. The Brass method was not applicable for census in 1995 because it did not have information on the number of children ever born.

Figure 1.4 plots TFRs from vital statistics and from Brass method in two areas by the marginality level during 1990-2005. 'Vital 1' was unadjusted TFR derived from vital statistics excluding late-registered births. 'Vital 2' was unadjusted TFR from vital statistics including late-registered births. 'Brass' was adjusted TFR, using the Brass P/F method. The difference between 'Vital 1' and 'Brass' indicated that under-reporting was more severe in marginalized areas than non-marginalized areas. The estimates from the Brass method were close to the estimates from

[5] The Margination Index was based on the share living in communities with less than 5000 inhabitants, the share earning less than twice the minimum wage, the share illiterate, and the shares with less than primary school, without a toilet, without electricity, without running water, with crowding, and with a dirt floor.

vital statistics including late-registered births ('Vital 2'), suggesting that vital statistics can be a credible data source for fertility if all late-registered births were included. Interestingly, the difference between the Brass estimates and 'Vital 2' estimates was smaller in marginalized areas than in non-marginalized areas. This was possibly because (1) Brass method was appropriate for low-income countries or areas where fertility was high (Sarma & Choudhury 2014; United Nations, 1990), so the Brass method predicted fertility more accurately for marginalized areas; or (2) most births were eventually registered due to the requirements for Progresa (Gamlin & Osrin, 2020), which was mainly implemented in marginalized areas, so more parents in these areas were encouraged to register their children's births even later.

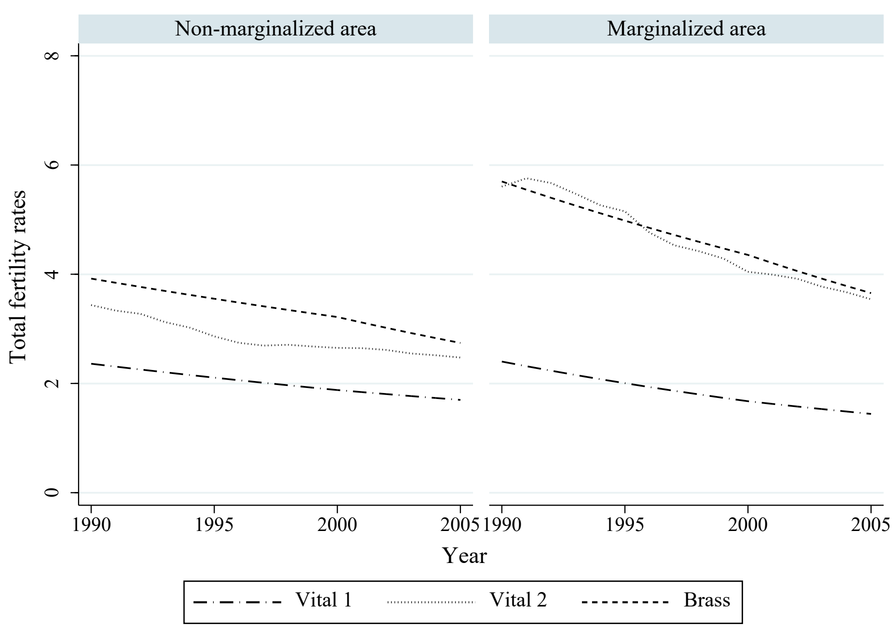


Figure 1.4. Comparison of total fertility rate (TFR) in non-marginalized and marginalized areas, Mexico (1990-2005)
Notes: 'Vital 1' indicated unadjusted TFR derived from vital statistics excluding late-registered births. 'Vital 2' was unadjusted TFR from vital statistics including late-registered births. 'Brass' was adjusted TFR based on the Brass P/F method using census and vital statistics excluding late-registered births.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican censuses and Mexican Population Council (CONAPO)

As an additional analysis, I used only vital statistics (1990-2020) to calculate the proportion of births registered 1 to 10 years after the births to identify the trends of late-reported births by poverty level. Table 1.3 presents the proportion of late-reported births by year of birth and marginality group during the period of 1990-2010. More births were registered several years later in high and very high marginalized areas compared to low and very low marginalized areas. In 1990, 8.49% of births were registered after 1 to 10 years in the municipalities with very low marginality, while it was 41.58% in those with very high marginality. Overall, the late-reporting

Table 1.3. Proportion of late-reported births, registered 1 -10 year after births by year of birth and marginality group, Mexico, 1990-2010 (%)

	Very low	Low	Medium	High	Very high
1990	8.49	14.89	22.00	29.86	41.58
1991	8.59	15.57	23.77	31.47	44.24
1992	8.54	16.23	24.96	32.64	46.26
1993	8.26	16.02	24.90	32.52	45.10
1994	8.27	15.84	24.57	32.45	46.02
1995	8.48	15.44	24.25	32.47	47.42
1996	8.30	14.77	23.13	31.78	46.86
1997	7.99	14.00	22.33	31.35	48.19
1998	7.79	13.38	21.28	30.12	48.90
1999	7.56	13.14	20.79	29.09	47.24
2000	7.85	13.58	21.32	30.21	48.58
2001	8.31	13.85	21.50	30.24	48.67
2002	8.55	13.91	20.95	29.12	46.74
2003	8.88	13.88	20.82	29.05	50.63
2004	8.59	13.31	19.95	28.15	49.66
2005	8.54	13.01	19.14	27.40	48.97
2006	8.49	12.51	18.31	25.67	45.90
2007	7.73	10.97	15.62	22.16	40.28
2008	7.35	10.30	13.98	19.89	38.72
2009	6.95	9.22	11.39	16.32	31.74
2010	6.64	8.63	10.60	14.63	27.72

Notes: Late-reported births (%) was the proportion of the number of births registered 1 -10 year after a birth in total number of births. Group of municipalities was based on the Margination Index, the municipality level of poverty index constructed by the Mexican Population Council (CONAPO) problem improved over time, particularly in highly marginalized municipalities: the late-reporting rate slightly decreased to 6.64% for the very low marginality group in 2010, while it significantly decreased to 27.72% in the same year for the very high marginality group.

1.4.2. Under-reported child mortality

Table 1.4 presents the results of applying the Palloni and Heligman (1985) version of the Brass method to indirectly estimate U5MR in all areas of Mexico using 1990 Mexican census. The 5-year age groups (i) presented in column 1 are as follows: i = 1 = 15-19 years, i = 2 = 20-24 years, …, i = 7 = 45-49 years. P(i) represents parity value, or the number of children ever born to each age group of mothers (column 2), while D(i) represents the proportion of children that died among all children ever born to women in each age group (column 3). Multiplier, k(i), was computed using the mean age at maternity[6], parity ratios of younger groups (15-19, 20-24, 25-29) and Latin American pattern of the United Nations model life tables derived from the United Nations (1990) (column 4). The q(x) represents the probability of dying at each child's exact age (x) and it was calculated by multiplying k(i) by D(i) (column 6). Time reference, t(i), was calculated using parity ratios and Latin American pattern of the United Nations model life tables (column 7). Then reference date was computed by subtracting time reference from the date for census completion (March 12, 1990). The estimates of q(x) for each child age (x) were converted into equivalent estimates of $q^c(5)$, using the Latin American model life tables. Column 9 represents the U5MR, $q^c(5)$, in each reference year (1989, 1988, 1986, 1984, 1982, 1979, 1976). The estimate for age group 1 (women aged 15-19), which was 55 per 1,000 births in 1989, indicated the failure of assumption that mortality risks of children for a particular time period do

[6] The mean age at maternity is 26.08, estimated based on the number of births and the midpoints of the age groups of mothers.

not vary by age of mother, which usually happens with real data (Moultrie et al., 2013; United Nations, 1990). Therefore, the estimates of mortality derived from women aged 15-19 should be treated with a high degree of circumspection or ignored (Moultrie et al., 2013).

Table 1.4. Application of the Brass for under-5 mortality, Mexico, all areas (1990)

(1) Age Group*	(2) P_i	(3) D_i	(4) k_i	(5) Child's age x	(6) q_x	(7) t_i	(8) Reference date	(9) q^c (5)
1	0.1667	0.044	0.996	1	0.0443	1.074	1989.1	0.055
2	0.9949	0.044	1.065	2	0.0467	2.310	1987.9	0.049
3	2.1057	0.046	1.018	3	0.0469	3.956	1986.2	0.047
4	3.1285	0.053	1.008	5	0.0538	6.042	1984.1	0.054
5	4.0569	0.070	1.018	10	0.0710	8.444	1981.7	0.066
6	4.8669	0.087	0.974	15	0.0851	11.233	1979.0	0.076
7	5.6565	0.108	0.983	20	0.1060	14.744	1975.4	0.089

*Age group of mothers was defined as 1 for 15-19, 2 for 20-24, 3 for 25-29, 4 for 30-34, 5 for 35-39, 6 for 40-44, and 7 for 45-49.
Note: M (mean age of maternity) = 26.08
Source: Mexican census (1990)

Figure 1.5 compares the trend of U5MR using different data sources in 1975-2000. 'Vital' was U5MR using vital statistics on births and child deaths, including all late-registered births and deaths. 'Brass' was an indirect estimate of U5MR based on the Palloni and Heligman version of the Brass method, using two censuses (1990 and 2005). 'United Nations' was U5MR estimated by the United Nations Inter-agency Group for Child Mortality Estimation (2021).[7] The graph with vital statistics starts from 1990 because information on deaths only has been available since 1990. Despite the non-linearity in the Brass estimate between 1983 and 1989 as two censuses used together, the figure indicates that the Brass method performed adequately, and closely

[7] The United Nations Inter-agency Group for Child Mortality Estimation (UN IGME) comprises the United Nations Children's Fund (UNICEF), the World Health Organization (WHO), the World Bank, the United Nations Population Division, and other universities and research institutes. It developed and adopted a statistical method using vital statistics, survey, census to obtain a best estimate trend line by fitting a country-specific regression model of mortality rates against their reference dates.

traced the official estimate. Compared to the Brass estimate, U5MR based on vital statistics was largely underestimated.

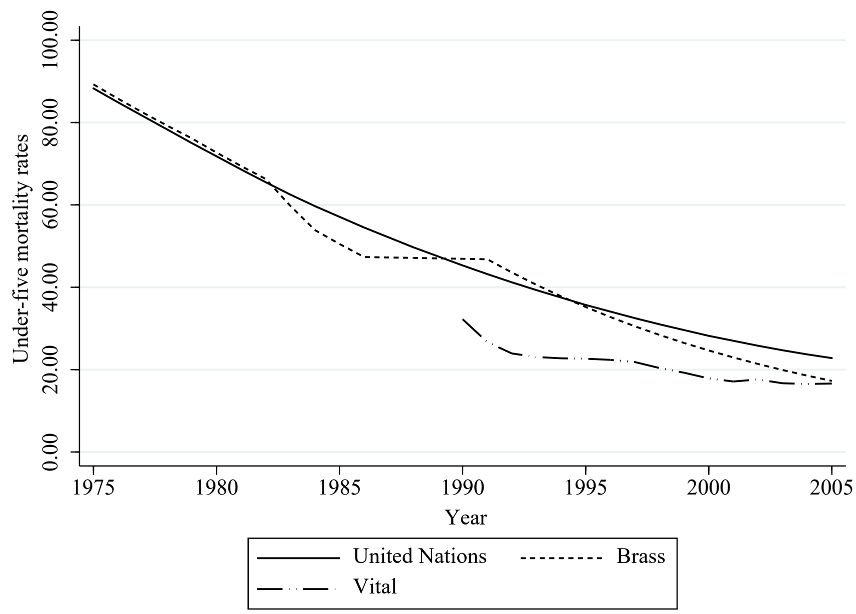


Figure 1.5. Comparison of under-5 mortality rates, Mexico, all areas (1975-2000)
Notes: 'Vital' was under-5 mortality using vital statistics on births and deaths, including all late-registered ones. 'Brass' was an indirect estimate of under-5 mortality using census. 'United Nations' was the under-5 mortality estimated by the United Nations Inter-agency Group for Child Mortality Estimation.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican census, and United Nations.

Figure 1.6 presents U5MR estimate based on the Brass method using census and U5MR estimate using vital statistics by the level of marginality. Vital statistics included all late-registered births and deaths to calculate U5MR. U5MR had been decreasing during the period in both areas with a larger reduction in marginalized areas, while under-reported deaths of children under 5 had been also decreasing over time. Although all late-reported births and child deaths were taken account of, U5MR derived from vital statistics was still much lower than that from the Brass method in both areas. The comparison indicates that child mortality in vital statistics was more under-reported in marginalized areas than non-marginalized areas.

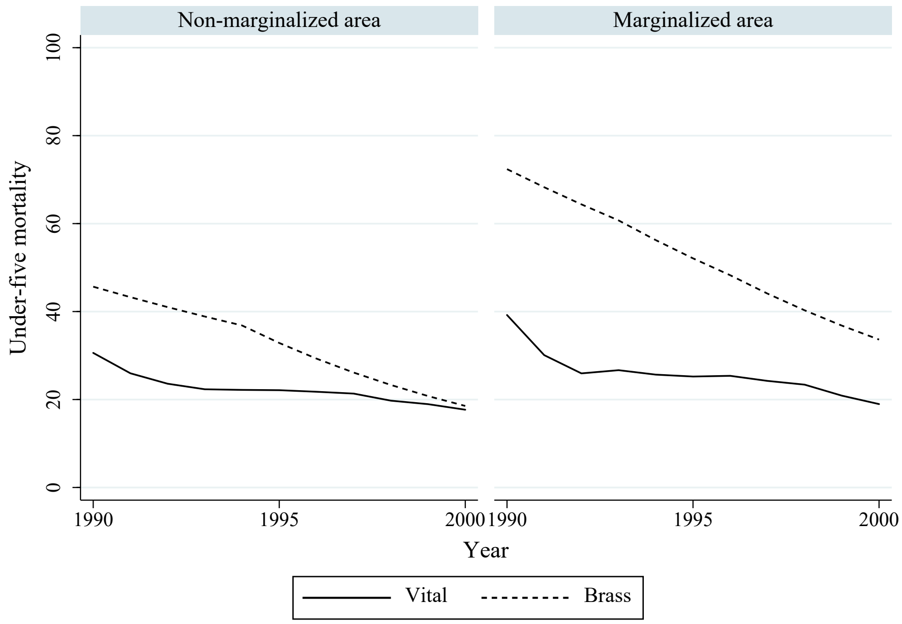


Figure 1.6. Comparison of under-5 mortality in non-marginalized and marginalized areas, Mexico (1990-2005)
Notes: 'Vital' was under-5 mortality using vital statistics on births and deaths, including all late-registered ones. 'Brass' was an indirect estimate of under-5 mortality using census.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican census and Mexican Population Council (CONAPO)

As an additional analysis, I used only vital statistics (1990-2020) to calculate the proportion of late-registered deaths by poverty level of municipalities. I found only 0.03-0.44% of total deaths of children under the age of 5 were registered 1 or more years after the deaths. Late-reporting rate was not significantly different across time or municipalities. Therefore, child deaths had under-reporting problem, while there was little evidence of late-reporting.

1.5. Discussion and Conclusion

Little research has been done on under-registered births and deaths in national vital statistics in developing countries. To fill the gap, this paper studies nationwide evidence of under-reported births and deaths in Mexican vital statistics by comparing fertility and child mortality derived only from vital statistics and those from the Brass method. For fertility, the

Brass P/F ratio adjusted period fertility from vital statistics by leveraging information from census on the number of children ever born to a woman. For mortality, the Brass method employs the age of the mother as a proxy to calculate the children's risk of dying by using information about the number of children ever born, the number of children dead, and maternal age from census. The indirect estimation methods allowed identifying late or under-reported births and deaths in the vital statistics during the early years of Progresa.

The Brass P/F ratio method suggested that there was little evidence of under-reporting of births once late-registered births were taken into account. This result was consistent with the finding of Gamlin and Osrin (2020) that most births were eventually registered due to the requirements for school enrollment and Progresa, although it was common for registration to be delayed until a child was several months or years old. Harbers (2020) also found that enrollment in Progresa was strongly associated with a shorter delay in registration, suggesting that the prospect of program benefits prompted parents to register their children more quickly. The comparison of TFR using different data sources by poverty level of area also indicated that the under-reporting or late-reporting of births was more severe in poorer areas, which supported the first hypothesis.

Child mortality derived only from vital statistics and indirect estimate using the Brass method indicated that child deaths were under-registered in vital statistics, and much more of child deaths were under-registered in marginalized areas than non-marginalized areas. The results supported the second hypothesis that child deaths are under-reported in the Mexican vital statistics, and under-reporting is more severe in poor areas than non-poor areas. The findings aligned with several prior studies (Braine, 2006; Gamlin & Osrin, 2020; Hernández-Prado et al., 2012; Tomé et al., 1997), which used verbal autopsy, medical records review, and ethnographic approach and found the under-reported child deaths in small areas of Mexico. Additional analysis suggested that there was little evidence of late-reporting, which may be because there were less incentives to report children's deaths later compared to births. This paper contributes to the literature by demonstrating the under-reporting of child deaths in nationwide vital statistics.

Although this study suggests crucial findings, there are some limitations to highlight. First, the comparison among estimates from the Brass method and those from vital statistics started from 1990 because vital statistics on deaths has been available since 1990. If the data was available for earlier years, the Brass method would be a useful to estimate how much births and child deaths were under-registered when the vital registration system had lower quality. Second, I was not able to apply the Brass method to indirectly estimate smaller geographic level (e.g., municipality) of fertility or child mortality. This was because the Brass method has been usually used in estimating the national level of fertility and U5MR, while the level of child mortality or fertility should be very high when using the method in smaller geographic areas. Therefore, this chapter compared demographic estimates by categorizing Mexican municipalities into marginalized and non-marginalized areas. It would be more interesting if indirect estimates of fertility and child mortality could be compared among states or municipalities. Finally, the Brass methods for both fertility and child mortality are based on several assumptions. For example, one assumption for fertility is that misreporting of current fertility in vital statistics is constant across all age groups, while under-reporting of recalling children ever born is different across age groups, with older women more likely to under-report. However, it may be possible that misreporting of current fertility was more severe among older women, which can lead to less accurate estimates of adjusted TFR.

Civil registration and vital statistics system provides individuals with documentation needed to establish legal identity and family relationships and to exercise civil and political rights and to participate in modern societies (AbouZahr et al., 2015). The system allows policy makers to understand demographic changes and patterns and to formulate policies and interventions that aim to improve people's social, economic, and health outcomes. In particular, births and deaths are vital indicators of public health and socio-economic development of one country. Exact estimate correcting under-reported vital events is a significant priority for developing countries where reducing fertility and child mortality is the main goal to end poverty and ensure prosperity. Future studies in Mexico should use another demographic method that allows identifying under-reporting of child mortality at smaller geographic level in poor areas of Mexico. Additionally, there is a need to apply a similar method to explore whether births or deaths are under- or late-reported and evaluate the validity of vital statistics in other developing countries.

Chapter 2: Effects of Progresa on Demography and Health

2.1. Introduction

The Conditional Cash Transfer (CCT) program, the most popular anti-poverty policy in Latin America, aimed to alleviate short- and long-term poverty by breaking the intergenerational transmission of poverty (Parker & Todd, 2017). Progresa/Oportunidades (last name Prospera) was Mexico's national CCT program, which provided financial incentives for low-income families to invest in the human capital of their children and to receive health care services.

Progresa's benefits were structured in an innovative way that not only relaxed family budget constraints with cash transfers, but also provided incentives for participating in program activities aimed at improving the educational, health, and nutritional status of families in rural and poor areas (Skoufias & McClafferty, 2001). The cash payments were conditioned on (1) enrollment and regular attendance of school-age children in school; (2) receipt of preventive health care services for all family members; (3) clinic visits by lactating mothers and children aged 0-5 for post-natal care, nutritional supplements and education on nutrition and hygiene; and (4) clinic visits by pregnant women to receive prenatal care, nutritional supplements, and health education (Gertler & Boyce, 2003).

With an integrated focus on education, nutrition, and health services, Progresa encouraged use of health and education services among beneficiary households. Numerous studies have demonstrated that the program has contributed to improving health, education, women empowerment and reducing extreme poverty (Barber & Gertler, 2008; Behrman &

Hoddinott, 2005; Gertler & Boyce, 2003; Huerta, 2006; Ozer et al., 2009; Parker & Todd, 2017; Parker & Vogl, 2018; Rivera et al., 2004; Segura-Pérez et al., 2016; Skoufias, 2005; Skoufias & McClafferty, 2001). Progresa has been a model for more than 60 countries where similar CCT programs also have been implemented.

Despite its popularity and emphasis on health and family planning, there is limited research on how Progresa has affected Mexican demographic and health outcomes. This chapter examines the effects of Progresa on fertility, child mortality, and maternal health in poor and rural areas, using the phasing-in over time of the program. Fertility measures included age-specific fertility rates (ASFR) and total fertility rate (TFR). Child mortality was measured using the under-5 mortality rate (U5MR), while maternal health was assessed by place of delivery (public clinic, private clinic, and home) and type of birth attendant (physician and nurse or midwife). I used nationwide vital statistics combined with census and administrative information on program beneficiaries and poverty index at the municipal level. The main strategy was difference-in-difference estimations using variations in the beneficiaries of Progresa across municipalities and time (1990-2010). First, Progresa was found to significantly reduce 0.41-0.50 births during a woman's lifetime in poor and rural areas. In particular, teenage pregnancy was decreased by 13-18%. Although Progresa also reduced child mortality by 19% through the reduction in infectious and parasitic disease and conditions originating in the perinatal period, the effect was only temporary. Lastly, the program improved maternal health: it significantly increased institutional deliveries and birth attendance by physician, while decreasing childbirth at home and birth attendance by nurse or midwife. This chapter proves that Progresa successfully contributed to enhancing health outcomes and reducing fertility among poor and rural households. The findings suggest crucial public health and demographic implications for Mexico and other developing countries where CCT programs are implemented.

2.2. Progresa and Demographic and Health Outcomes

2.2.1. Program description

Progresa was introduced as an anti-poverty program to replace existing food subsidies that generally targeted urban areas (Levy, 2006). The replacement of food subsidies with Progresa indicated a major shift in anti-poverty spending from primarily urban areas to primarily rural areas. Due to logistical reasons and budget constraints, localities received the benefits from the program in phases (Skoufias & McClafferty, 2001). Figure 2.1 shows the number of Progresa beneficiaries during 1997-2010. The program first operated in small rural communities in 1997 and extended benefits to 2.6 million families in 50,000 rural villages over the first three years of its existence, accounting for 40% of rural families and 10% of all families in Mexico (Gertler, 2004). Beginning in 2000, it gradually expanded to urban areas. Progresa was one of the oldest and best-known CCT programs, supporting 7 million low-income families through direct monetary transfers.

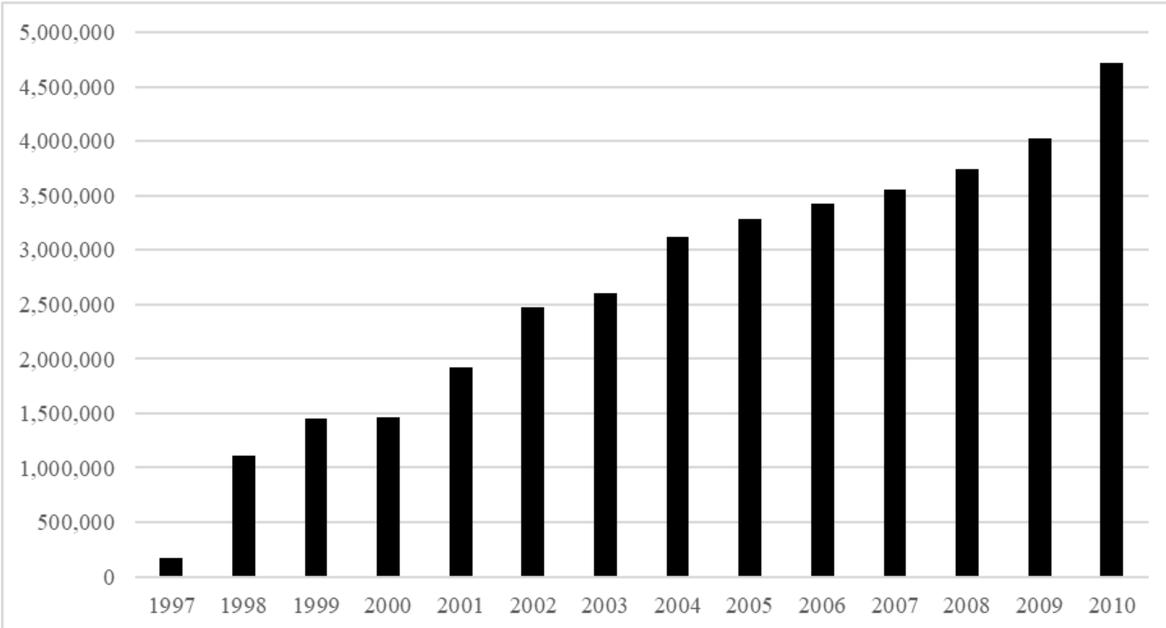


Figure 2.1. The number of Progresa beneficiaries, Mexico (1997-2010)

As Progresa targeted poor households, the proportion of beneficiaries was higher in poor and rural areas. Figure 2.2 compares municipality average of the program intensity in marginalized and non-marginalized areas. The program intensity was defined as the number of beneficiaries in the total number of households. The areas were classified according to the Margination Index produced by the Mexican Population Council (CONAPO) based on census.[8]Marginalized areas included municipalities with high and very high margination index, while non-marginalized areas included municipalities with medium, low, and very low margination index. The figure shows a more substantial and rapid increase of the program intensity in marginalized areas than the non-marginalized areas during 1997-2010.

[8] To select eligible poor rural communities, government classified municipalities using a Margination Index using the nine-municipality level socioeconomic variables from census. The variables included the share illiterate, the share with less than primary school education, the share without a toilet, the share without electricity, the share without running water, the share with crowding (few rooms per capita), the share with a dirt floor, the share living in communities with less than 5000 inhabitants, and the share earning less than twice the minimum wage.

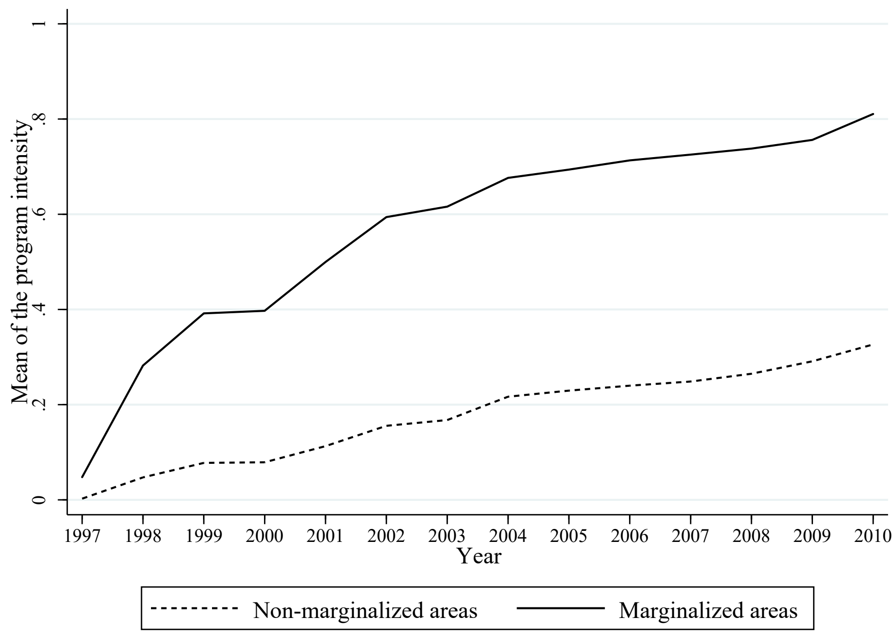


Figure 2.2. Municipality average of program intensity in non-marginalized and marginalized areas, Mexico (1990-2010)
Note: Program intensity was the number of beneficiaries in the total number of households.
Source: Progresa administrative information and Mexican Population Council (CONAPO)

The size of the cash transfer was large, accounting for a 25% increase in household incomes for beneficiaries living in extreme poverty (Parker & Todd, 2017). The average monetary benefits per household increased substantially over time, reflecting that the additional benefits were added to the program. The monthly benefits per household were estimated at 800 pesos, and the budget for the program accounted for 0.5% of GDP. All cash payments were given to the mother or female head of the family.

Table 2.1 shows the summary of the program's benefits by component. The education component provided cash payments in lump sums every 2 months only for children in primary and middle schools (grade 3 to 9). Payments were extended to include children in high school (grade 10 to 12) in 2001. The payment amounts increased with each grade and 15% higher for girls than for boys from middle schools to high schools (grade 7 to grade 12) to account for the higher school drop-out rate among girls in poor areas who had finished primary school. Specific monthly grant amounts (in 2017) ranged from 175 pesos for third graders to 980 pesos for boys and 1,120 pesos for girls in the third year of senior high school. For families to receive benefits, children had to be enrolled in school and be in attendance at school for at least 85% of school days (Parker & Todd, 2017; Skoufias & McClafferty, 2001).

The health and nutritional components of Progresa targeted all households but had a special emphasis on mothers and children. The services were provided by public hospitals and clinics. The program provided a fixed grant to all beneficiaries and nutritional supplements to pregnant and lactating women and to children between the ages of 4 months and 2 years. These supplements were also given to children between 2 and 5 years with clinical signs of malnutrition. Beneficiary mothers visited clinics at least once a month to pick up the supplement, which included whole dry milk, sugar, maltodextrin, vitamins, and minerals. To receive monthly cash payment (335 pesos), all family members were required to visit clinics and beneficiary mothers were required to attend nutrition and health education seminars. The services were provided by public health institutions. Various topics on preventive health care were discussed in these lectures, including hygiene, infectious diseases, immunization, family planning, and chronic diseases. The lectures also covered appropriate use of the supplements, child feeding and feeding during pregnancy and lactation (Parker & Todd, 2017; Skoufias, 2005).

Table 2.1. Progresa's benefits by component

Component	Benefits	Directed to
Education	Education scholarships	Children attending primary, middle, and high schools
	School supplies in cash or in kind	
Health	Health care services and healthcare workshops • Basic hygiene and vaccinations • Prevention and treatment of diarrhea, respiratory infections, tuberculosis, high blood pressure and diabetes • Accident prevention and first aid for injuries	All household members
	Prenatal, childbirth, and postnatal care	Pregnant and lactating women
	Monthly health and nutrition education seminars	Mothers
Nutrition	Nutritional supplements	Pregnant and lactating women, children aged 4 months to 2 years, children aged 2 to 5 who have malnutrition
	Food support through cash payment	All household members
	Childhood support through cash payment	Children aged 0 to 9

Source: Lárraga (2016); Parker & Todd (2017)

2.2.2. Targeting and eligibility

To determine the eligibility of low-income households to participate in Progresa, beneficiary households were identified through two stages of the selection process. In the first stage, poor rural localities were ranked by the Margination Index (geographic targeting), a locality level measure of poverty produced by the Mexican Population Council (CONAPO) based on census (Skoufias & McClafferty, 2001).[9] Only localities with a high or very high degree of marginality were considered as priorities for the program. Due to logistical and financial problems as well as Progresa's components that required the use of education and health services, other criteria were considered: geographic location, distance between localities,

[9] Components of the Margination Index included the share illiterate, the share with less than primary school education, the share without a toilet, the share without electricity, the share without running water, the share with crowding (few rooms per capita), the share with a dirt floor, the share living in communities with less than 5000 inhabitants, and the share earning less than twice the minimum wage.

and the existence of health and school infrastructure (Skoufias et al., 2001). Using information on population density and the geographical information, localities were grouped into marginality zones. During the process, any locality with less than 50 inhabitants, or that was determined to be geographically isolated was excluded from the program. Since the restrictions were necessary for the operation of Progresa, excluding these localities was not considered as mistargeting.

In the second stage, the program conducted a survey on households' socioeconomic characteristics within the selected localities, which was named as Encuesta de Características Socioeconómicas y Demográficas de los Hogares – ENCASEH survey. The survey collected the data on multidimensional nature of poverty, such as dwelling conditions, dependency ratios, ownership of assets, and the presence of disabled individuals, through interview[10] with a respondent in the household (Lárraga, 2016). A welfare index was established using total household income calculated based on these data, and then households were categorized as poor and non-poor. Only the poor were eligible for Progresa benefits. The list of potential beneficiaries was presented to a community assembly for final approval. When households agreed to participate in the program, they were provided with program registration forms for schools and the family clinic. As most of the selected households enrolled in the Progresa in rural areas, there is little concern about self-selection in program participation (Parker & Todd, 2017). Skoufias and colleagues (2001) demonstrated that the program performed well in targeting the poorest households.

For three years, beneficiary families were able to remain in the program without further verification of their socioeconomic status. After three years, interviews were conducted so that

[10] For detailed information on the data collected, please refer to the Encuesta de Características Socioeconómicas y Demográficas de los Hogares - ENCASEH at https://www.prospera.gob.mx/swb/work/Web2015/documentos/TransparenciaFocalizada/ENCASEH_2014_V1.pdf

their eligibility status was renewed, or they were transitioned to a scheme of partial benefits. The partial benefits included only secondary and high school educational subsidy but excluded primary-school subsidy and cash payment associated with the health and nutritional component (Parker & Todd, 2017).

2.2.3. Trends of demographic and health outcomes

2.2.3.1. Fertility

Fertility is an important factor of shaping the overall demographic structure, which is affected by socioeconomic changes. Fertility declines when the incentives to have children are changed (e.g., higher opportunity cost due to women's higher education) or women have better access to contraceptive methods (Bryant, 2007). Therefore, fertility has a close relationship with women's socioeconomic status and national development. In particular, teenage pregnancy is a significant indicator of women's empowerment and well-being: it increases the risk of morbidity and mortality and limits opportunities for education and labor force participation, thus contributing to the cycle of poverty and inequalities (Parsons & Mccleary-Sills, 2014; Perez-Amador & Giorguli, 2018). Moreover, children born into early marriages are more likely to have worse health and educational outcomes (Bellés-Obrero & Lombardi, 2020; Chari et al., 2017; Sekhri & Debnath, 2014). Therefore, eradicating early pregnancy is a key target of the Sustainable Development Goal (SDG) that should be achieved by the year 2030 for gender equality and empowerment of all women and girls.

Along with socioeconomic growth, fertility has been falling in Mexico in recent decades. TFR (number of children who would be born per woman) declined from 4.84 in 1980 to 2.13 in 2018. The largest part of the fertility decline was attributed to the increase in modern contraceptives (Barber, 2007; Pullum et al., 1985). In the 1980s, the Mexican government developed community-based programs to introduce and distribute contraceptives use (Potter et al., 1987), increasing the contraceptive prevalence rate from 30% in 1976 to 60% in 2005 (Barber, 2007; United Nations Population Fund, 2005). However, teenage pregnancy is still prevalent in the country. Mexico has the highest adolescent fertility rate among the member countries of the Organization for Economic Co-operation and Development (OECD), with 59 out of every 1,000 pregnancies in girls and adolescents (United Nations World Population Prospects, 2019). Studies have found that early marriage and pregnancy are more common in Mexican rural areas and among less privileged girls in terms of education or socioeconomic status (Hubert et al., 2019; United Nations Children's Fund, 2019).

Figure 2.3 shows municipality average of ASFRs in marginalized and non-marginalized areas in 1990-2010. The figure demonstrates the overall decrease in ASFR, with larger reductions for women aged 20 to 29 and smaller reductions for both teenagers and women over 30. Although all ASFR estimates including teenage pregnancy are much higher in marginalized areas compared to non-marginalized areas, the overall decline in fertility was more significant in marginalized areas over time.

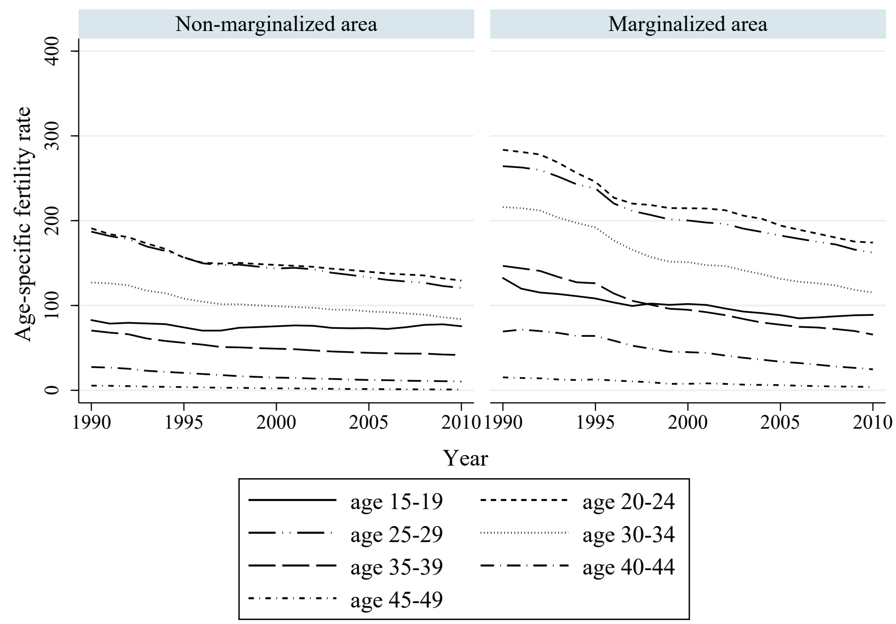


Figure 2.3. Municipality average of age-specific fertility rates in non-marginalized and marginalized areas, Mexico (1990-2010)
Note: Age-specific fertility rate was the number of live births occurring during a given year per 1,000 women of reproductive age classified in 5-year age groups.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI) and Mexican Population Council (CONAPO)

2.2.3.2. Child mortality

Child mortality is a major indicator of the level of child health and the degree of progress in a country in the areas of social and economic development. Reducing child mortality was one of the eight Millennium Development Goals (MDGs) established by the United Nations Member States to be achieved by 2015 in a global effort to reduce extreme poverty. One specific target for this goal was to reduce the U5MR by two-thirds between 1990 and 2015 (United Nations General Assembly, 2000). Mexico successfully achieved this goal with a 64.2% reduction in U5MR (45.3 in 1990, 16.2 in 2015). Figure 2.4 shows that the decline was more pronounced in marginalized areas, particularly during the 1990-2000, compared to non-marginalized areas. However, it should be noted that many of child deaths have been under-reported in marginalized areas (Hernández-Prado et al., 2012; Tomé et al., 1997) due to physical distance, cultural and language barriers, and lack of health care centers (Farmer et al., 2006; Holmes, 2012).

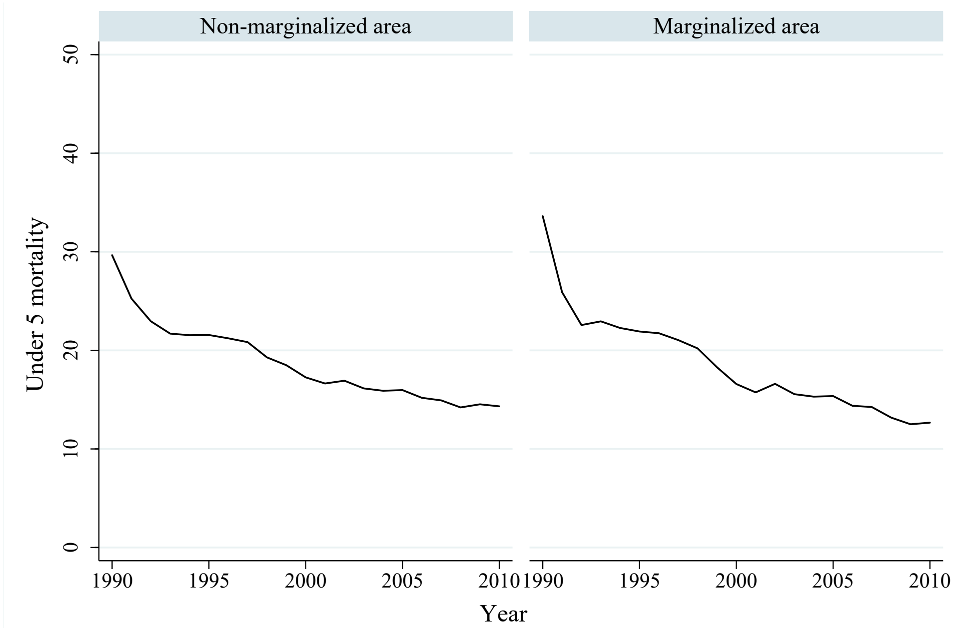


Figure 2.4. Municipality average of under-5 mortality rate in non-marginalized and marginalized areas, Mexico (1990-2010)
Note: Under-5 mortality rate was the number of children who die by exactly 5 years of age per 1,000 live births.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI) and Mexican Population Council (CONAPO)

The substantial reduction in child mortality was related to the introduction of several health interventions in the early 1990s, including the Universal Vaccination Programme, the Clean Water Programme, and the National Health Weeks (Sepúlveda et al., 2006). The National Health Weeks offered free oral rehydration salts and a basic package of health services to households, and the Clean Water Programme focused on water chlorination, appropriate disposal of waste, and the maintenance of drainage systems. The Vaccination Program was adopted after a measles epidemic in 1989-1990 to provide comprehensive immunization (Frenk et al., 2003). These public health intervention programs largely contributed to the remarkable decrease in the main causes of death in children under 5 years, such as diarrhea, lower respiratory infections, low birthweight, and birth asphyxia (Gutierrez et al., 1999; Sepúlveda et al., 2006).

Another possible factor that might contribute to the reduction in child mortality was an increase in family planning and decrease in fertility (Hobcraft, 1987). Births that occur at the extremes of maternal age and those after very short birth intervals have higher mortality risks. Increased access to contraceptive usage could reduce these births in high risk and more health care resources could be used to fewer infants (Bongaarts, 1997), contributing to the decrease of adverse birth outcomes and infant mortality (Kozuki et al. 2013; Saha & van Soest, 2013).

Nonetheless, the poor and indigenous populations in rural areas still have high child mortality due to high levels of poverty and the lack of access to health care services. For example, the U5MR was 76 per 1,000 live births in the predominantly indigenous municipalities in 2005, which was estimated as 20 at the national level (Gamlin & Osrin, 2020). In addition, stillbirths and child deaths were underreported in many marginalized areas. Using a representative sample of 101 marginalized municipalities, Hernández-Prado et al. (2012) demonstrated that child deaths under 5 years old were underreported by 23% in 2007, while Tomé et al. (1997) estimated the underreporting of deaths under 5 as 69%–73% in Guerrero state in 1993-1994. Using ethnographic methods, a recent study by Gamlin and Osrin (2020) also suggested a low rate of death registration in indigenous communities, with the custom of burying infants where they died.

2.2.3.3. Maternal health

Maternal health is an indicator of national development, public health, poverty, and equality levels. For example, women living in poor, rural, indigenous states of Mexico have a two or three times higher risk of maternal mortality compared to those in non-poor areas (Rodríguez-Aguilar, 2018). Compared to several Latin American countries, Mexico has improved maternal health indicators such as use of contraceptives (Naciones Unidas, 2010); however, it is still one of countries with the highest rate of maternal mortality and lowest prevalence rate of using contraceptives in the OECD (OECD/World Bank, 2020). This threatens not only women's survival and well-being, but also children's survival and health in Mexico (Finlay et al., 2015).

Institutional deliveries and skilled birth attendants are key indicators of improved infant and maternal health (Campbell & Graham, 2006; Carlough & McCall, 2005; Gupta et al., 2012; Randive et al., 2013). Research of Latin America and the Caribbean countries has demonstrated that maternal mortality is inversely related to the coverage of deliveries in health facilities and skilled births attendance (Organization for Economic Co-operation and Development & World Bank, 2020). Mexican women in rural and poor communities are still less likely to have institutional deliveries and professional attendance at delivery due to the lack of geographic, economic, and social access to medical care, which leads to a higher risk of mortality (Rodríguez-Aguilar, 2018).

Figure 2.5 compares the municipality average of place of delivery in non-marginalized areas and marginalized areas during 1990-2010. In non-marginalized areas, the proportion of childbirth at public clinics continuously increased from 57.5% in 1990 to 79.3% in 2010, while the proportion of childbirths at home decreased from 21.3% to 1.8%. In marginalized areas, the proportion of deliveries at public clinics rapidly increased from 21.9% in 1990 to 72.5% in 2010, whereas the proportion of childbirths at home significantly decreased from 65.1% to 15.1%.

However, the institutional deliveries were relatively lower and home deliveries were still more common in marginalized areas than the counterparts.

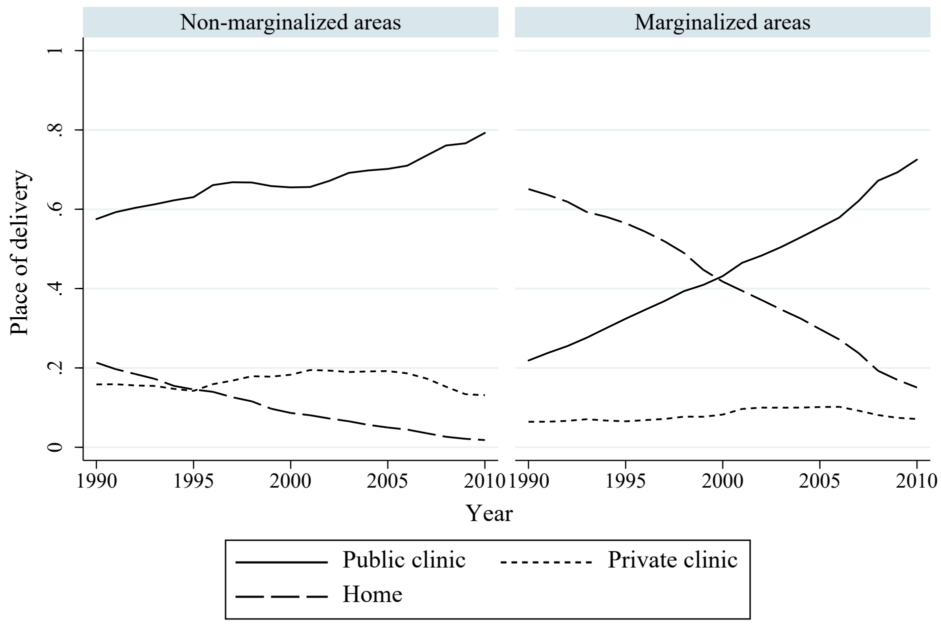


Figure 2.5. Municipality average of place of delivery in non-marginalized and marginalized areas, Mexico (1990-2010)
Note: The proportion of births at public clinic, private clinic, and home in total births was examined.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI) and Mexican Population Council (CONAPO)

Figure 2.6 indicates the type of birth attendants in non-marginalized areas and marginalized areas during 1990-2010. As the data of birth attendance by nurse and by midwife were aggregated in early years, it was not able to examine the trends of them separately. In non-marginalized areas, the proportion of birth attendance by physician was more than 80% since 1996 and it had been slightly increasing until 2010. The proportion of birth attendance by nurse or midwife had been constantly decreasing since 1990. In marginalized areas, the proportion of birth attendance by physician significantly increased from 28.7% in 1990 to 78.5% in 2010. The proportion of birth attendance by nurse or midwife was estimated at approximately 67.3% in 1990 and it rapidly decreased to 16.4% in 2010. The figure implies that maternal health indicators had been significantly improved in marginalized areas, but it was still worse compared to non-marginalized areas.

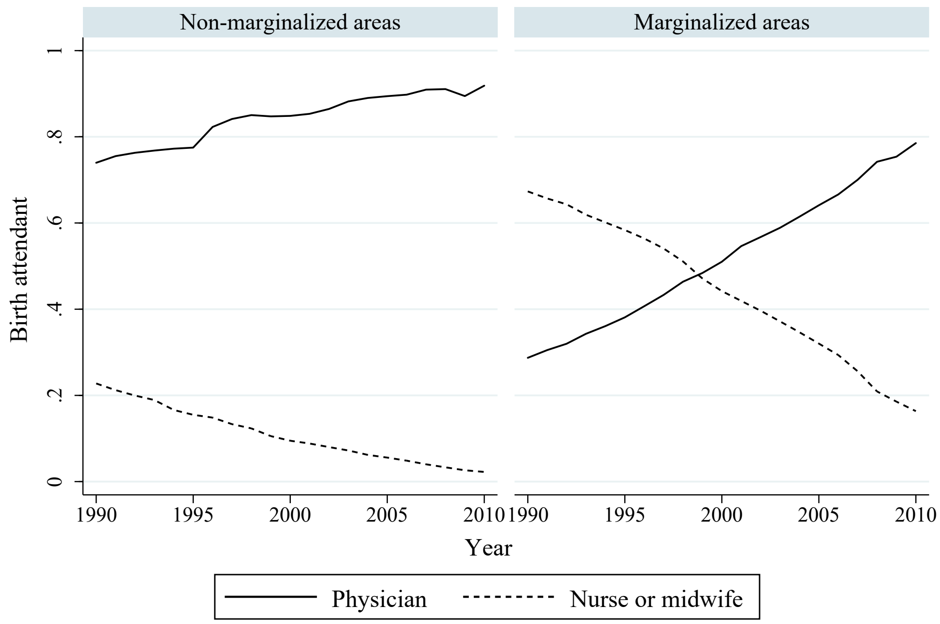


Figure 2.6. Municipality average of the proportion of birth attendance in non-marginalized and marginalized areas, Mexico (1990-2010)
Note: The proportion of birth attendance by physician and nurse or midwife in total births was examined.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI) and Mexican Population Council (CONAPO)

2.3. Research Questions

2.3.1. Fertility

The program was expected to affect fertility behavior either by: (1) encouraging fertility by linking benefit amounts to the number of children in household (price effect); or (2) discouraging fertility because public health lectures emphasized family planning (Stecklov et al. 2007) or because participating parents would want fewer children to invest more in each child (Becker & Lewis, 1973) or because young women attending school to meet the program's requirements would be less likely to have children.

Previous studies on Progresa's actual impact on fertility had conflicting results. Using the experimental data from the first eighteen months, Todd and Wolpin (2006) and Stecklov et al. (2007) concluded that Progresa did not have significant effects on overall fertility. Darney et al. (2013) also argued that the program did not have a direct effect on adolescent pregnancy using a survey in 1992, 2006, 2009. Feldman et al. (2009) reported that Progresa beneficiaries were more likely to use modern contraceptives than the non-beneficiaries, while birth spacing was similar between the beneficiaries and controls. By contrast, Gulemetova-Swan (2009) found that the program delayed marriage and childbirths of adolescent girls in urban areas. However, the prior studies share the limitation of using evaluation data or household survey data during a short initial period of Progresa's existence.

Given the emphasis on girls' enrollment and regular attendance in school, the program would negatively affect fertility among young women (ages 15 to 19), while it would not have significant net effect among older women (ages over 20). Therefore, I posited the first hypothesis as follows:

> Hypothesis 1. *Progresa reduces pregnancy among young women (ages 15 to 19), with ambiguous effects on fertility among older women in marginalized areas.*

2.3.2. Child mortality

In addition to education, Progresa aimed to improve the health and nutritional status of impoverished households, particularly for infants, children, and pregnant and lactating women. Monetary payments were provided conditional on growth monitoring from conception to age 5; regular preventative health check-ups for household members, including prenatal care and immunizations; and mother's attendance at health, hygiene, and nutrition education talks

(Barham, 2011). The nutritional benefits included nutritional supplements and treatment for parasites, principally targeted to children between the ages of four months and two years, and pregnant and lactating women (Parker & Todd, 2017). There has been evidence on the contribution of Progresa to improving health and nutritional status of young child (Andalón, 2011; Barber & Gertler, 2008; Behrman & Hoddinott, 2005; Gertler, 2004; Glassman et al., 2013; Ozer et al., 2009; Parker & Todd, 2017).

The only previous study on this topic that I am aware of was by Barham (2011), who found that Progresa reduced infant mortality by 17% in 2001 by reducing intestinal and respiratory diseases and alleviating nutritional deficiencies. However, Barham's study was limited to short-term effects, observed during the first few years of Progresa's existence (1997-2001).

Health and nutritional components of Progresa were designed to reduce the major causes of child mortality, such as child respiratory diseases, intestinal infections, and malnutrition by providing vaccinations, health education, and prenatal, childbirth, and postnatal care. Therefore, I postulated the following hypothesis:

Hypothesis 2. *Progresa reduces child mortality in marginalized areas through the reduction in infection, respiratory disease, and nutritional deficiency*.

2.3.3. Maternal health

Although Progresa did not provide any incentives for institutional deliveries and skilled birth attendants, it had pathways that might potentially affect the outcomes. First and most obvious mechanism is through an income effect. As the disposable income from Progresa was given to women, cash transfer might be spent on women-specific good and health services related to delivery outcomes (Handa et al., 2016), such as institutional deliveries and skilled birth assistance. Second, the program required pregnant women to visit clinics regularly to receive prenatal care, nutritional supplements, and health education. Visiting clinics and receiving health care may introduce them to a broad range of reproductive and health services in the clinics, such as deliveries at medical units (Barber, 2010). Finally, women were required to attend nutrition and health education seminars, which provided information on the importance of care during pregnancy and childbirth. Through these mechanisms, Progresa might increase the likelihood of delivering a birth at clinic rather than at home and having a medical professional as a birth assistant rather than a midwife.

Only one previous study examined the effects of Progresa on relevant maternal health indicators. Urquieta et al. (2009) showed that Progresa increased skilled attendance at delivery in rural areas of Mexico, which was defined as deliveries attended by either physicians or nurses or in a healthcare facility. However, this study was limited to the early evaluation data in 1997-2000.

Based on the possible mechanism that Progresa could enhance maternal health, two hypotheses were established. As the data on birth attendance by nurse and by midwife could not be disaggregated, I combined them together.

Hypothesis 3. *Progresa reduces childbirth at home and increases institutional deliveries in marginalized areas.*

Hypothesis 4. *Progresa reduces birth attendance by nurse or midwife and increases birth attendance by physician in marginalized areas.*

2.4. Data and Methods

2.4.1. Data

To investigate the effects of Progresa on demographic and health outcomes, nationwide vital statistics data on births, and deaths (1990-2017) were drawn from the Mexican National Institute of Statistics and Geography (INEGI).[11] The vital statistics contains information on the place and date that a birth and a death occurred, and they were reported. For the denominator of fertility, population data were pooled from census (1990, 1995, 2000, 2005, 2010), also available in INEGI. Linear interpolation was used to obtain the population data for the years when the data was not available. The vital statistics and censuses were combined with nonexperimental administrative information (1997-2010) on the number of households enrolled in Progresa by year and by municipality, provided by Progresa administrative personnel. The main identification strategy was difference-in-difference estimation, using variations in the beneficiaries of Progresa across geographic areas and years (Parker & Vogl, 2018). As the vital statistics are available at the locality level only since 2002, all analyses were conducted at the municipality level, a larger geographic unit than locality. The regression analyses were restricted to marginalized municipalities identified as eligible by Progresa in 1997.

2.4.2. Measures

The independent variable was Progresa intensity in each municipality. It was a ratio of the cumulative number of beneficiary households in each year of the program to the total number of households in each municipality in the pre-program year (1990) to ignore changing number of

[11] Due to late-reporting of vital events, more years of vital statistics (2011-2017) were included.

households after the program. Progresa intensity was used as a continuous variable, ranging from 0 to 1.

Dependent variables were fertility, child mortality, and maternal health. Fertility was measured by ASFR and TFR. ASFR was defined as the number of live births occurring during a given year per 1,000 women of reproductive age classified in 5-year age groups. ASFR measured the age pattern of fertility, the relative frequency of childbearing among women of different ages within the reproductive years. Based on the ASFR, TFR was constructed, defined as the total number of children born to a woman in her lifetime if she were subject to the prevailing rate of ASFRs in the population. The Brass P/F ratio method in chapter 1 indicated that there was little evidence of under-reported births once late-registered births were considered. Therefore, I collapsed the birth data (1990-2017) by year of birth to consider all late-registered births in vital statistics.

Child mortality was represented by under-5 mortality rate (U5MR), which is the number of children who die by exactly 5 years of age per 1,000 live births. The differential impacts of the program were examined by gender and by cause of death, given the program's focus on specific intervention and its emphasis on gender. The cause of death was classified based on the International Classification of Diseases-10 (ICD-10) classification and U.S. Centers for Disease Control and Prevention, and I included six major causes that accounted for infant mortality in Mexico: (1) infectious and parasitic diseases; (2) endocrine, nutritional and metabolic diseases; (3) diseases of the respiratory system; (4) certain conditions originating in the perinatal period; (5) congenital malformations, deformations and chromosomal abnormalities; and (6) accidents. The effects on deaths caused by accidents were examined as a falsification test as it seems unlikely that they would be affected by the benefits of Progresa. Although the results based on the Brass method in chapter 1 suggested that deaths of children aged under 5 were under-reported in poor and rural areas, I was not able to correct under-reporting of child deaths in estimating the effects of Progresa on child mortality. This was because the Brass method can be applied to adjust U5MR only when the rates are high enough, while the municipality level of U5MR were too low in some areas of Mexico, particularly in 2000s. If the different levels of under-reporting in municipalities were consistent over time, the estimations would not be biased due to time fixed effects. Additionally, if under-reporting did not change over time within a municipality, the estimates would not be biased due to municipality fixed effects. However, any changes in under-reporting over time and across municipalities that were correlated with Progresa would bias the results. The death data (1990-2017) were collapsed by year of death.

Maternal health indicators included place of delivery and type of birth attendant. I constructed the proportion of births at (1) public clinic, (2) private clinic, and (3) home in total births was examined. For the type of birth attendant, the proportion of birth attendance by (1) physician and (2) nurse or midwife in total births. All health and demographic outcomes were constructed at the municipality level for each year.

2.4.3. Model estimation

First, the pre-intervention trends were tested to examine whether each dependent variable was similar across municipalities before the program started. I compared the difference in mean of fertility, child mortality and maternal health indicators among five municipality groups for the years 1990-1996 by using the equation (following the approach for testing for pre-trends in Barham, 2011):

$$Y_{mt} = \beta_0 + \sum_{j=1990}^{1995} \beta_j \, Year_{jt} + \sum_{j=1990}^{1995} \sum_{k=2}^{5} \sigma_{jk} Year_{jt} * Municipality\ group_{km} + X_{mt} + \delta_m + \varepsilon_{mt}$$

where Y were TFR, ASFR, U5MR, place of delivery and type of birth attendant in municipality m in time t. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999. 1996 and group 1 were excluded as reference groups. Covariates (X_{mt}) were characteristics of municipalities, which were components of the Margination index (i.e., percent of illiterate population, percent of household without piped water and percent of household without electricity), interpolated using census in 1990, 2000, 2005, and 2010. Fixed effects on municipality (δ_m) were included. σ estimated the difference in the mean of health and demographic outcomes between each of the other groups during 1990-1995 and group 1 in 1996. If σ was not significantly different from zero, the pre-intervention trends would be statistically similar between the municipality quintiles.

To estimate the effects of Progresa on fertility, child mortality, and maternal health indicators, I estimated the following equation:

$$Y_{mt} = \beta_0 \, Progresa \; intensity_{m,\, t-1} + X_{mt} + \delta_m + \gamma_t + \varepsilon_{mt}$$

where *Progresa intensity* was percent of cumulative beneficiary households in m municipality and in time t-1 (t-3 and t-5 for 3 and 5 years lagged specification). Covariates (X_{mt}) were components of the Margination index (i.e., percent of illiterate population, percent of household without piped water and percent of household without electricity), which were interpolated using census in 1990, 2000, 2005, and 2010. Fixed effects on municipality (δ_m) and year (γ_t) were included to control for time-variant and time-invariant unobservable variables. The treatment effect of Progresa on the treated was estimated by β_0. If unobserved time-varying municipality characteristics were correlated with program intensity, the estimates β_0 would be biased. The analysis relied on the assumptions: (1) in absence of Progresa, the differences of outcome variables among municipalities with different Progresa intensity were constant over time; (2) no spillover effects. The time period for data analysis was from 1990 to 2010. I used 1, 3, and 5 years lagged specification, assuming the proportion of program beneficiaries in 1, 3, and 5 year-ago period affected the outcomes in the next period. All regressions were weighted by the total number of populations in a municipality.

2.5. Results

2.5.1. Descriptive statistics

Table 2.2 reports the characteristics of households in the areas in pre-program year. In 1990,

Table 2.2. Descriptive statistics of the population in non-marginalized and marginalized municipalities before Progresa (1990), Mexico (%)

	Not marginalized areas	Marginalized areas
Cumulative beneficiaries up to 1999	0.08 (0.10)	0.39 (0.20)
Cumulative beneficiaries up to 2005	0.23 (0.18)	0.72 (0.28)
Illiterate population	13.34 (6.58)	33.51 (13.38)
With less than primary education	45.77 (12.33)	69.68 (9.69)
Without a toilet	25.91 (16.63)	60.15 (18.58)
Without electricity	11.78 (10.27)	36.75 (24.86)
Without running water	19.34 (14.81)	50.57 (24.11)
With crowding[12]	59.82 (9.80)	74.10 (8.26)
With dirt floor	22.08 (14.24)	62.14 (21.56)
In communities with less than 5,000 inhabitants	60.29 (36.19)	95.40 (13.69)
Earning less than twice the minimum wage	69.25 (11.65)	85.87 (8.50)
N	1,232	1,140

Note: The table reports sample mean (%) of each variable, while standard deviations are in the parentheses.
Source: Mexican census (1990)

[12] The share with crowding is measured by the number of rooms divided by household size.

before the program started, households in marginalized municipalities had lower socioeconomic characteristics and poor dwelling conditions compared to those in non-marginalized municipalities.

2.5.2. Pre-intervention trends

2.5.2.1. Fertility

Figure 2.7 shows the differences in means of TFR before the program between group 1 in 1996 and the other groups over years in marginalized municipalities. In 1990, the average of TFR at the municipality level was 4.56. As the differences for group 5 (municipalities with the highest proportion of beneficiaries of Progresa in 1999) were significantly different from zero in some years, group 5 was excluded. Except for group 5, the pre-intervention trends were statistically similar among the marginalized municipality groups (see Appendix T2.1). The results for the pre-intervention trends of ASFR are reported in the Appendix F2.1 and T2.2, which also indicates that the coefficients of the interaction terms of group and year were statistically insignificant. Due to the pre-intervention trends, the main analysis excluded group 5.

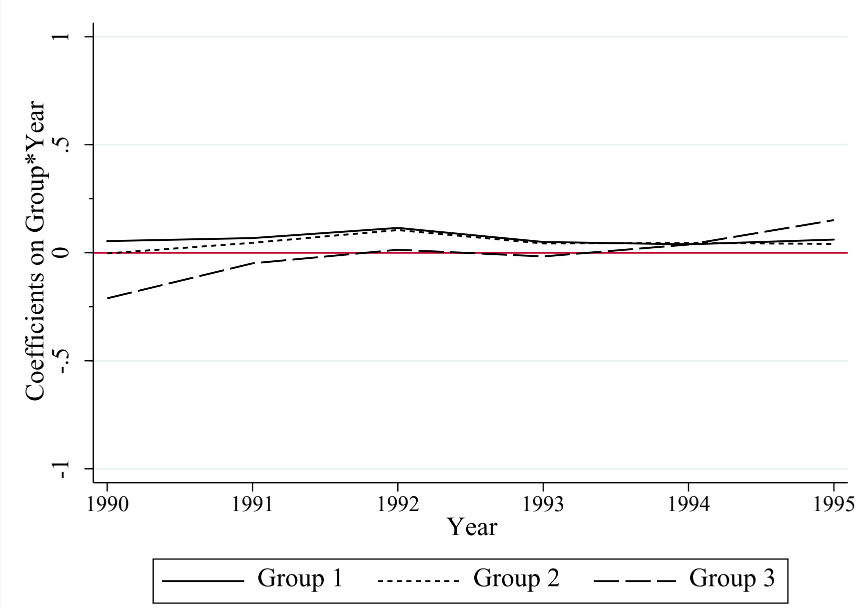


Figure 2.7. Coefficients on pre-intervention trends: difference in mean of total fertility rate between group 1 in 1996 and other groups by year, marginalized municipalities, Mexico
Notes: Dependent variable was total fertility rate, the total number of children born to a woman in her lifetime if she were subject to the prevailing rate of age-specific fertility in the population. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999 (group 1: the lowest proportion of beneficiaries of Progresa – group 5: the highest proportion of beneficiaries of Progresa). 1996 and group 1 were excluded as reference groups. Group 5 was excluded due to pre-intervention trends.
Source: Instituto Nacional de Estadistica y Geografia and Mexican Census

2.5.2.2. Child mortality

Figure 2.8 presents the differences in means of U5MR before Progresa between group 1 in 1996 and the other groups over years in marginalized municipalities. In 1990, the municipality average of U5MR was 30.0. Most of the coefficients of the interaction terms of group and year were statistically insignificant, which implies that pre-intervention trends were similar among municipality groups from 1990 to 1996 (see Appendix T2.3). The results for U5MR by gender are reported in Appendix T2.3 and F2.2, which also indicate that there were no statistically significant pre-intervention trends.

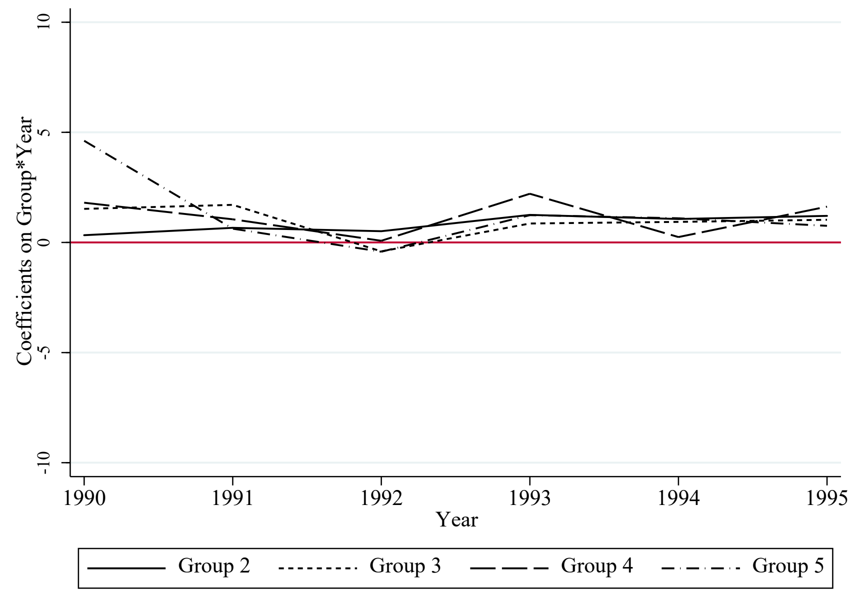


Figure 2.8. Coefficients on pre-intervention trends: difference in mean of under-5 mortality rate between group 1 in 1996 and other groups by year, marginalized municipalities, Mexico
Notes: Dependent variable was under-5 mortality rate, the number of children who die by exactly 5 years of age per 1,000 live births. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999 (group 1: the lowest proportion of beneficiaries of Progresa – group 5: the highest proportion of beneficiaries of Progresa). 1996 and group 1 were excluded as reference groups.
Source: Instituto Nacional de Estadistica y Geografia and Mexican Census

2.5.2.3. Maternal health

Figure 2.9 shows the differences in means of the proportion of deliveries by place of delivery before the program between group 1 in 1996 and the other groups in 1990-1995 in marginalized areas. Each graph presents the differences in means of proportion of deliveries at public clinic, private clinic, and home, respectively. In 1990, the municipality mean of the proportion of deliveries was 0.27 at public clinic, 0.08 at private clinic, and 0.60 at home. Group 5 (municipalities with the highest proportion of beneficiaries of Progresa in 1999) was excluded because the differences were significantly different from zero in some years. Except for group 5, most of the coefficients of the interaction terms of group and year were statistically insignificant, which means that the pre-intervention trends were similar among groups from 1990 to 1996 (see Appendix T2.4).

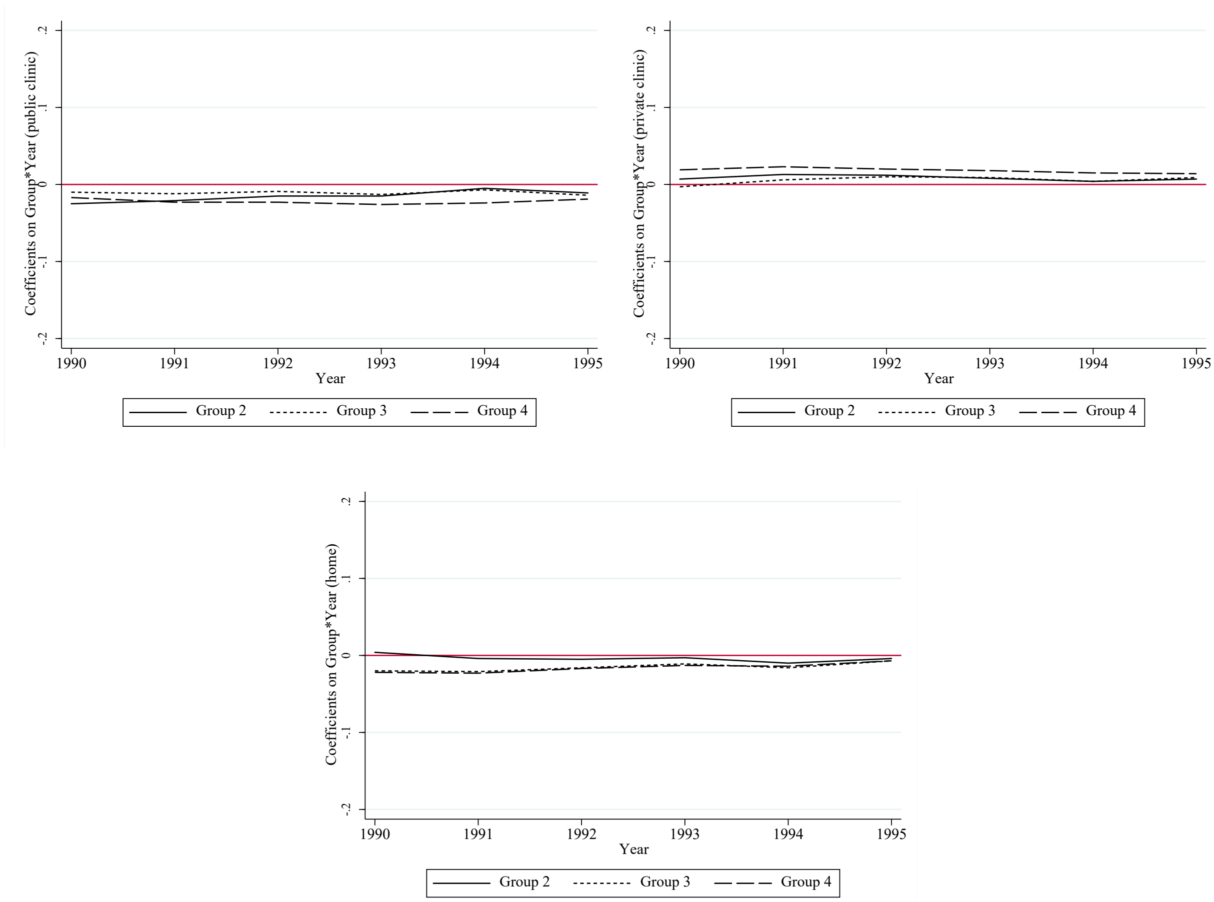


Figure 2.9. Coefficients on pre-intervention trends: difference in mean of proportion of each place of delivery (public clinic, private clinic, and home) between group 1 in 1996 and other groups by year, marginalized municipalities, Mexico

Notes: Dependent variable was the proportion of births at (1) public clinic, (2) private clinic, and (3) home in total births. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999 (group 1: the lowest proportion of beneficiaries of Progresa – group 5: the highest proportion of beneficiaries of Progresa). 1996 and group 1 were excluded as reference groups. Group 5 was excluded due to pre-intervention trends.

Source: Instituto Nacional de Estadistica y Geografia and Mexican Census

Figure 2.10 shows the differences in means of the proportion of type of birth attendant before the program between group 1 in 1996 and the other groups in 1990-1995 in marginalized areas. The first graph presents the differences in means of proportion of birth attendance by physician, and the second one presents by nurse or midwife. In 1990, the municipality mean of birth attendance by physician was 0.35 and birth attendance by nurse or midwife was 0.58.

Group 5 was excluded due to significant pre-trends. Appendix T2.5 reports the coefficients of the interaction terms of group and year, most of which were statistically insignificant except for group 5. Therefore, I excluded group 5 in the analysis for maternal health to include only municipalities which did not have any different pre-intervention trends.

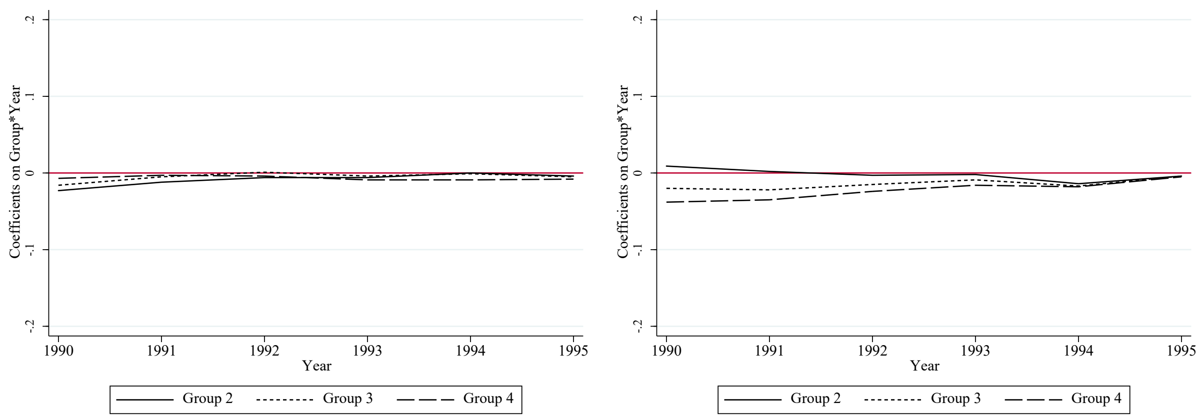


Figure 2.10. Coefficients on pre-intervention trends: difference in mean of proportion of each type of birth attendant (physician and nurse or midwife) between group 1 in 1996 and other groups by year, marginalized municipalities, Mexico

Notes: Dependent variable was the proportion of birth attendance by (1) physician and (2) nurse or midwife in total births. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999 (group 1: the lowest proportion of beneficiaries of Progresa – group 5: the highest proportion of beneficiaries of Progresa). 1996 and group 1 were excluded as reference groups.

Source: Instituto Nacional de Estadistica y Geografia and Mexican Census

2.5.3. Effects of Progresa

2.5.3.1. Fertility

Table 2.3 reports the effects of the lag of Progresa by 1, 3, and 5 years on ASFR of marginalized municipalities in column (1), (2), and (3), respectively. Group 5 (municipalities with the highest proportion of beneficiaries of Progresa in 1999) was excluded due to significant pre-intervention trends of fertility. The coefficients of the lagged program intensity were from -18.89 to -13.19 for the age group 15-19, all statistically significant at the 1% level. On average, Progresa reduced 13 to 18 births for every 1,000 adolescent females in marginalized areas.

Progresa also had a significant negative impact on older age groups. The program led to a reduction in childbirths by 14-17% for women aged 30-34, by 13-17% for women aged 35-39, by 16-28% for those aged 40-44, and by 14-20% for those aged 45-49. The effects were robust to the long-term specifications.

Table 2.3. The effects of 1, 3, and 5 years lagged Progresa on age-specific fertility rates, marginalized municipalities, Mexico (1990-2010) (n=18,879)

	(1) 1-year-lagged	(2) 3-year-lagged	(3) 5-year-lagged	(4) Municipality mean, 1996
ASFR, 15-19				
Lag of Progresa intensity	-13.059***	-17.266***	-18.826***	100.95
	(3.479)	(3.618)	(3.661)	(31.41)
ASFR, 20-24				
Lag of Progresa intensity	-1.331	-3.565	-8.601	222.94
	(6.489)	(6.608)	(6.664)	(53.26)
ASFR, 25-29				
Lag of Progresa intensity	-1.290	-1.746	-7.767	217.22
	(6.940)	(7.039)	(7.215)	(56.24)
ASFR, 30-34				
Lag of Progresa intensity	-22.896***	-25.068***	-28.369***	171.30
	(5.937)	(6.481)	(7.141)	(56.03)
ASFR, 35-39				
Lag of Progresa intensity	-14.687**	-17.842**	-19.334**	110.92
	(5.370)	(5.554)	(5.900)	(46.02)
ASFR, 40-44				
Lag of Progresa intensity	-9.096**	-13.347***	-15.560***	56.52
	(3.437)	(3.350)	(3.595)	(28.37)
ASFR, 45-49				
Lag of Progresa intensity	-2.087*	-2.149*	-1.638†	11.12
	(0.894)	(0.848)	(0.904)	(9.48)

Notes: All regressions included municipality and time fixed effects, and were weighted by the number of total population in a municipality. Components of the Margination index were included as covariates but not presented. Dependent variable was age-specific fertility rates, the number of live births occurring during a given year per 1,000 women of reproductive age classified in 5-year age groups. Independent variable was lag of program intensity, the percent of cumulative beneficiary households in each municipality and previous year. Group 5 (municipalities with the highest proportion of beneficiaries of Progresa in 1999) was excluded due to significant pre-trends. Robust standard errors clustered at municipality level are in the parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
*†p ‹ .10; *p ‹ .05; **p ‹ .01; ***p ‹ .001*

Table 2.4 presents the effects of the lag of Progresa by 1, 3, and 5 years on TFR in marginalized municipalities in column (1), (2), and (3), respectively. Group 5 (municipalities with the highest proportion of beneficiaries of Progresa in 1999) was excluded due to significant pre-trends. According to the 1-year-lagged specification, Progresa decreased 0.33 births per woman during her lifetime. For longer-term specifications, the magnitude became larger: Progresa reduced 0.41-0.50 births during a woman's lifetime.

Table 2.4. The effects of 1, 3, and 5 years lagged Progresa on total fertility rate, marginalized municipalities, Mexico (1990-2010) (n=18,879)

	Total fertility rate			
	(1)	(2)	(3)	
	1-year-lagged	3-year-lagged	5-year-lagged	Municipality mean, 1996
Lag of Progresa intensity	-0.322*	-0.405**	-0.500***	4.455
	(0.130)	(0.133)	(0.138)	(1.167)

Notes: All regressions included municipality and time fixed effects, and were weighted by the number of total population in a municipality. Components of the Margination index were included as covariates but not presented. Total fertility rate was the total number of children born to a woman in her lifetime if she were subject to the prevailing rate of age-specific fertility in the population. Lag of Progresa intensity was the percent of cumulative beneficiary households in each municipality and previous year. Group 5 (municipalities with the highest proportion of beneficiaries of Progresa in 1999) was excluded due to significant pre-trends. Robust standard errors clustered at municipality level are in the parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
$*p < .05$; $**p < .01$; $***p < .001$

2.5.3.2. Child mortality

For child mortality, there were no significant pre-intervention trends depending on the level of Progresa beneficiaries, so all poor and rural municipalities were included in the analysis. Table 2.5 presents the effects of the lag of Progresa by 1, 3, and 5 years on U5MR by gender in marginalized municipalities during 1990-2010 in column (1), (2), and (3), respectively. In the 1-year lagged specification, Progresa substantially reduced child mortality: 4 deaths per 1,000 live births were decreased, which was a large effect corresponding to 19.0% decrease given the mean of U5MR in 1996. The effect was larger and statistically more significant for females (22.0% decrease) compared to males (16.9% decrease). However, the effect was statistically insignificant in the 3-year and 5-year lagged specifications, implying that Progresa's reducing effects on child mortality was temporary, not lasting more than 1 year.

Table 2.5. The effects of 1, 3, and 5 years lagged Progresa on under-5 mortality rate, marginalized municipalities, Mexico (1990-2010) (n=23,541)

	(1) 1-year-lagged	(2) 3-year-lagged	(3) 5-year-lagged	Municipality mean, 1996
U5MR, all				
Lag of Progresa intensity	-4.399*	-2.085	0.207	21.44
	(1.986)	(1.938)	(1.889)	
U5MR, female				
Lag of Progresa intensity	-4.767*	-2.469	-0.489	19.49
	(1.967)	(1.900)	(1.822)	
U5MR, male				
Lag of Progresa intensity	-4.123*	-1.788	0.849	23.36
	(2.099)	(2.079)	(2.051)	

Notes: All regressions included municipality and time fixed effects, and were weighted by the number of total population in a municipality. Components of the Margination index were included as covariates but not presented. Under-5 mortality rate was the number of children who die by exactly 5 years of age per 1,000 live births. Lag of Progresa intensity was the percent of cumulative beneficiary households in each municipality and previous year. Robust standard errors clustered at municipality level are in the parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
*$p < .05$

Table 2.6 reports the program effects on child mortality by cause of death in marginalized municipalities. There was a significant reduction per 1,000 live births of 1.45 deaths due to infectious and parasitic disease. This was 46.9% decrease considering its municipality mean in 1996. There was also a marginally significant reduction by 1.08 deaths per 1,000 live births due to conditions originating in the perinatal period (19% decrease).

Table 2.6. The effects of 1, 3, and 5 years lagged Progresa on under-5 mortality rate by cause of death, marginalized municipalities, Mexico (1990-2010) (n=15,694)

	(1) 1-year-lagged	(2) 3-year-lagged	(3) 5-year-lagged	Municipality mean, 1996
Infectious and parasitic disease				
Lag of program intensity	-1.448*	-0.715	0.116	3.089
	(0.647)	(0.611)	(0.587)	(3.638)
Endocrine, nutritional, metabolic diseases				
Lag of program intensity	-0.262	0.111	0.280	1.788
	(0.266)	(0.249)	(0.247)	(2.967)
Respiratory disease				
Lag of program intensity	-0.683	-0.111	0.284	4.878
	(0.746)	(0.639)	(0.571)	(5.876)
Conditions originating in the perinatal period				
Lag of program intensity	-1.084†	-0.588	0.196	5.681
	(0.556)	(0.588)	(0.615)	(5.882)
Congenital malformations, deformations, chromosomal abnormalities				
Lag of program intensity	0.139	0.127	0.134	2.226
	(0.254)	(0.260)	(0.257)	(2.750)
Accidents				
Lag of program intensity	0.083	0.176	0.103	0.816
	(0.141)	(0.136)	(0.145)	(1.388)

Notes: All regressions included municipality and time fixed effects, and were weighted by the number of total population in a municipality. Components of the Margination index were included as covariates but not presented. Dependent variable was the number of children who die by exactly 5 years of age per 1,000 live births due to each cause of death. The cause of death was based on International Statistical Classification of Diseases and Related Health Problems 10th Revision. Available from https://icd.who.int/browse10/2019/en. Lag of Progresa intensity was the percent of cumulative beneficiary households in each municipality and previous year. Standard errors clustered at municipality level are in the parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
*†p ‹ .10; *p ‹ .05*

In addition to the under-5 mortality, I estimated the effects of Progresa on infant mortality using the same specifications. There were no significant effects of Progresa on infant mortality (Appendix T2.6) possibly because under-reporting was usually most severe for deaths that happened in early infancy such as the neonatal period. If early neonatal deaths were underreported, this would result in an abnormally low ratio of neonatal mortality to infant mortality (Sullivan & Tureeva, 2004). A value for the ratio of neonatal mortality to infant mortality less than 0.50 suggests the underreporting of neonatal deaths and underestimation of the infant mortality rate. I found that the municipality mean of the ratio of neonatal mortality to infant mortality was lower than 0.50 in 1990-1996, suggesting under-reported infant mortality during the period. When the analysis was restricted to 1997-2010, Progresa reduced 3 infant deaths per 1,000 live births, statistically significant in the l-year lagged specification (Appendix T2.7). This may suggest that under-reported infant mortality led to underestimated Progresa's effects on infant mortality.

2.5.3.3. Maternal health

Table 2.7 reports the effects of the lag of Progresa by 1, 3, and 5 years on place of delivery in poor and rural municipalities during 1990-2010 in column (1), (2), and (3), respectively. Due to significant pre-intervention trends in Group 5 (the poorest group), municipalities in Group 5 were excluded from the analysis. Across all specifications, Progresa significantly increased childbirths at public clinics, while reducing those at home. In the 1-year lagged specification, Progresa increased deliveries at public clinic by 10.6 percentage points and decreased deliveries at home by 12.4 percentage points. The effects were larger in the long-term specification: the proportion of deliveries at public clinic was increased by 16.3 percentage points and that at home was decreased by 20.5 percentage points in the 5-year lagged specification. Progresa's effects on place of delivery were considerable, which increased deliveries at public clinic by 27.7-42.7% and reduced those at home by 25.8-42.6%. Progresa did not have any effects on deliveries at private clinics.

Table 2.7. The effects of 1, 3, and 5 years lagged Progresa on place of delivery, marginalized municipalities, Mexico (1990-2010) (n=19,002)

	(1) 1-year-lagged	(2) 3-year-lagged	(3) 5-year-lagged	Municipality mean (SD), 1996
Public clinic				
Lag of Progresa intensity	0.106**	0.146***	0.163***	0.382
	(0.037)	(0.037)	(0.036)	(0.222)
Private clinic				
Lag of Progresa intensity	0.009	0.016	0.027	0.093
	(0.018)	(0.019)	(0.019)	(0.099)
Home				
Lag of Progresa intensity	-0.124**	-0.169***	-0.205***	0.481
	(0.043)	(0.041)	(0.039)	(0.245)

Notes: All regressions included municipality characteristics and municipality and time fixed effects, and were weighted by the total population in a municipality. Components of the Margination index were included as covariates but not presented. Dependent variable was the proportion of births at (1) public clinic, (2) private clinic, and (3) home in total births. Lag of Progresa intensity was the percent of cumulative beneficiary households in each municipality and previous year. Group 5 (municipalities with the highest proportion of beneficiaries of Progresa in 1999) was excluded due to significant pre-trends. Robust standard errors clustered at municipality level are in the parentheses.
*Source***:** Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
***p ‹ .01; ***p ‹ .001*

Table 2.8 reports the effects of the lag of Progresa by 1, 3, and 5 years on birth attendants in poor and rural municipalities during 1990-2010 in column (1), (2), and (3), respectively. Municipalities in group 5 were excluded due to significant pre-intervention trends. On average, Progresa largely increased the proportion of birth attendance by physicians by 10.6-19.2 percentage points, while reducing the proportion of birth attendance by nurse or midwife by 17.1-28.6 percentage points. As the municipality mean of the proportion of birth attendance by physician was 0.48 and by nurse or midwife was 0.476 in 1996, the effects were large corresponding to 22.3-40.3% increase for physician and 36.0-60.2% decrease for nurse or midwife. The effects were greater and more statistically significant in the longer-term specifications.

Table 2.8. The effects of 1, 3, and 5 years lagged Progresa on birth attendants, marginalized municipalities, Mexico (1990-2010) (n=19,002)

	(1) 1-year-lagged	(2) 3-year-lagged	(3) 5-year-lagged	Municipality mean (SD), 1996
Physician				
Lag of Progresa intensity	0.106**	0.158***	0.192***	0.476
	(0.038)	(0.035)	(0.032)	(0.235)
Nurse or midwife				
Lag of Progresa intensity	-0.171***	-0.231***	-0.286***	0.475
	(0.033)	(0.033)	(0.031)	(0.238)

Notes: All regressions included municipality characteristics and municipality and time fixed effects, and were weighted by the number of total population in a municipality. Components of the Margination index were included as covariates but not presented. Dependent variable was the proportion of birth attendance by (1) physician and (2) nurse or midwife in total births. Lag of Progresa intensity was the percent of cumulative beneficiary households in each municipality and previous year. Group 5 (municipalities with the highest proportion of beneficiaries of Progresa in 1999) was excluded due to significant pre-trends. Robust standard errors clustered at municipality level are in the parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
$^{**}p < .01$; $^{***}p < .001$

2.6. Discussion and Conclusion

This research makes significant contributions to the literature in the field of public policy, public health, and demography by extending the analysis of CCT programs to a novel set of demographic and health outcomes: fertility, child mortality, and maternal health. These are vital indicators of public health and social and economic development of a nation. Reducing early fertility and child mortality and improving maternal health outcomes have been the main goals that all United Nations Member States should achieve to end poverty and ensure prosperity.

The difference-in-difference estimation using variations in the beneficiaries of Progresa across municipalities and time indicated that the program significantly reduced fertility in poor and rural areas. Progresa reduced 0.41-0.50 births during a woman's lifetime. In particular, teenage pregnancy was decreased by 13-18% possibly because Progresa provided cash payment conditional on children's enrollment and regular attendance in school with a special emphasis on girls. Moreover, the program reduced childbirths by 14-17% for women aged 30-34, by 13-17%

for women aged 35-39, by 16-28% for those aged 40-44 because participating parents would choose to have fewer children in order to invest more in each child (Becker & Lewis, 1973) or because public health lectures provided by Progresa emphasized family planning by using contraceptive use. The findings partially support the first hypothesis (*Progresa reduces pregnancy among young women (ages 15 to 19), with ambiguous effects on fertility among older women in marginalized areas*). The results are consistent with Gulemetova-Swan (2009), which found that Progresa delayed the first and second births of adolescent girls (ages 13-19) in urban areas with various effects depending on age when the program was first provided. The greatest effects were among girls aged 15 and 16 with delays of their first baby by over two months. On contrast, the findings contradict previous studies that suggested Progresa did not have significant effects on overall fertility (Darney et al., 2013; Stecklov et al., 2007; Todd & Wolpin, 2006). This might be because Stecklov et al. (2007) and Todd and Wolpin (2006) used experimental data during eighteen months and Darney et al. (2013) used a survey in three years (1992, 2006, 2009), while current study used 20-years of nationwide data which had larger variations across areas and time. Also, it may be because previous studies measured fertility differently: Darney and colleagues used lifetime experience of pregnancy; Stecklov and colleagues measured having a birth or pregnancy during the study period; and Todd and Wolpin (2006) used the number of children ever born.

Furthermore, I found that Progresa reduced child mortality by 19% with a greater effect on females than males through the reduction in infectious and parasitic disease and conditions originating in the perinatal period. However, the effects were only significant in the first year of the program, not lasting over time. The results partially support the second hypothesis that Progresa reduces child mortality in marginalized areas through the reduction in infection, respiratory disease, and nutritional deficiency. The findings also partially align with Barham (2011), which found that Progresa reduced infant mortality by 17% in 2001 by reducing intestinal and respiratory diseases and alleviating nutritional deficiencies. The possible mechanism may be that Progresa was designed to reduce child mortality by providing cash payment conditional on growth monitoring from conception to age 5; regular preventative health check-ups, including prenatal care and immunizations; and mother's attendance at health education seminars. For example, treatment for parasites were offered during pregnancy (Kramer & Kakuma, 2003; Ladipo, 2000), while mothers learned how to make oral rehydration salts for managing intestinal infections and to prevent and recognize the signs of diarrheal disease (Phavichitr & Catto-Smith, 2003; Thapar & Sanderson, 2004). Additionally, the decrease in child mortality could also result from an increase in family planning and a reduction of fertility, which reduced births at high risk and provided more health care resources to fewer infants.

Lastly, Progresa improved maternal health in rural and poor areas. The program significantly increased childbirths at public clinic by 27.7-42.7%, while reducing those at home by 25.8-42.6%. Additionally, Progresa largely increased the proportion of physician's birth attendance by 22.3-40.3%, while decreasing that by nurse or midwife by 36.0-60.2%. The program had greater effects in the long-term. The findings support hypothesis 3 (*Progresa reduces childbirth at home and increases institutional deliveries in marginalized areas*) and hypothesis 4 (*Progresa reduces birth attendance by nurse or midwife and increases birth attendance by physician in marginalized areas*). The results are consistent with a previous study, which suggested that Progresa increased deliveries attended by either physician or nurse or in a health care facility in rural areas (Urquieta et al. 2009). Although Progresa did not provide incentives for institutional deliveries and skilled birth attendants, cash transfer from Progresa might be spent on health services related to delivery outcomes (Handa et al., 2016). As the program required pregnant women to visit clinics regularly, women might be exposed to reproductive and health services in the clinics, including institutional deliveries (Barber, 2010). Nutrition and health education seminars provided by the program also might emphasize the importance of skilled attendance at delivery.

Despite novel findings and implications, there are limitations to highlight. First, the analyses did not consider migrants and immigrants. If Progresa affected international migration from Mexico, individuals staying in Mexico might be non-randomly selected (Parker & Vogl, 2018). For example, if women who received benefits from Progresa left Mexico, the estimates for the reducing effects of implementing Progresa on fertility among women (aged 15 to 49) would be under-estimated. With regard to the impacts of Progresa on international migration, three studies found conflicting results. Angelucci (2014) reported that Progresa increased Mexican migration to the US by relaxing financial constraints for poor households. In contrast, Stecklov and colleagues (2005) found that Progresa reduced rural out-migration to international destinations, while Tirado-Alcaraz (2014) suggested that Progresa had no significant association with international migration in rural areas.

Second, the Progresa's effects on child mortality may be under-estimated due to under-reporting of children's deaths. The analysis based on the Brass method in chapter 1 indicated that under-reporting was prevalent in marginalized areas where the main analysis focused on, and the under-reporting was more severe in poorer areas. Lower municipality mean of the ratio of neonatal mortality to infant mortality (less than 0.50) also suggested under-reported infant mortality and under-5 mortality. However, I was not able to adjust under-reported child deaths using the Brass method because it allowed indirectly estimating fertility and child mortality at the large geographic level (e.g., national-level), while I used much smaller geographic level of data (i.e., municipality-level) to estimate the effects of Progresa on fertility and child mortality. Moreover, Progresa might also increase the reporting of child deaths among the beneficiaries because they had to see a health provider regularly to receive the cash transfer from the program. It is possible that municipalities with higher percent of Progresa beneficiaries would have more child deaths reported than before the program began (Barham, 2011). Therefore, the effects of Progresa on child mortality might be under-estimated.

Finally, maternal mortality was not examined as the main outcome variable. Estimating the effect of CCTs on maternal mortality is prone to measurement errors as maternal deaths are too rare events (Glassman et al., 2013). When Powell-Jackson & Hanson (2012) studied the effects of a national CCT program on maternal health in Nepal, the authors were not able to include maternal mortality as an outcome variable because the sample size should be very large to detect the impact of CCT. Another study in India reported a similar problem. Lim et al. (2010) found that a CCT program in India significantly reduced perinatal and neonatal deaths, but it did not have any significant effects on maternal death. The authors explained that the absence of the CCT on maternal mortality might have been attributable to insufficient sample size to find any change. As maternal deaths were far rare events in Mexico (54 per 100,000 live births in 2005) compared to Nepal (415 per 100,000 live births in 2005) and India (286 per 100,000 live births in 2005), I used place of delivery and type of birth attendants as alternatives. However, they might be not accurate measures of maternal health since educated and trained midwives could provide high quality care services to mothers and infants (Renfrew et al. 2014).

This paper found that the oldest and well-known cash transfer program significantly contributed to reducing fertility including teenage pregnancies and child mortality as well as improving maternal health in rural and poor areas of Mexico. The results suggest crucial public health, demographic, and policy implications not only for Mexico but also for more than 60 countries where CCT programs are implemented to improve health and nutritional status of children and mothers. The findings also have reverberations for other middle and low-income countries when designing and implementing their anti-poverty CCT programs.

Chapter 3: Effects of the Elimination of Progresa on Infant and Maternal Health

3.1. Introduction

Progresa, Mexico's national CCT (Conditional Cash Transfer) program, was introduced in 1997 to alleviate existing poverty by providing poor families with income and also future poverty by breaking the intergenerational cycle of poverty through conditionalities (Parker & Todd, 2017). To achieve the objective, cash payments were provided conditionally to poor households engaging in behaviors designed to enhance their education, health, and nutrition. Specifically, it provided financial incentives conditional upon children attending school and regular preventive health clinic visits. The program also provided lactating and pregnant women as well as young children with nutritional supplements and health education. The program was means tested with geographic and household-level targeting. From 1997-1999, Progresa extended benefits to 2.6 million families (40% of rural families) and it gradually expanded to urban areas (Gertler, 2004). Progresa was one of the oldest and best-known CCT programs, supporting 7 million low-income families through direct monetary transfers in 2019. Due to its integrative package of education, nutrition, and health services, Progresa has contributed to improving health, nutrition, education, women empowerment and reducing extreme poverty (Barber & Gertler, 2008; Behrman & Hoddinott, 2005; Gertler & Boyce, 2003; Huerta, 2006; Ozer et al., 2009; Parker & Todd, 2017; Parker & Vogl, 2018; Rivera et al., 2004; Segura-Pérez et al., 2016; Skoufias, 2005; Skoufias & McClafferty, 2001)

During four presidential terms, Progresa changed its name to “Oportunidades” in 2002, then to “Prospera” in 2015 (Ordóñez-Barba & Hernández, 2019). While specific designs were slightly changed, the program maintained its primary objectives and educational, health, and nutritional components. However, under the administration of President Andrés Manuel López Obrador (2018-2024), the Mexican government terminated Progresa in Spring 2019, and introduced two educational programs as potential substitutes: *Beca Bienestar para las Familias,* which provides low-income families with a fixed cash payment conditioned on having at least one child under 15 years of age enrolled in preschool, primary or secondary school; and *Becas Benito Juárez,* which gives a fixed grant to each youth from a low-income family who is enrolled in high school (López, 2021). These programs are not means-tested so households do not need to demonstrate their poverty level to be eligible for the scholarships (Schober, 2020). Although two scholarship programs may replace Progresa’s educational component, the government did not announce any replacement for its health and nutritional components.

Progresa was found to improve health and nutritional outcomes of infants and mothers from low-income families (Barham, 2011; Gertler, 2004; Glassman et al., 2013; Parker & Todd, 2017; Rivera et al., 2004; Skoufias & McClafferty, 2001). For example, Progresa reduced infant mortality in rural areas by 17% through the decline in deaths due to intestinal infections, respiratory infections, and nutritional deficiency. Additionally, the program was found to increase skilled attendance at delivery, which was defined as deliveries attended by either physicians or nurses or in a healthcare facility. Thus, the sudden termination of the program may adversely affect maternal and newborn health.

Against this backdrop, this paper estimated the effects of the recent termination of Progresa on infant mortality and maternal health indicators in the year following program elimination. Maternal health indicators are place of delivery (public clinic, private clinic, or home) and type of birth attendant (physician, nurse, or midwife). Nationwide vital statistics (2018-2020) were combined with census (2000) and administrative information on program beneficiaries in 2018 at the municipal level. I used difference-in-difference estimations using variations in the beneficiaries of Progresa across municipalities and time. The result was based on 1 year after the termination, just before the Covid-19 pandemic. The sudden termination of Progresa led to the immediate increase in infant mortality due to infectious and parasitic diseases. Additionally, it reduced deliveries at private clinic, while increasing deliveries with midwives' attendance, which was marginally significant. For falsification tests, I conducted the same regression analysis using 2017-2018 data. The results demonstrated that the model estimation was valid and sound. The findings suggest crucial public health and policy implications not only for Mexico but also for more than 60 middle- and low-income countries, which replicated Progresa to improve maternal and newborn health.

3.2. Trends of Health Outcomes

3.2.1. Infant mortality

Infant mortality is a major indicator of the level of child health and the degree of progress in a country in the areas of social and economic development. Reducing preventable infant mortality was target of the Sustainable Development Goals (MDGs) that were established by the United Nations Member States to be achieved by 2030 in a global effort to reduce extreme poverty and improve health, reduce inequality, and spur sustainable economic growth.

Figure 3.1 compares infant mortality in 2010-2019 in non-marginalized areas and marginalized areas. The areas were classified according to the Margination Index produced by the Mexican Population Council (CONAPO) based on census.[13] Marginalized areas included municipalities with high and very high margination index, while non-marginalized areas included municipalities with medium, low, and very low margination index. Infant mortality had been relatively constant in both areas, but there was an increase in 2017[14] and a sudden increase in 2019 in marginalized areas.

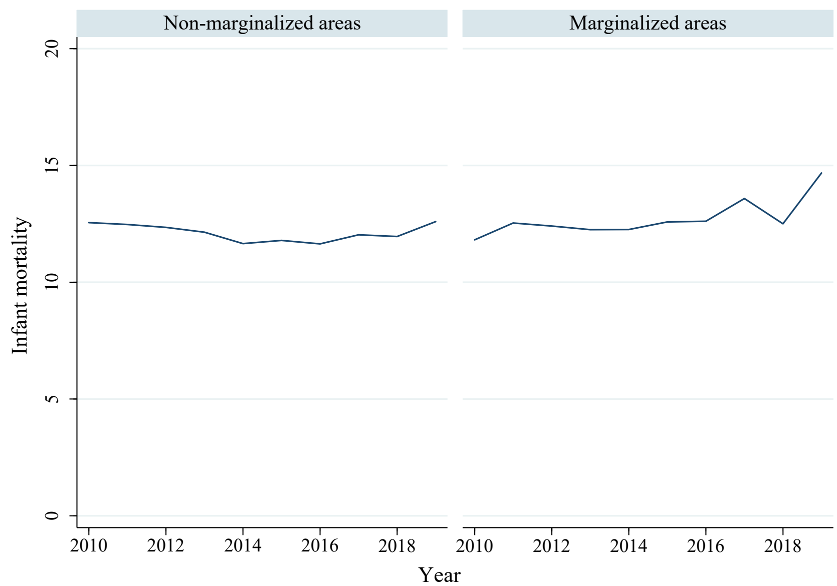


Figure 3.1. Municipality mean of infant mortality in non-marginalized and marginalized areas, Mexico (2010-2019)
Note: Infant mortality was calculated using the number of deaths before the first birthday per 1,000 live births.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI) and Mexican Population Council (CONAPO)

3.2.2. Maternal health

Maternal health is an indicator of national development and inequality levels, particularly unequal access to health services. Institutional deliveries and skilled birth attendants are essential

[13] To select eligible poor rural communities, government classified municipalities using a Margination Index using the nine-municipality level socioeconomic variables from census. The variables included the share illiterate, the share with less than primary school education, the share without a toilet, the share without electricity, the share without running water, the share with crowding (few rooms per capita), the share with a dirt floor, the share living in communities with less than 5000 inhabitants, and the share earning less than twice the minimum wage.
[14] According to the Mexican Institute of Statistics Geography and Informatics (INEGI), infant mortality increased in 2017 at the national level due to an increase in infant deaths.

factors to prevent maternal deaths and improve maternal health outcomes (Campbell & Graham, 2006; Carlough & McCall, 2005; Gupta et al., 2012; Randive et al., 2013). Additionally, postpartum maternal health is critical to children's survival and health (Finlay et al., 2015). Figure 3.2 compares the proportion of place of delivery and type of birth attendant in 2010-2019 in non-marginalized areas and marginalized areas. The place of delivery was the proportion of childbirths at public clinic, private clinic, and home, while the type of birth attendant was the proportion of birth attendance by physician, nurse, and midwife. In marginalized areas, the proportion of deliveries in public clinic continuously increased and deliveries at home decreased until 2018. However, both indicators were constant from 2018 to 2019. In non-marginalized areas, the proportion of deliveries at home had been very low for all years and the deliveries in private clinic slightly increased from 2016 to 2019. Additionally, there was a continuous increase in the proportion of birth attendance by physician and a decrease in the birth attendance by midwife in marginalized areas until 2018, but there were no changes from 2018 to 2019. In non-marginalized areas, most of births had been assisted by physicians during all years.

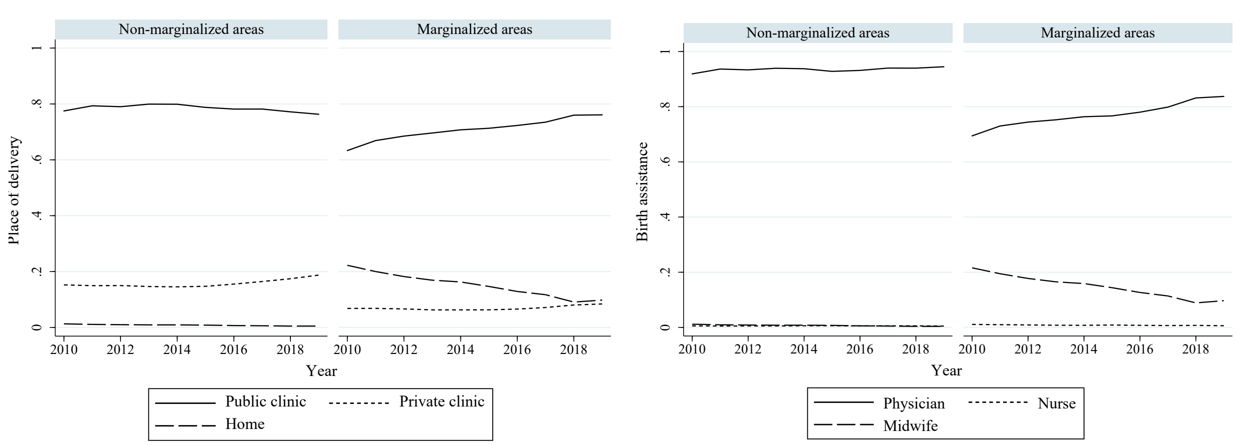


Figure 3.2. Municipality mean of the proportion of place of delivery and type of birth attendant in non-marginalized and marginalized areas, Mexico (2010-2019)

Note: The first figure examined the proportion of births at public clinic, private clinic, and home in total births. The second figure examined the proportion of birth attendance by physician, nurse, and midwife in total births.

Source: Mexican Institute of Statistics Geography and Informatics (INEGI) and Mexican Population Council (CONAPO)

3.3. Research Questions

3.3.1. Infant mortality

The elimination of health and nutritional benefits may increase infant mortality. Health and nutritional interventions of Progresa was designed to improve the health status of infants, children, and pregnant and lactating women, and to reduce newborn and maternal mortality. The health component provided basic healthcare services, including supervision of nutrition and children's growth; vaccinations; prenatal, childbirth, and postnatal care; and health education. Health services provided by the program aimed to reduce the major causes of infant mortality, such as child respiratory diseases, intestinal infections, and malnutrition (Barham, 2011). The health education also taught mothers to prevent and treat diarrheal and respiratory diseases (e.g., how to make oral rehydration salts to manage intestinal infections) and to understand the importance of breastfeeding and child nutrition (Phavichitr & Catto-Smith, 2003; Thapar & Sanderson, 2004). The nutritional component offered a fixed monthly monetary transfer, nutritional supplements, and treatment for parasites, principally targeted to children between the ages of four months and two years, and pregnant and lactating women (Parker & Todd, 2017).

Due to these interventions, one study found that Progresa significantly reduced infant mortality by 17% in rural areas mainly through the reduction in intestinal infection, respiratory infection, and nutritional deficiency (Barham, 2011). Thus, I posited the first hypothesis for the effects of terminating Progresa on infant mortality:

Hypothesis 1: *The termination of Progresa increases infant mortality in marginalized areas through the increases in infection, respiratory disease, and nutritional deficiency.*

3.3.2. Maternal health

There are three mechanisms of Progresa that its elimination may adversely affect maternal health such as institutional deliveries and skilled birth attendance. First, Progresa required pregnant women to visit clinics regularly to receive prenatal care, nutritional supplements, and health education. While visiting clinics and receiving health care services, women were introduced to diverse reproductive and health services in the clinics, including deliveries at medical unit (Barber, 2010). The elimination of the program might block this mechanism. Second, a decrease in disposable income, which had been offered by Progresa, might make households to modify health-seeking behavior related to delivery outcomes (income effect). Previous beneficiaries could spend less money on institutional deliveries and skilled birth assistance. Third, nutrition and health education seminars have become no longer provided for women, which gave information about the importance of the care during pregnancy and childbirth (Urquieta et al., 2009). Through these mechanisms, a sudden termination of Progresa may increase the likelihood of delivering a birth at home rather than in health institution and having a midwife as a birth assistant rather than a physician or nurse. One previous study provided evidence on the positive effects of the program on maternal health indicators. Using evaluation data in 1997-2000, Urquieta et al. (2009) found that Progresa increased deliveries attended by either physicians or nurses or in a healthcare facility in rural areas of Mexico. Therefore, I posited two hypotheses on the effects of the rollback of program on maternal health indicators as follows:

Hypothesis 2: *The termination of Progresa reduces institutional deliveries, while increasing childbirth at home in marginalized areas.*

Hypothesis 3. *The termination of Progresa reduces birth attendance by physician and nurse while increasing birth attendance by midwife in marginalized areas.*

3.4. Data and Methods

3.4.1. Data

To investigate the effects of terminating Progresa, nationwide vital statistics data on infant death, birth, place of delivery and type of birth attendant (2018-2020) were drawn from the Mexican Institute of Statistics Geography and Informatics (INEGI). Due to the late-registration of death and birth (Gamlin & Osrin 2020), vital events occurred in 2018 but late-reported in 2019 as well as those occurred in 2019 but late-reported in 2020 were included. The vital statistics contains information on the place and date that a birth and a death occurred, and they were reported. Recent Mexican civil registration and vital statistics system on cause of death has been evaluated as having high quality of the performance (Mahapatra et al., 2007; Phillips et al., 2014). The vital statistics and census were combined with administrative information on the number of households enrolled in Progresa in 2018 by municipality, provided by Progresa administrative personnel. All of the regression analyses were restricted to marginalized municipalities identified as eligible by Progresa in 1997. Marginalized areas included municipalities which were classified as high and very high category based on the Margination Index, a municipality level measure of poverty produced by the Mexican Population Council (CONAPO).

3.4.2. Measures

The independent variable was the Progresa intensity in each municipality. It was measured as the proportion of beneficiary households by 2018[15] in the total number of households in 2000 before the rollback of the program. It was used as a continuous variable, ranging from 0 to 1.

Dependent variables were infant mortality and maternal health indicators. Infant mortality was calculated using the number of deaths before the first birthday per 1,000 live births. The differential effects of the program were examined by gender and by cause of death, given the program's focus on specific intervention and its emphasis on gender. The cause of death was classified based on the International Classification of Diseases-10 (ICD-10) classification and U.S. Centers for Disease Control and Prevention, and I included the six causes that accounted for infant mortality in Mexico: (1) infectious and parasitic diseases; (2) endocrine, nutritional and metabolic diseases; (3) diseases of the respiratory system; (4) certain conditions originating in the perinatal period; (5) congenital malformations, deformations and chromosomal abnormalities; and (6) accidents. The effects on infant death caused by accidents were examined as a falsification test as it seems unlikely that they would be affected by the benefits of Progresa.

Maternal health indicators were place of delivery and type of birth attendant. For place of delivery, the proportion of childbirths at (1) public clinic, (2) private clinic, and (3) home was examined. For the type of birth attendant, the proportion of birth attendance by (1) physician, (2) nurse, and (3) midwife was examined. All measures were constructed at the municipality level for each time period.

---

[15] In 2016, Food Support Program (*Programa de Apoyo Alimentario* - PAL) was merged with Progresa Social Inclusion Program. Families benefiting from PAL were included in the Scheme of Benefits without Co-Responsibility, whereas *Progresa* beneficiaries were included in the Scheme of Benefits with Co-Responsibility. In this chapter, I used only Progresa beneficiaries (with Co-Responsibility).

3.4.3. Model estimation

I used a difference-in-differences design using variations in the beneficiaries of program between municipalities and over time in the termination of the program. To estimate the effects of Progresa's recent termination on infant mortality and maternal health indicators, I used the following equation:

$$Y_{mt} = \beta_0 \, Progresa\ intensity_m \times Termination_t + \delta_m + \gamma_t + \varepsilon_{mt}$$

where *Y* were infant mortality, place of delivery, and type of birth attendant in marginalized municipality *m* in year *t*; $Progresa\ intensity_m$ was percent of beneficiary households in *m* municipality before the rollback of the program. As a robustness check, I used a binary variable of $Progresa\ intensity_m$ which equals 1 for the highest quartile or 0 for the lowest quartile. The indicator for time $Termination_t$ was defined in two ways: (i) 1 for 2019 and 0 for 2018; (ii) 1 for March-December 2018 and 0 for March-December 2019. The first specification allowed including all births that occurred in each year, which provided more observations. As Progresa was eliminated in March 2019, the second specification attempted to compare pre- (March-December 2018) and post-elimination (March-December 2019) more accurately than the first specification. Fixed effects on municipality (δ_m) and year (γ_t) were included to control for time-variant and time-invariant unobservable variables. The effect of the cash transfer program's termination on each outcome was estimated by β_0, and the result was based on 1 year after the termination prior to the Covid-19 pandemic. The analysis relied on the following assumptions: (1) in absence of Progresa's termination, the differences of outcome variables among municipalities with different Progresa intensity were constant over time; (2) no spillover effects. To demonstrate that the model estimation was valid and sound, I conducted the same regression analysis using 2017-2018 data as falsification tests. All regressions were weighted by the number of children ages 0-5 in a municipality. The analyses were conducted using Stata version 15.1.

3.5. Results

3.5.1. Effects of the termination of Progresa on infant mortality

Table 3.1 presents the effects of the recent elimination of Progresa on infant mortality in marginalized municipalities. Column 1 includes all infant mortality occurred in each year (pre: 2018; post: 2019), while column 2 includes those occurred for 10 months for each period (pre: Mar-Dec 2018; post: Mar-Dec 2019). The coefficients for infant mortality rates (infant deaths per 1,000 live births) were positive but statistically insignificant. The results were similar when a binary variable of Progresa intensity was used as an independent variable based on the highest and lowest quartile (see Appendix T3.1). Table 3.2 reports the effects of terminating Progresa on infant mortality by cause of death in marginalized municipalities. The classification of the causes of deaths was based on the International Classification of Diseases-10 (ICD-10) classification and U.S. Centers for Disease Control and Prevention, and I included the main causes that accounted for infant mortality in Mexico. Although the effects on infant mortality were not significant, it is crucial to examine the effects by disease because the aggregated disease can mask the significant findings. There was a significant increase per 1,000 live births of 0.52-0.62 of infant deaths due to infectious and parasitic diseases. This was a considerable increase given that the municipality average before the elimination was 0.60-0.63 for infant mortality caused by infectious and parasitic diseases. Moreover, the termination of Progresa increased infant mortality due to respiratory diseases by 0.78-0.94 infant deaths per 1,000 live births (municipality average before the elimination: 1.07, 1.01), which was marginally significant. On the contrary, infant mortality due to other diseases or accidents was not significantly changed. Appendix T3.2 reports the results with the binary Progresa intensity. There was an increase of 0.45-0.50 of infant deaths per 1,000 live births due to infectious and parasitic diseases among municipalities with the highest level of program intensity compared to municipalities with the lowest level of program intensity, but only marginally significant. However, there were no any significant effects on other diseases or accidents.

Table 3.1. Effect of the elimination of Progresa on infant mortality, marginalized areas (n=2,256)

	(1) Jan-Dec	(2) Mar-Dec
All		
Elimination of Progresa	1.125	1.386
	(1.170)	(1.684)
Municipality mean before the elimination	12.75	12.82
Female		
Elimination of Progresa	1.007	2.097
	(1.592)	(1.871)
Municipality mean before the elimination	11.83	11.90
Male		
Elimination of Progresa	1.101	0.365
	(1.706)	(2.589)
Municipality mean before the elimination	13.75	13.81

Notes: All regressions included municipality and time fixed effects and were weighted by number of children ages 0-5 in a municipality. In all regression analyses, the observations included only balanced panels. Column 1 has infant mortality occurred for whole year in 2018-2019 (pre: 2018; post: 2019). Column 2 has infant mortality occurred for 10 months for each period (pre: Mar-Dec 2018; post: Mar-Dec 2019) and has smaller observations. Standard errors clustered at municipality level are in parentheses.
*Source***:** Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census

Table 3.2. Effect of the termination of Progresa on infant mortality by cause of death, marginalized areas, Mexico (n=2,256)

	(1) Jan-Dec	(2) Mar-Dec
Infectious and parasitic disease		
Lag of program intensity	0.520*	0.621*
	(0.228)	(0.284)
Municipality mean before the elimination	0.60	0.63
Endocrine, nutritional, and metabolic diseases		
Lag of program intensity	-0.032	0.011
	(0.159)	(0.183)
Municipality mean before the elimination	0.29	0.30
Respiratory disease		
Lag of program intensity	0.781†	0.944†
	(0.467)	(0.524)
Municipality mean before the elimination	1.07	1.01
Conditions originating in the perinatal period		
Lag of program intensity	0.150	0.097
	(0.710)	(0.895)
Municipality mean before the elimination	6.79	6.95
Congenital malformations, deformations, chromosomal abnormalities		
Lag of program intensity	-0.430	-0.498
	(0.619)	(0.881)
Municipality mean before the elimination	3.00	3.14
Accidents		
Lag of program intensity	-0.042	0.008
	(0.099)	(0.111)
Municipality mean before the elimination	0.26	0.23

Notes: All regressions included municipality and time fixed effects, and were weighted by the number of children aged under 5 in a municipality. Column 1 has infant mortality occurred for whole year in 2018-2019 (pre: 2018; post: 2019). Column 2 has infant mortality occurred for 10 months for each period (pre: Mar-Dec 2018; post: Mar-Dec 2019) and has smaller observations. The cause of death was based on International Statistical Classification of Diseases and Related Health Problems 10th Revision. Available from https://icd.who.int/browse10/2019/en. Standard errors clustered at municipality level are in the parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
*†p ‹ .10; *p ‹ .05*

3.5.2. Effects of the termination of Progresa on maternal health

This section examines maternal health indicators, where I hypothesized that the recent elimination of Progresa would reduce deliveries at clinics and increase deliveries at home, while decreasing birth attendance by physicians and increasing birth attendance by midwives. Table 3.3 presents the effects of eliminating Progresa on place of delivery in marginalized municipalities. Column 1 includes all births that occurred in each year (pre: 2018; post: 2019), while column 2 includes those which occurred for 10 months for each period (pre: Mar-Dec 2018; post: Mar-Dec 2019). On average, eliminating Progresa reduced the proportion of giving a birth at private clinic by 0.8 percentage points in both specifications, but it was marginally significant ($p<0.1$). There were no significant effects on the proportion of childbirths at public clinic or home. The results were similar when municipalities with the highest program intensity and those with the lowest program intensity were compared (see Appendix T3.3).

Table 3.3. Effect of the elimination of Progresa on place of delivery, marginalized areas (n=2,260)

	(1) Jan-Dec	(2) Mar-Dec
Public clinic		
Elimination of Progresa	0.015	0.016
	(0.011)	(0.012)
Municipality mean before the elimination	0.77	0.77
Private clinic		
Elimination of Progresa	-0.008†	-0.008†
	(0.004)	(0.004)
Municipality mean before the elimination	0.08	0.08
Home		
Elimination of Progresa	0.047	0.051
	(0.029)	(0.032)
Municipality mean before the elimination	0.08	0.08

Notes: All regressions included municipality and time fixed effects and were weighted by number of children ages 0-5 in a municipality. Column 1 has births occurred for whole year in 2018-2019 (pre: 2018; post: 2019). Column 2 has births occurred for 10 months for each period (pre: Mar-Dec 2018; post: Mar-Dec 2019) and has smaller observations (n=2,258). Standard errors clustered at municipality level are in parentheses. In all regression analyses, the observations included only balanced panels.
*Source***:** Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
†p ‹ .10

Table 3.4 reports the effects of terminating Progresa on the type of birth assistant in marginalized municipalities. There was an increase in the proportion of deliveries with midwives' attendance (5.1-5.5 percentage points), which were marginally significant (p<0.1). Given its municipality mean before the elimination, it was 63.8-68.8% increase. The effects on the proportion of deliveries with more skilled attendants such as a physician or nurse were not significant. The findings were also similar when the binary variable of program intensity was used (see Appendix T3.4).

Table 3.4. Effect of the elimination of Progresa on birth assistant, marginalized areas (n=2,260)

	(1) Jan-Dec	(2) Mar-Dec
Physician		
Elimination of Progresa	0.016	0.016
	(0.012)	(0.013)
Municipality mean before the elimination	0.84	0.84
Nurse		
Elimination of Progresa	-0.007	-0.008
	(0.005)	(0.005)
Municipality mean before the elimination	0.01	0.01
Midwife		
Elimination of Progresa	0.051†	0.055†
	(0.029)	(0.032)
Municipality mean before the elimination	0.08	0.08

Notes: All regressions included municipality and time fixed effects and were weighted by number of children ages 0-5 in a municipality. In all regression analyses, the observations included only balanced panels. Column 1 has births occurred for whole year in 2018-2019 (pre: 2018; post: 2019). Column 2 has births occurred for 10 months for each period (pre: Mar-Dec 2018; post: Mar-Dec 2019) and has smaller observations (n=2,258). Standard errors clustered at municipality level are in parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
†p ‹ .10

As the falsification tests for the same regression analysis, I estimated the same regression models using 2017-2018 data. The results are reported in Appendix T3.5 for infant mortality and Appendix T3.6 and T3.7 for maternal health outcomes. The first specification in column 1 includes infant deaths and births occurred for whole year in 2017-2018 (pre: 2017; post: 2018). The second specification in column 2 has infant deaths and births occurred for 10 months for each period (pre: Mar-Dec 2017; post: Mar-Dec 2018). For infant mortality, the coefficients were negative and statistically insignificant. For maternal health, Progresa significantly increased the deliveries at public clinics by 2.9-3.0 percentage points and deliveries assisted by physicians by 2.5 percentage points. However, it did not affect the proportion of giving a birth at home and birth assistance by midwives. The results of falsification tests demonstrated that Progresa did not have any worsening effects on infant and maternal health outcomes before the program's elimination.

3.6. Discussion and Conclusions

This paper examines the effects of the sudden elimination of an longstanding and well-known CCT program on infant mortality and maternal health outcomes in poor and rural areas. Although the sudden termination of Progresa did not significantly affect infant mortality in marginalized areas, there was a significant increase in infant mortality caused by the particular disease that the program was most designed to address: infant deaths per 1,000 live births increased by 0.52-0.62 due to infectious and parasitic diseases and 0.60-0.63 due to respiratory diseases. The effects were large given that the municipality average before the elimination was estimated as 0.60-0.63 and 1.01-1.07 respectively. The results partially supported Hypothesis 1 that the termination of Progresa would increase infant mortality in marginalized areas through increases in infectious and respiratory disease and nutritional deficiency. On the contrary, infant mortality due to other diseases or accidents were not affected. In particular, the effects of Progresa on deaths caused by accidents were examined as a falsification test, as the benefits of Progresa were not related to damage by accidents.

The findings were consistent with Barham's (2011) result that Progresa reduced 0.73 infant deaths per 1,000 live births due to intestinal infections and 1.56 deaths per 1,000 live births due to respiratory diseases. Progresa was developed to reduce the major causes of infant mortality by providing cash payment conditional upon preventative care visits and giving nutritional supplements and health education to mothers. In particular, micronutrient and protein supplements and treatment for parasites during pregnancy were crucial interventions (Kramer &

Kakuma, 2003; Ladipo, 2000; Mishra et al., 2005; O'Ryan et al., 2005; Shaheen et al., 2006; Zar & Mulholland, 2003). The health education programs taught mothers to make oral rehydration salts for managing intestinal infections and to prevent and recognize the signs of respiratory and diarrheal disease (Phavichitr & Catto-Smith, 2003; Thapar & Sanderson, 2004).

I also found that the elimination of Progresa reduced giving birth at private clinic by 0.8 percentage points, while it increased deliveries with a midwife's assistance by 5.1-5.5 percentage points. The results for maternal health were marginally significant ($p<0.1$). The results partially supported the second hypothesis (*The termination of Progresa reduces institutional deliveries, while increasing childbirth at home in marginalized areas*) and the third hypothesis (*The termination of Progresa reduces birth attendance by physician and nurse while increasing birth attendance by midwife in marginalized areas*).

The findings aligned with a previous study on the effects of Progresa on skilled attendance at delivery in rural areas (Urquieta et al., 2009). Using the initial period of the program (1997-2000), the authors found that Progresa increased the proportion of deliveries attended by either physicians or nurses or in healthcare facilities by 2.8 percentage points. Progresa may be related to the proportion of place of delivery and type of birth attendance due to the fact that beneficiaries of Progresa were more likely to use reproductive health services of the formal health system compared to non-beneficiaries (Barber, 2010). Moreover, cash transfers may have motivated the beneficiaries to change their behavior regarding the delivery process. Another possible mechanism may be the offered nutrition and health education lectures, which provided the beneficiary mothers with information about care during pregnancy (Urquieta et al., 2009).

While this research suggested significant findings, there are some limitations. First, I was not able to evaluate the effects on maternal deaths and maternal mortality ratio in this study. A maternal death was such a rare event that the influence of eliminating the program could not detect. Similar problems were noted in other studies on the effects of CCT programs in Nepal and India (Lim et al., 2010; Powell-Jackson & Hanson, 2012). Therefore, this study used place of delivery (public clinic, private clinic, home) and type of birth attendant (physician, nurse, or midwife) as proxies of maternal health. This approach still has a limitation because recent studies indicate that educated and trained midwives could contribute to high quality maternal and newborn services (Renfrew et al. 2014). In Mexico, the health ministry tried to create co-delivery by bringing traditional midwives into formal medical settings to work with doctors, which was found to improve maternal health (Braine, 2008). However, as the vital statistics from birth certification only allows choosing an option among physician, nurse, and midwife as a birth attendant, I was not able to distinguish births assisted by both physician and midwife.

Another limitation is that I did not present event study plots because the proportion of Progresa's beneficiaries in the program was changing over time before the elimination of the program since 1997. Event study plots are employed in many papers to visually test for pre-trends (Roth, 2019). As the pre-trends of the dependent variables were different due to different program's intensity over time, the event study plots could not be used to assess the pre-treatment differences in trends.

Lastly, this research was limited to a short period of time. The results were based on 1 year after the termination of Progresa just before the Covid-19 pandemic. More studies should be conducted to examine the long-term effects of eliminating Progresa on maternal and infant health.

Progresa was an effective anti-poverty program to reduce infant mortality and improve several health outcomes for young children and mothers from low-income households. This study demonstrates that a sudden rollback of the program significantly increased infant mortality due to particular causes of death, while adversely affecting maternal health outcomes in poor and rural areas of Mexico. Reducing infant mortality and improving maternal health have been one of the most important policy objectives in developing countries, and have been included in Millennium Development goals and Sustainable Development goals. To prevent Progresa's rollback from having further adverse effects, the Mexican government should provide poor families with health and nutritional interventions that can improve newborn and maternal health.

Appendices

T2.1. Coefficients on pre-intervention trends: difference in mean of total fertility rate between group 1 in 1996 and other groups by year, marginalized municipalities, Mexico (1990-1996) (n=6,293)

	Group 2	Group 3	Group 4
1990	0.158†	0.087	-0.078
	(0.082)	(0.089)	(0.108)
1991	0.150†	0.138	0.089
	(0.078)	(0.085)	(0.100)
1992	0.157*	0.146†	0.109
	(0.069)	(0.077)	(0.090)
1993	0.083	0.095	0.071
	(0.060)	(0.067)	(0.074)
1994	0.053	0.077	0.112†
	(0.049)	(0.053)	(0.067)
1995	0.058	0.067	0.198***
	(0.043)	(0.044)	(0.053)

Notes: All regressions included municipality and time fixed effects, and were weighted by total number of population in a municipality. Components of the Margination index were included as covariates but not presented. Total fertility rate was the total number of children born to a woman in her lifetime if she were subject to the prevailing rate of age-specific fertility in the population. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999. Group 5 was excluded due to significant pre-trends. Robust standard errors clustered at municipality level are in the parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
*†p ‹ .10; *p ‹ .05; ***p ‹ .001*

T2.2. Coefficients on pre-intervention trends: difference in mean of age-specific fertility rates between group 1 in 1996 and other groups by year, marginalized municipalities Mexico (1990-1996). (n=6,293)

	(1) ASFR 15-19	(2) ASFR 20-24	(3) ASFR 25-29
Year 1990 x Group 2	4.837†	9.981*	6.617
	(2.933)	(4.810)	(5.509)
Year 1990 x Group 3	2.997	3.392	2.831
	(3.337)	(5.573)	(5.713)
Year 1990 x Group 4	3.687	-1.483	-6.499
	(3.777)	(6.393)	(6.393)
Year 1991 x Group 2	2.287	7.435	5.769
	(2.731)	(4.649)	(5.276)
Year 1991 x Group 3	-1.260	4.833	4.877
	(2.796)	(5.429)	(5.177)
Year 1991 x Group 4	0.573	2.705	2.557
	(3.248)	(6.033)	(6.167)
Year 1992 x Group 2	3.260	9.493*	3.809
	(2.257)	(4.138)	(5.160)
Year 1992 x Group 3	2.003	7.828	3.987
	(2.407)	(4.756)	(5.395)
Year 1992 x Group 4	0.128	6.495	3.017
	(2.913)	(5.190)	(6.048)
Year 1993 x Group 2	0.088	6.570†	4.228
	(2.134)	(3.831)	(4.192)
Year 1993 x Group 3	-1.849	6.018	5.947
	(2.173)	(4.380)	(4.561)
Year 1993 x Group 4	-0.614	5.661	6.447
	(2.636)	(4.517)	(5.163)
Year 1994 x Group 2	0.139	8.881**	-0.250
	(1.832)	(3.179)	(3.852)
Year 1994 x Group 3	-3.306†	8.497*	6.055
	(1.880)	(3.439)	(4.271)
Year 1994 x Group 4	-1.171	9.485*	5.352
	(2.187)	(3.981)	(4.807)
Year 1995 x Group 2	1.144	2.066	1.505
	(1.812)	(3.209)	(3.352)
Year 1995 x Group 3	-1.023	3.874	3.550
	(1.922)	(3.358)	(3.421)
Year 1995 x Group 4	0.705	7.274*	12.039**
	(2.031)	(3.354)	(4.236)

Notes: All regressions included municipality and time fixed effects, and were weighted by total number of population in a municipality. Components of the Margination index were included as covariates but not presented. Age-specific fertility rate was the number of live births occurring during a given year per 1,000 women of reproductive age classified in 5-year age groups. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999. Group 5 was excluded due to significant pre-trends. Robust standard errors clustered at municipality level are in the parentheses.

Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census

*†p ‹ .10; *p ‹ .05; **p ‹ .01*

	(4) ASFR 30-34	(5) ASFR 35-39	(6) ASFR 40-44	(7) ASFR 45-49
Year 1990x Group 2	2.352	4.162	4.107	0.299
	(4.384)	(3.780)	(2.644)	(1.174)
Year 1990x Group 3	3.098	5.052	1.564	-0.180
	(5.184)	(4.046)	(2.886)	(1.366)
Year 1990x Group 4	-3.902	-3.594	-4.684†	-0.273
	(6.018)	(4.206)	(2.801)	(1.289)
Year 1991x Group 2	5.570	4.427	4.744†	0.150
	(4.776)	(3.222)	(2.472)	(1.095)
Year 1991x Group 3	6.018	8.526*	3.691	2.420*
	(5.534)	(3.728)	(2.775)	(1.183)
Year 1991x Group 4	7.487	5.082	-0.581	0.599
	(5.715)	(3.551)	(2.728)	(1.244)
Year 1992 x Group 2	5.501	5.299	3.428	1.248
	(4.668)	(3.338)	(2.104)	(1.096)
Year 1992 x Group 3	5.862	4.315	5.196*	0.793
	(5.070)	(3.826)	(2.429)	(1.218)
Year 1992 x Group 4	6.460	6.260†	-0.662	0.416
	(5.131)	(3.752)	(2.676)	(1.154)
Year 1993 x Group 2	1.499	4.156	1.166	-0.237
	(4.242)	(2.927)	(2.306)	(1.054)
Year 1993 x Group 3	5.182	6.495†	-0.167	0.157
	(4.789)	(3.377)	(2.596)	(1.161)
Year 1993 x Group 4	4.982	4.472	-3.701	-1.143
	(4.981)	(3.374)	(2.489)	(1.101)
Year 1994 x Group 2	0.473	0.799	0.025	1.060
	(3.556)	(2.441)	(1.987)	(0.961)
Year 1994 x Group 3	0.781	3.902	0.673	0.291
	(3.873)	(3.095)	(2.239)	(1.060)
Year 1994 x Group 4	4.665	5.876*	-1.548	0.601
	(4.291)	(2.891)	(2.324)	(1.076)
Year 1995 x Group 2	-0.751	4.840†	1.445	1.135
	(3.335)	(2.618)	(1.795)	(0.990)
Year 1995 x Group 3	-0.939	5.893*	2.905	0.592
	(3.784)	(2.653)	(2.177)	(1.035)
Year 1995 x Group 4	5.914	8.170**	5.029*	0.815
	(3.971)	(2.814)	(2.204)	(1.039)

Notes: All regressions included municipality and time fixed effects, and were weighted by total number of population in a municipality. Components of the Margination index were included as covariates but not presented. Age-specific fertility rate was the number of live births occurring during a given year per 1,000 women of reproductive age classified in 5-year age groups. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999. Group 5 was excluded due to significant pre-trends. Robust standard errors clustered at municipality level are in the parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
*†p ‹ .10; *p ‹ .05; **p ‹ .01*

T2.3. Coefficients on pre-intervention trends: difference in mean of under-5 mortality rate between group 1 in 1996 and other groups by year and gender, marginalized municipalities, Mexico (1990-1996) (n=7,847)

	(1) U5MR	(2) U5MR, female	(3) U5MR, male
Year 1990 x Group 2	0.069	0.793	-0.865
	(2.240)	(2.339)	(2.652)
Year 1990 x Group 3	1.040	1.392	0.487
	(2.340)	(2.379)	(2.783)
Year 1990 x Group 4	0.548	-0.218	1.285
	(2.772)	(2.848)	(3.158)
Year 1990 x Group 5	2.578	3.053	2.327
	(3.040)	(3.097)	(3.477)
Year 1990 x Group 2	0.452	0.971	-0.108
	(1.574)	(1.867)	(1.844)
Year 1991 x Group 3	1.305	1.991	0.593
	(1.552)	(1.819)	(1.921)
Year 1991 x Group 4	0.010	-0.207	0.210
	(1.698)	(1.978)	(2.065)
Year 1991 x Group 5	-1.066	-1.312	-0.871
	(1.787)	(2.202)	(2.045)
Year 1992 x Group 2	0.345	1.686	-1.096
	(1.400)	(1.637)	(1.783)
Year 1992 x Group 3	-0.724	-0.122	-1.471
	(1.455)	(1.647)	(1.912)
Year 1992 x Group 4	-0.751	0.277	-1.881
	(1.343)	(1.707)	(1.747)
Year 1992 x Group 5	-1.772	-1.210	-2.352
	(1.575)	(1.901)	(1.957)
Year 1993 x Group 2	1.130	1.748	0.538
	(1.266)	(1.743)	(1.473)
Year 1993 x Group 3	0.623	-0.475	1.698
	(1.221)	(1.566)	(1.608)
Year 1993 x Group 4	1.595	0.143	2.872*
	(1.194)	(1.611)	(1.477)
Year 1993 x Group 5	0.229	-0.754	1.188
	(1.426)	(1.742)	(1.791)
Year 1994 x Group 2	0.986	1.905	0.162
	(1.166)	(1.612)	(1.394)
Year 1994 x Group 3	0.776	0.886	0.523
	(1.203)	(1.502)	(1.548)
Year 1994 x Group 4	-0.163	0.170	-0.517
	(1.255)	(1.605)	(1.510)
Year 1994 x Group 5	0.427	0.170	0.818
	(1.419)	(1.711)	(1.758)
Year 1995 x Group 2	1.167	0.215	2.035
	(1.183)	(1.587)	(1.599)
Year 1995 x Group 3	0.948	0.625	1.133
	(1.244)	(1.743)	(1.703)
Year 1995 x Group 4	1.419	0.069	2.536

	(1.257)	(1.564)	(1.621)
Year 1995 x Group 5	0.419	-0.639	1.449
	(1.370)	(1.768)	(1.802)

Notes: All regressions included municipality and time fixed effects, and were weighted by total number of population in a municipality. Components of the Margination index were included as covariates but not presented. Under-5 mortality rate was the number of children who die by exactly 5 years of age per 1,000 live births. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999.Robust standard errors clustered at municipality level are in the parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
**p ‹ .05; **p ‹ .01*

T2.4. Coefficients on pre-intervention trends: difference in mean of proportion of deliveries by place of delivery between group 1 in 1996 and other groups by year, marginalized municipalities, Mexico (1990-1996) (n=6,335)

	(1) Public clinic	(2) Private clinic	(3) Home
Year 1990 x Group 2	-0.025	0.007	0.004
	(0.018)	(0.015)	(0.016)
Year 1990 x Group 3	-0.010	-0.003	-0.020
	(0.021)	(0.017)	(0.018)
Year 1990 x Group 4	-0.017	0.019	-0.022
	(0.018)	(0.015)	(0.015)
Year 1991 x Group 2	-0.021	0.013	-0.004
	(0.019)	(0.014)	(0.015)
Year 1991 x Group 3	-0.012	0.006	-0.021
	(0.022)	(0.016)	(0.016)
Year 1991 x Group 4	-0.023	0.023†	-0.023†
	(0.020)	(0.014)	(0.013)
Year 1992 x Group 2	-0.015	0.012	-0.005
	(0.016)	(0.011)	(0.014)
Year 1992 x Group 3	-0.009	0.010	-0.016
	(0.018)	(0.013)	(0.013)
Year 1992 x Group 4	-0.023	0.020*	-0.017
	(0.016)	(0.010)	(0.012)
Year 1993 x Group 2	-0.015	0.008	-0.003
	(0.015)	(0.010)	(0.013)
Year 1993 x Group 3	-0.013	0.009	-0.011
	(0.015)	(0.011)	(0.011)
Year 1993 x Group 4	-0.026†	0.018*	-0.013
	(0.016)	(0.009)	(0.010)
Year 1994 x Group 2	-0.005	0.004	-0.010
	(0.012)	(0.008)	(0.010)
Year 1994 x Group 3	-0.007	0.004	-0.016†
	(0.013)	(0.009)	(0.009)
Year 1994 x Group 4	-0.024†	0.015†	-0.014
	(0.014)	(0.008)	(0.009)
Year 1995 x Group 2	-0.011	0.007	-0.004
	(0.009)	(0.005)	(0.006)
Year 1995 x Group 3	-0.014	0.009	-0.007
	(0.011)	(0.007)	(0.007)
Year 1995 x Group 4	-0.019*	0.014**	-0.007
	(0.010)	(0.005)	(0.006)

Notes: All regressions included municipality and time fixed effects, and were weighted by total number of population in a municipality. Components of the Margination index were included as covariates but not presented. Dependent variable was the proportion of births at (1) public clinic, (2) private clinic, and (3) home in total births. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999. Group 5 was excluded due to significant pre-trends. Robust standard errors clustered at municipality level are in the parentheses.

*Source***:** Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census

*†p ‹ .10; *p ‹ .05; **p ‹ .01*

T2.5. Coefficients on pre-intervention trends: difference in mean of proportion of type of birth attendant between group 1 in 1996 and other groups by year, marginalized municipalities, Mexico (1990-1996) (n=6,335)

	(1) Physician	(2) Nurse or midwife
Year 1990 x Group 2	-0.027†	0.013
	(0.016)	(0.017)
Year 1990 x Group 3	-0.025	-0.013
	(0.019)	(0.019)
Year 1990 x Group 4	-0.031	-0.020
	(0.019)	(0.023)
Year 1991 x Group 2	-0.015	0.005
	(0.016)	(0.016)
Year 1991 x Group 3	-0.012	-0.016
	(0.017)	(0.017)
Year 1991 x Group 4	-0.022	-0.020
	(0.019)	(0.017)
Year 1992 x Group 2	-0.008	-0.001
	(0.015)	(0.016)
Year 1992 x Group 3	-0.005	-0.010
	(0.016)	(0.015)
Year 1992 x Group 4	-0.020	-0.012
	(0.017)	(0.015)
Year 1993 x Group 2	-0.008	-0.001
	(0.014)	(0.014)
Year 1993 x Group 3	-0.009	-0.005
	(0.014)	(0.015)
Year 1993 x Group 4	-0.021	-0.007
	(0.015)	(0.013)
Year 1994 x Group 2	-0.002	-0.013
	(0.011)	(0.011)
Year 1994 x Group 3	-0.004	-0.015
	(0.012)	(0.011)
Year 1994 x Group 4	-0.017	-0.012
	(0.013)	(0.010)
Year 1995 x Group 2	-0.004	-0.004
	(0.008)	(0.007)
Year 1995 x Group 3	-0.007	-0.003
	(0.010)	(0.007)
Year 1995 x Group 4	-0.012	-0.002
	(0.009)	(0.007)

Notes: All regressions included municipality and time fixed effects, and were weighted by total number of population in a municipality. Components of the Margination index were included as covariates but not presented. Dependent variable was the proportion of birth attendance by (1) physician and (2) nurse or midwife in total births. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999. Group 5 was excluded due to significant pre-trends. Robust standard errors clustered at municipality level are in the parentheses.
*Source***:** Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
*†p ‹ .10; *p ‹ .05*

T2.6. The effects of 1, 3, and 5 years lagged Progresa on infant mortality rate, marginalized municipalities, Mexico (1990-2010) (n=23,541)

	(1) 1-year-lagged	(2) 3-year-lagged	(3) 5-year-lagged	Municipality mean, 1996
Infant mortality, all				
Lag of Progresa intensity	-1.875	-0.401	1.046	14.46
	(1.603)	(1.582)	(1.527)	
Infant mortality, female				
Lag of Progresa intensity	-2.072	-0.505	0.543	12.75
	(1.593)	(1.540)	(1.457)	
Infant mortality, male				
Lag of Progresa intensity	-1.754	-0.348	1.515	16.12
	(1.694)	(1.711)	(1.670)	

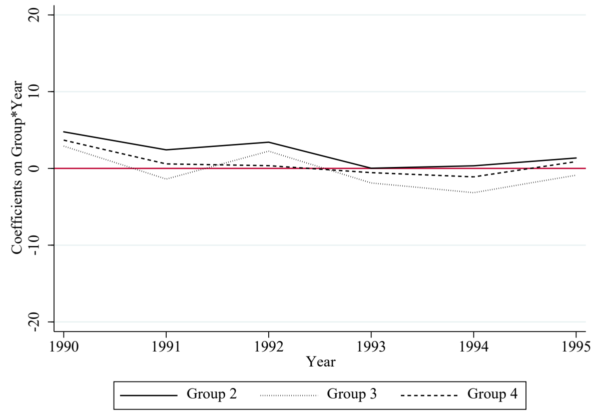
Notes: All regressions included municipality and time fixed effects, and were weighted by the number of total population in a municipality. Components of the Margination index were included as covariates but not presented. Infant mortality rate was the number of deaths of children under 1 year of age per 1,000 live births. Lag of Progresa intensity was the percent of cumulative beneficiary households in each municipality and previous year. Robust standard errors clustered at municipality level are in the parentheses.
*Source***:** Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
**p ‹ .05*

T2.7. The effects of 1, 3, and 5 years lagged Progresa on infant mortality rate, marginalized municipalities, Mexico (1997-2010) (n=15,694)

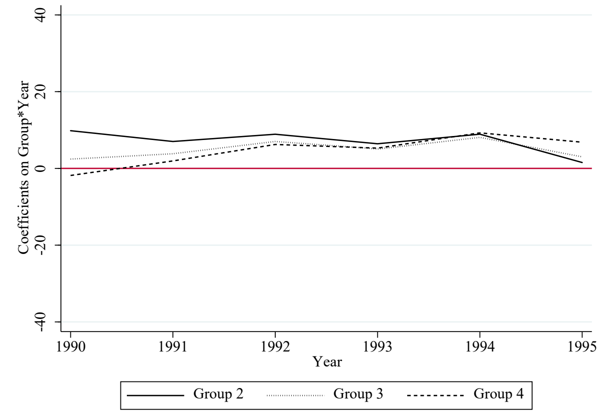
	(1) 1-year-lagged	(2) 3-year-lagged	(3) 5-year-lagged	Municipality mean, 1996
Infant mortality, all				
Lag of Progresa intensity	-3.126**	-1.184	0.122	14.46
	(1.189)	(1.147)	(1.129)	
Infant mortality, female				
Lag of Progresa intensity	-3.443**	-1.280	-0.451	12.75
	(1.271)	(1.157)	(1.098)	
Infant mortality, male				
Lag of Progresa intensity	-2.854*	-1.108	0.690	16.12
	(1.283)	(1.306)	(1.289)	

Notes: All regressions included municipality and time fixed effects, and were weighted by the number of total population in a municipality. Components of the Margination index were included as covariates but not presented. Infant mortality rate was the number of deaths of children under 1 year of age per 1,000 live births. Lag of Progresa intensity was the percent of cumulative beneficiary households in each municipality and previous year. Robust standard errors clustered at municipality level are in the parentheses.
*Source***:** Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census
$*p < .05$

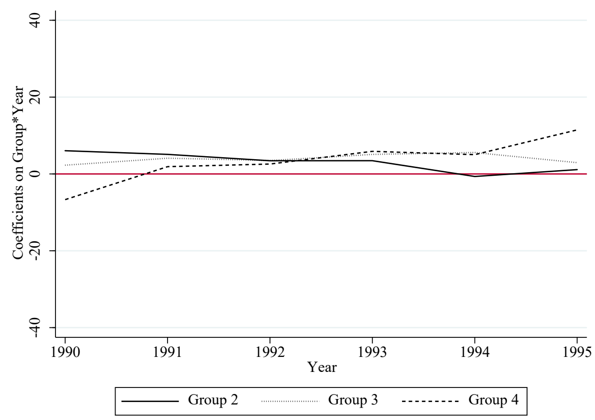
F2.1. Coefficients on pre-intervention trends: difference in mean of age-specific fertility rates between group 1 in 1996 and other groups by year, marginalized municipalities, Mexico (1990-1996)



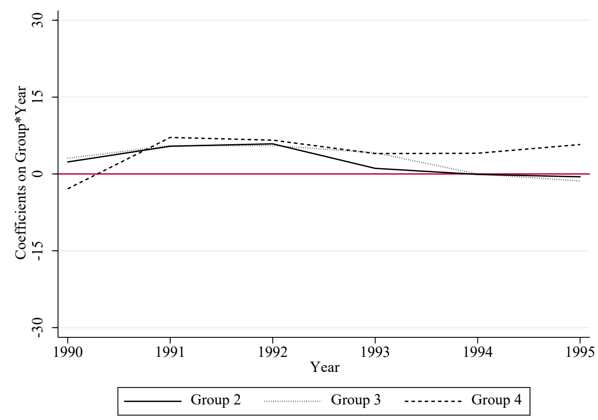
ASFR, 15-19



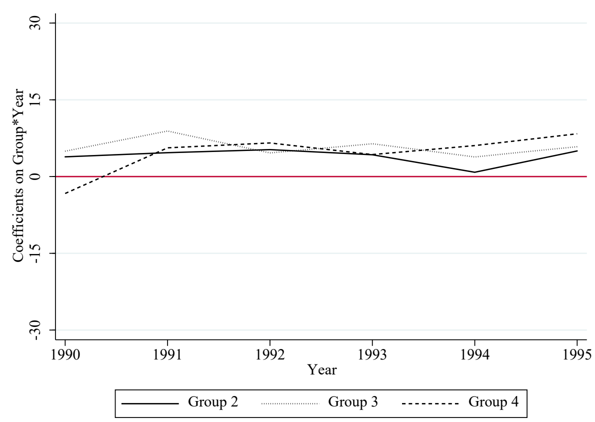
ASFR, 20-24



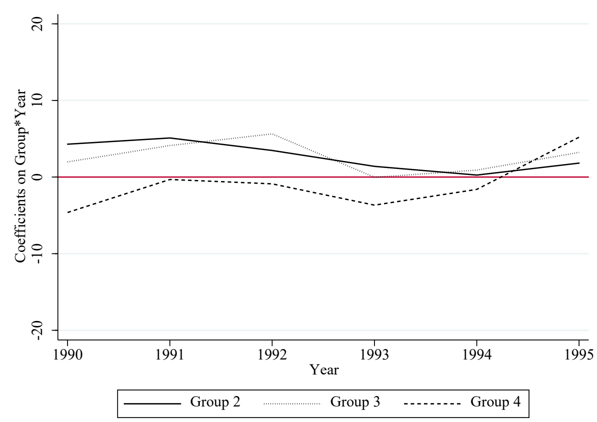
ASFR, 25-29



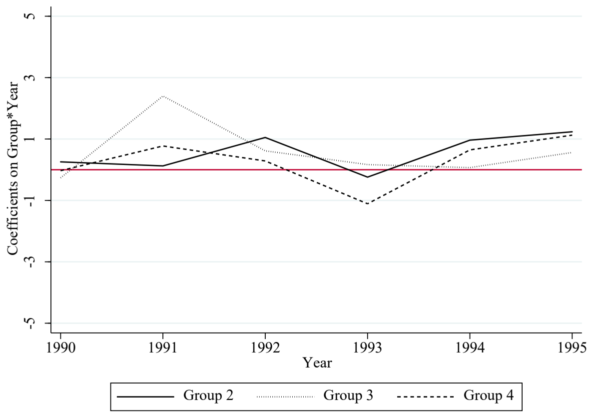
ASFR, 30-34



ASFR, 35-39



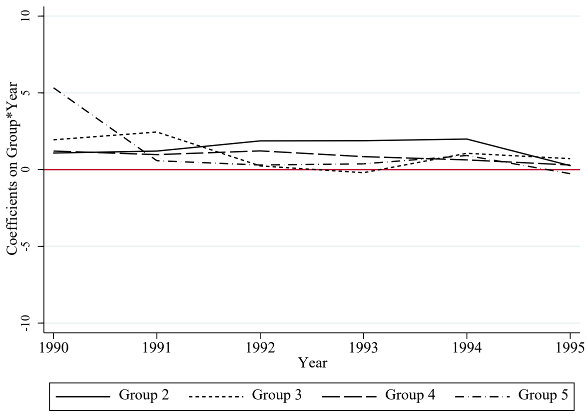
ASFR, 40-44



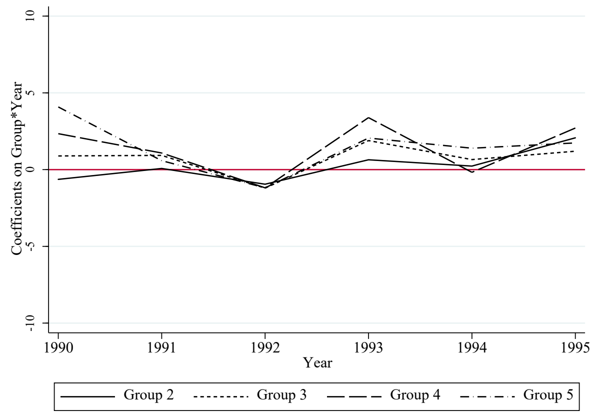
ASFR, 45-49

Notes: Dependent variable was age-specific fertility rate, the number of live births occurring during a given year per 1,000 women of reproductive age classified in 5-year age groups. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999 (group 1: the lowest proportion of beneficiaries of Progresa – group 5: the highest proportion of beneficiaries of Progresa). 1996 and group 1 were excluded as reference groups. Group 5 was excluded due to pre-intervention trends.
Source: Instituto Nacional de Estadistica y Geografia and Mexican census

F2.2. Coefficients on pre-intervention trends: difference in mean of under-5 mortality rate by gender between group 1 in 1996 and other groups by year, marginalized municipalities, Mexico (1990-1996)



U5MR, female



U5MR, male

Notes: Dependent variable was under-5 mortality by gender. Under-5 mortality rate was the number of children who die by exactly 5 years of age per 1,000 live births. The municipality groups were assigned numbers 1 to 5 according to percent of cumulative beneficiary households in 1999 (group 1: the lowest proportion of beneficiaries of Progresa – group 5: the highest proportion of beneficiaries of Progresa). 1996 and group 1 were excluded as reference groups.
Source: Instituto Nacional de Estadistica y Geografia and Mexican census

T3.1. Effect of the elimination of Progresa on infant mortality, comparison of the highest quartile of Progresa's intensity to the lowest quartile, marginalized areas, Mexico (n=1,130)

	(1) Jan-Dec	(2) Mar-Dec
All		
Elimination of Progresa	0.995	1.215
	(1.379)	(1.690)
Municipality mean before the elimination	12.69	12.79
Female		
Elimination of Progresa	0.355	1.289
	(1.831)	(2.093)
Municipality mean before the elimination	12.01	12.09
Male		
Elimination of Progresa	1.215	0.525
	(2.043)	(2.469)
Municipality mean before the elimination	13.55	13.75

Notes: All regressions included municipality and time fixed effects and were weighted by number of children ages 0-5 in a municipality. The analyses compared the highest quartile of Progresa's intensity with the lowest quartile in the marginalized areas. In all regression analyses, the observations included only balanced panels. Column 1 has infant mortality occurred for whole year in 2018-2019 (pre: 2018; post: 2019). Column 2 has infant mortality occurred for 10 months for each period (pre: Mar-Dec 2018; post: Mar-Dec 2019) and has smaller observations. Standard errors clustered at municipality level are in parentheses.
*Source***:** Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census

T3.2. Effect of the termination of Progresa on infant mortality by cause of death, comparison of the highest quartile of Progresa's intensity to the lowest quartile, marginalized areas, Mexico (n=1,130)

	(1) Jan-Dec	(2) Mar-Dec
Infectious and parasitic disease		
Lag of program intensity	0.499†	0.451
	(0.265)	(0.312)
Municipality mean before the elimination	0.59	0.61
Endocrine, nutritional, and metabolic diseases		
Lag of program intensity	-0.010	-0.010
	(0.162)	(0.189)
Municipality mean before the elimination	0.34	0.36
Respiratory disease		
Lag of program intensity	0.672	0.728
	(0.431)	(0.453)
Municipality mean before the elimination	1.12	1.06
Conditions originating in the perinatal period		
Lag of program intensity	0.619	0.852
	(0.961)	(1.122)
Municipality mean before the elimination	6.31	6.42
Congenital malformations, deformations, chromosomal abnormalities		
Lag of program intensity	-0.583	-0.536
	(0.654)	(0.756)
Municipality mean before the elimination	2.92	2.96
Accidents		
Lag of program intensity	-0.121	-0.144
	(0.145)	(0.168)
Municipality mean before the elimination	0.22	0.19

Notes: All regressions included municipality and time fixed effects, and were weighted by the number of children aged under 5 in a municipality. The analyses compared the highest quartile of Progresa's intensity with the lowest quartile in the marginalized areas. In all regression analyses, the observations included only balanced panels. Column 1 has infant mortality occurred for whole year in 2018-2019 (pre: 2018; post: 2019). Column 2 has infant mortality occurred for 10 months for each period (pre: Mar-Dec 2018; post: Mar-Dec 2019) and has smaller observations. The cause of death was based on International Statistical Classification of Diseases and Related Health Problems 10th Revision. Available from https://icd.who.int/browse10/2019/en Standard errors clustered at municipality level are in the parentheses.

Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census

†p ‹ .10

T3.3. Effect of the elimination of Progresa on place of delivery, comparison of the highest quartile of Progresa's intensity to the lowest quartile, marginalized areas, Mexico (n=1,130)

	(1) Jan-Dec	(2) Mar-Dec
Public clinic		
Elimination of Progresa	0.009	0.018
	(0.011)	(0.012)
Municipality mean before the elimination	0.72	0.72
Private clinic		
Elimination of Progresa	-0.008	-0.008*
	(0.006)	(0.004)
Municipality mean before the elimination	0.07	0.07
Home		
Elimination of Progresa	0.029	0.039
	(0.018)	(0.026)
Municipality mean before the elimination	0.13	0.13

Notes: All regressions included municipality and time fixed effects and were weighted by number of children ages 0-5 in a municipality. The analyses compared the highest quartile of Progresa's intensity with the lowest quartile in the marginalized areas. In all regression analyses, the observations included only balanced panels. Column 1 has births occurred for whole year in 2018-2019 (pre: 2018; post: 2019). Column 2 has births occurred for 10 months for each period (pre: Mar-Dec 2018; post: Mar-Dec 2019) and has smaller observations. Standard errors clustered at municipality level are in parentheses.

*Source***:** Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census

*$p < .05$

T3.4. Effect of the elimination of Progresa on birth assistant, comparison of the highest quartile of Progresa's intensity to the lowest quartile, marginalized areas, Mexico (n=1,130)

	(1) Jan-Dec	(2) Mar-Dec
Physician		
Elimination of Progresa	0.008	0.007
	(0.011)	(0.012)
Municipality mean before the elimination	0.77	0.78
Nurse		
Elimination of Progresa	-0.006	-0.006
	(0.004)	(0.004)
Municipality mean before the elimination	0.01	0.01
Midwife		
Elimination of Progresa	0.032†	0.035†
	(0.018)	(0.020)
Municipality mean before the elimination	0.13	0.13

Notes: All regressions included municipality and time fixed effects and were weighted by number of children ages 0-5 in a municipality. The analyses compared the highest quartile of Progresa's intensity with the lowest quartile in the marginalized areas. In all regression analyses, the observations included only balanced panels. Column 1 has births occurred for whole year in 2018-2019 (pre: 2018; post: 2019). Column 2 has births occurred for 10 months for each period (pre: Mar-Dec 2018; post: Mar-Dec 2019) and has smaller observations. Standard errors clustered at municipality level are in parentheses.

*Source***:** Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census

†p ‹ .10

T3.5. Falsification test using 2017-2018 data: infant mortality, marginalized areas (n=2,220)

	(1) Jan-Dec	(2) Mar-Dec
All		
Progresa intensity	-1.562	-1.354
	(1.979)	(1.554)
Municipality mean in 2017	14.01	14.18
Female		
Progresa intensity	-1.606	-1.795
	(2.401)	(2.105)
Municipality mean in 2017	12.69	12.65
Male		
Progresa intensity	-1.442	-0.743
	(2.175)	(1.777)
Municipality mean in 2017	15.44	15.65

Notes: All regressions included municipality and time fixed effects and were weighted by number of children ages 0-5 in a municipality. In all regression analyses, the observations included only balanced panels. Column 1 has infant deaths and births occurred for whole year in 2017-2018 (pre: 2017; post: 2018). Column 2 has infant deaths and births occurred for 10 months for each period (pre: Mar-Dec 2017; post: Mar-Dec 2018) and has smaller observations (n=2,216). Standard errors clustered at municipality level are in parentheses.
Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census

T3.6. Falsification test using 2017-2018 data: place of delivery, marginalized areas (n=2,226)

	(1) Jan-Dec	(2) Mar-Dec
Public clinic		
Progresa intensity	0.030**	0.029**
	(0.009)	(0.010)
Municipality mean in 2017	0.76	0.76
Private clinic		
Progresa intensity	-0.006	-0.006
	(0.004)	(0.004)
Municipality mean in 2017	0.07	0.08
Home		
Progresa intensity	-0.010	-0.010
	(0.012)	(0.012)
Municipality mean in 2017	0.10	0.09

Notes: All regressions included municipality and time fixed effects and were weighted by number of children ages 0-5 in a municipality. In all regression analyses, the observations included only balanced panels. Column 1 has births occurred for whole year in 2017-2018 (pre: 2017; post: 2018). Column 2 has births occurred for 10 months for each period (pre: Mar-Dec 2017; post: Mar-Dec 2018) and has smaller observations (n=2,216). Standard errors clustered at municipality level are in parentheses.

Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census

$^{**}p < .01$

T3.7. Falsification test using 2017-2018 data: birth assistant, marginalized areas (n=2,226)

	(1) Jan-Dec	(2) Mar-Dec
Physician		
Progresa intensity	0.025**	0.025**
	(0.009)	(0.010)
Municipality mean in 2017	0.82	0.83
Nurse		
Progresa intensity	-0.001	-0.002
	(0.003)	(0.003)
Municipality mean in 2017	0.01	0.01
Midwife		
Progresa intensity	-0.008	-0.008
	(0.012)	(0.012)
Municipality mean in 2017	0.09	0.09

Notes: All regressions included municipality and time fixed effects and were weighted by number of children ages 0-5 in a municipality. In all regression analyses, the observations included only balanced panels. Column 1 has births occurred for whole year in 2017-2018 (pre: 2017; post: 2018). Column 2 has births occurred for 10 months for each period (pre: Mar-Dec 2017; post: Mar-Dec 2018) and has smaller observations (n=2,216). Standard errors clustered at municipality level are in parentheses.

Source: Mexican Institute of Statistics Geography and Informatics (INEGI), Mexican Population Council (CONAPO) and Mexican census

$^{**}p < .01$

Bibliography

AbouZahr, C., de Savigny, D., Mikkelsen, L., Setel, P. W., Lozano, R., Nichols, E., Notzon, F., & Lopez, A. D. (2015). Civil registration and vital statistics: Progress in the data revolution for counting and accountability. *The Lancet*, *386*(10001), 1373–1385. https://doi.org/10.1016/S0140-6736(15)60173-8

Andalón, M. (2011). Oportunidades to reduce overweight and obesity in Mexico? *Health Economics*, *20 Suppl 1*, 1–18. https://doi.org/10.1002/hec.1773

Angelucci, M. (2014). Migration and financial constraints: Evidence from Mexico. *The Review of Economics and Statistics*, *97*(1), 224–228. https://doi.org/10.1162/REST_a_00487

Baker, J., Alcantara, A., & Ruan, X. (2011). A stochastic version of the Brass PF ratio adjustment of age-specific fertility schedules. *PLoS ONE*, *6*(8), e23222. https://doi.org/10.1371/journal.pone.0023222

Barber, S. L. (2007). Family planning advice and postpartum contraceptive use among low-income women in Mexico. *International Family Planning Perspectives*, 33(1), 6–12. http://www.jstor.org/stable/30039187

Barber, S. L. (2010). Mexico's conditional cash transfer programme increases cesarean section rates among the rural poor. *European Journal of Public Health*, *20*(4), 383–388. https://doi.org/10.1093/eurpub/ckp184

Barber, S. L., & Gertler, P. J. (2008). The impact of Mexico's conditional cash transfer programme, Oportunidades, on birthweight. *Tropical Medicine & International Health: TM & IH*, *13*(11), 1405–1414. https://doi.org/10.1111/j.1365-3156.2008.02157.x

Barham, T. (2011). A healthier start: The effect of conditional cash transfers on neonatal and infant mortality in rural Mexico. *Journal of Development Economics*, *94*(1), 74–85. https://doi.org/10.1016/j.jdeveco.2010.01.003

Becker, G. S., & Lewis, H. G. (1973). On the interaction between the quantity and quality of children. *Journal of Political Economy*, *81*(2), S279–S288. JSTOR.

Behrman, J., & Hoddinott, J. (2005). Programme evaluation with unobserved heterogeneity and selective implementation: The Mexican PROGRESA impact on child nutrition. *Oxford Bulletin of Economics and Statistics*, *67*(4), 547–569.

Bellés-Obrero, C., & Lombardi, M. (2020). Will you marry me, later? Age-of-marriage laws and child marriage in Mexico. Retrieved from http://scioteca.caf.com/handle/123456789/1654

Bongaarts, J. (1987). Does family planning reduce infant mortality rates? *Population and Development Review*, 13(2), 323–334. https://doi.org/10.2307/1973197

Braine, T. (2006). Mexico's quest for a complete mortality data set. *Bulletin of the World Health Organization*, *84*(3), 166–168. WHO IRIS.

Braine T. (2008). Mexico's midwives enter the mainstream. *Bulletin of the World Health Organization*, 86(4), 244–245. https://doi.org/10.2471/blt.08.010408

Brass, W. (1964). *Uses of census or survey data for the estimation of vital rates*. UN. ECA African Seminar on Vital Statistics, Addis Ababa, Ethiopia. https://repository.uneca.org/handle/10855/9560

Brass, W. (1985). *Advances in methods for estimating fertility and mortality from limited and defective data*. Centre for Population Studies, London School of Hygiene and Tropical Medicine.

Bryant, J. (2007). Theories of fertility decline and the evidence from development indicators. *Population and Development Review*, 33(1), 101–127.

Campbell, O. M., & Graham, W. J. (2006). Strategies for reducing maternal mortality: Getting on with what works. *The Lancet*, *368*(9543), 1284–1299. https://doi.org/10.1016/S0140-6736(06)69381-1

Carlough, M., & McCall, M. (2005). Skilled birth attendance: What does it mean and how can it be measured? A clinical skills assessment of maternal and child health workers in Nepal.

International Journal of Gynecology & Obstetrics, *89*(2), 200–208. https://doi.org/10.1016/j.ijgo.2004.12.044
Chari, A. V., Heath, R., Maertens, A., & Fatima, F. (2017). The causal effect of maternal age at marriage on child wellbeing: Evidence from India. *Journal of Development Economics*, *127*(C), 42–55. https://doi.org/10.1016/j.jdeveco.2017.02.002
Chen, W. (2016). *Evaluation of the completeness of birth registration in China using analytical methods and multiple Sources of Data*. 13.
Darney, B. G., Weaver, M. R., Sosa-Rubi, S. G., Walker, D., Servan-Mori, E., Prager, S., & Gakidou, E. (2013). The Oportunidades conditional cash transfer program: Effects on pregnancy and contraceptive use among young rural women in Mexico. *International Perspectives on Sexual and Reproductive Health*, *39*(04), 205–214. https://doi.org/10.1363/3920513
Farmer, P. E., Nizeye, B., Stulac, S., & Keshavjee, S. (2006). Structural violence and clinical medicine. *PLOS Medicine*, *3*(10), e449. https://doi.org/10.1371/journal.pmed.0030449
Feldman, B. S., Zaslavsky, A. M., Ezzati, M., Peterson, K. E., & Mitchell, M. (2009). Contraceptive use, birth spacing, and autonomy: An analysis of the *Oportunidades* program in rural Mexico. *Studies in Family Planning*, *40*(1), 51–62. https://doi.org/10.1111/j.1728-4465.2009.00186.x
Finlay, J. E., Moucheraud, C., Goshev, S., Levira, F., Mrema, S., Canning, D., Masanja, H., & Yamin, A. E. (2015). The effects of maternal mortality on infant and child survival in rural Tanzania: A cohort study. *Maternal and Child Health Journal*, *19*(11), 2393–2402. https://doi.org/10.1007/s10995-015-1758-2
Frenk, J., Sepúlveda, J., Gómez-Dantés, O., & Knaul, F. (2003). Evidence-based health policy: Three generations of reform in Mexico. *Lancet*, *362*(9396), 1667–1671. https://doi.org/10.1016/S0140-6736(03)14803-9
Gamlin, J., & Osrin, D. (2020). Preventable infant deaths, lone births, and lack of registration in Mexican indigenous communities: Health care services and the afterlife of colonialism. *Ethnicity & Health*, *25*(7), 925–939. https://doi.org/10.1080/13557858.2018.1481496
Gertler, P. (2004). Do conditional cash transfers improve child health? Evidence from PROGRESA's control randomized experiment. *The American Economic Review*, *94*(2), 336–341. https://doi.org/10.1257/0002828041302109
Gertler, P., & Boyce, S. (2003). *An experiment in incentive-based welfare: The impact of PROGESA on health in Mexico*.
Glassman, A., Duran, D., Fleisher, L., Singer, D., Sturke, R., Angeles, G., Charles, J., Emrey, B., Gleason, J., Mwebsa, W., Saldana, K., Yarrow, K., & Koblinsky, M. (2013). Impact of conditional cash transfers on maternal and newborn health. *Journal of Health, Population, and Nutrition*, *31*(4), 48-66.
Gulemetova-Swan, M. (2009). *Evaluating the impact of conditional cash transfer programs on adolescent decisions about marriage and fertility: The case of Oportunidades*. University of Pennsylvania.
Gupta, S. K., Pal, D. K., Tiwari, R., Garg, R., Shrivastava, A. K., Sarawagi, R., Patil, R., Agarwal, L., Gupta, P., & Lahariya, C. (2012). Impact of Janani Suraksha Yojana on institutional delivery rate and maternal morbidity and mortality: An observational study in India. *Journal of Health, Population, and Nutrition*, *30*(4), 464–471. https://doi.org/10.3329/jhpn.v30i4.13416
Gutierrez, G., reyes-morales, H., Fernández, S., Pérez, L., Perez-Cuevas, R., & Guiscafré, H. (1999). Impacto de los servicios de salud, el saneamiento y la alfabetización en la mortalidad de menores de cinco años. *Salud Pública de México*, *41*. https://doi.org/10.1590/S0036-36341999000500004
Handa, S., Peterman, A., Seidenfeld, D., & Tembo, G. (2016). Income transfers and maternal health: Evidence from a national randomized social cash transfer program in Zambia. *Health Economics*, *25*(2), 225–236. https://doi.org/10.1002/hec.3136
Harbers, I. (2020). Legal identity for all? Gender inequality in the timing of birth registration in Mexico. *World Development*, *128*, 104778. https://doi.org/10.1016/j.worlddev.2019.104778

Hernandez, B., Rodriguez Angulo, E., Johnson, L. M., Palmisano, E. B., Ojeda, R., Ojeda, R., Gómez Carro, S., Chen, A., Camarda, J., Johanns, C., & Flaxman, A. (2022). Assessment of the quality of the vital registration system for under-5 mortality in Yucatan, Mexico. *Population health metrics*, *20*(1), 7. https://doi.org/10.1186/s12963-022-00284-5

Hernández, B., Ramírez-Villalobos, D., Romero, M., Gómez, S., Atkinson, C., & Lozano, R. (2011). Assessing quality of medical death certification: Concordance between gold standard diagnosis and underlying cause of death in selected Mexican hospitals. *Population Health Metrics*, *9*(1). https://doi.org/10.1186/1478-7954-9-38

Hernández, B., Ramírez-Villalobos, D., Duarte gomez, M. beatriz, Corcho, A., Villarreal, G., Jiménez, A., & Torres, L. (2012). Underreporting of deaths in children and birth certification in a representative sample of the 101 municipalities with lowest human development index in Mexico. *Salud Pública de México*, *54*, 393–400.

Hobcraft, J. (1987) Does family planning save children's lives?

Holmes, S. M. (2012). The clinical gaze in the practice of migrant health: Mexican migrants in the United States. *Social Science & Medicine*, *74*(6), 873–881. https://doi.org/10.1016/j.socscimed.2011.06.067

Hubert, C., Villalobos, A., Abreu, A. B., Suárez-López, L., & Castro, F. de. (2019). Factors associated with pregnancy and motherhood among Mexican women aged 15-24. *Cadernos de Saúde Pública*, *35*(6). https://doi.org/10.1590/0102-311x00142318

Huerta, M. C. (2006). Child health in rural Mexico: Has Progresa reduced children's morbidity risks? *Social Policy and Administration*, *40*(6), 652–677. https://doi.org/10.1111/j.1467-9515.2006.00525.x

Kamal, S. M. M. (2010). Fertility decline in Bangladesh: Understanding the future direction and contribution of demographic components. *Journal of Applied Science and Technology*, *7*, 98–103.

Kozuki, N., Lee, A. C., Silveira, M. F., Sania, A., Vogel, J. P., Adair, L., …Child Health Epidemiology Reference Group (CHERG) Small-for-Gestational-Age-Preterm Birth Working Group (2013). The associations of birth intervals with small-for-gestational-age, preterm, and neonatal and infant mortality: A meta-analysis. *BMC Public Health* 13, S3. https://doi.org/10.1186/1471-2458-13-S3-S3

Kramer, M. S., & Kakuma, R. (2003). Energy and protein intake in pregnancy. *The Cochrane Database of Systematic Reviews*, *4*, CD000032. https://doi.org/10.1002/14651858.CD000032

Ladipo, O. A. (2000). Nutrition in pregnancy: Mineral and vitamin supplements. *The American Journal of Clinical Nutrition*, *72*(1 Suppl), 280S-290S. https://doi.org/10.1093/ajcn/72.1.280S

Lárraga, L. G. D. (2016). *How does Prospera work?: Best practices in the implementation of conditional cash transfer programs in Latin America and the Caribbean* (Technical Note IDB-TN-971). Retrieved from Inter-American Development Bank website: https://publications.iadb.org

Levy, S. (2006). *Progress against poverty: Sustaining Mexico's Progresa- Oportunidades program*. Brookings Institution Press.

Lim, S. S., Dandona, L., Hoisington, J. A., James, S. L., Hogan, M. C., & Gakidou, E. (2010). India's Janani Suraksha Yojana, a conditional cash transfer programme to increase births in health facilities: An impact evaluation. *The Lancet*, *375*(9730), 2009–2023. https://doi.org/10.1016/S0140-6736(10)60744-1

López, A. R. (2021). School nonattendance and child labor in Mexico: North-South, gender, and rural divides. *Análisis Económico*, *36*(91), 33–62.

Mahapatra, P., Shibuya, K., Lopez, A. D., Coullare, F., Notzon, F. C., Rao, C., & Szreter, S. (2007). Civil registration systems and vital statistics: Successes and missed opportunities. *The Lancet*, *370*(9599), 1653–1663. https://doi.org/10.1016/S0140-6736(07)61308-7

Mathers, C. D., Fat, D. M., Inoue, M., Rao, C., & Lopez, A. D. (2005). Counting the dead and what they died from: An assessment of the global status of cause of death data. *Bulletin of the World Health Organization*, *83*(3), 171–177.

Mikkelsen, L., Phillips, D. E., AbouZahr, C., Setel, P. W., de Savigny, D., Lozano, R., & Lopez, A. D. (2015). A global assessment of civil registration and vital statistics systems: Monitoring data quality and progress. *The Lancet*, *386*(10001), 1395–1406. https://doi.org/10.1016/S0140-6736(15)60171-4

Mishra, V., Thapa, S., Retherford, R. D., & Dai, X. (2005). Effect of iron supplementation during pregnancy on birthweight: Evidence from Zimbabwe. *Food and Nutrition Bulletin*, *26*(4), 338–347. https://doi.org/10.1177/156482650502600403

Moultrie, T. A., & Dorrington, R. (2008). Sources of error and bias in methods of fertility estimation contingent on the P/F ratio in a time of declining fertility and rising mortality. *Demographic Research*, *19*, 1635–1662. https://doi.org/10.4054/DemRes.2008.19.46

Moultrie, T. A., Dorrington, R., Hill, A. G., Hill, K., Timaeus, I., & Zaba, B. (Ed.). (2013). *Tools for demographic estimation*. Paris: International Union for the Scientific Study of Population. demographicestimation.iussp.org

Mturi, A. J., & Hinde, A. (2001). *Fertility levels and differentials in Tanzania.* Proceedings of the workshop on prospects for fertility decline in high fertility countries, New York.

Naciones Unidas (2010). Objetivos de desarrollo del milenio. El progreso de AmeÂ rica Latina y el Caribe hacia los objetivos de desarrollo del milenio. DesafõÂos para lograrlos con igualdad. Chile: ONU

Ordóñez-Barba, G., & Hernández, A. (2019). Progresa-Oportunidades-Prospera: Transformations, reaches and results of a paradigmatic program against poverty. *Papeles de Población*, *25*, 77–109.

Organization for Economic Co-operation and Development & World Bank (2020). *Health at a glance: Latin America and the Caribbean 2020*, OECD Publishing, Paris. https://doi.org/10.1787/6089164f-en

O'Ryan, M., Prado, V., & Pickering, L. K. (2005). A millennium update on pediatric diarrheal illness in the developing world. *Seminars in Pediatric Infectious Diseases*, *16*(2), 125–136. https://doi.org/10.1053/j.spid.2005.12.008

Ozer, E. J., Fernald, L. C. H., Manley, J. G., & Gertler, P. J. (2009). Effects of a conditional cash transfer program on children's behavior problems. *Pediatrics*, *123*(4), e630-637. https://doi.org/10.1542/peds.2008-2882

Palloni, A., & Heligman, L. (1985). Re-estimation of structural parameters to obtain estimates of mortality in developing countries. *Population Bulletin of the United Nations*, *18*, 10–33.

Parker, S., & Todd, P. (2017). Conditional cash transfers: The case of Progresa/Oportunidades. *Journal of Economic Literature*, *55*(3), 866–915. https://doi.org/10.1257/jel.20151233

Parker, S., & Vogl, T. (2018). *Do conditional cash transfers improve economic outcomes in the next generation? Evidence from Mexico* (No. w24303). Retrieved from National Bureau of Economic Research website: https://www.nber.org/papers/w24303

Parsons, J., & Mccleary-Sills, J. (2014). *Preventing child marriage: Lessons from World Bank group gender impact evaluations*. Retrieved from Girls Not Brides website: https://www.girlsnotbrides.org/learning-resources/resource-centre/preventing-child-marriage-lessons-world-bank-group-gender-impact-evaluations/

Perez-Amador, J., & Giorguli, S. (2018). Child marriage and early transitions to adulthood in Mexico. In S. Verma & A. C. Petersen (Eds.), *Developmental science and sustainable development goals for children and youth* (pp. 239–256). Springer International Publishing.

Phavichitr, N., & Catto-Smith, A. (2003). Acute gastroenteritis in children: What role for antibacterial? *Paediatric Drugs*, *5*(5), 279–290. https://doi.org/10.2165/00128072-200305050-00001

Phillips, D. E., Lozano, R., Naghavi, M., Atkinson, C., Gonzalez-Medina, D., Mikkelsen, L., Murray, C. J., & Lopez, A. D. (2014). A composite metric for assessing data on mortality and causes of death: The vital statistics performance index. *Population Health Metrics*, *12*(1). https://doi.org/10.1186/1478-7954-12-14

Potter, J. E., Mojarro, O., and Nunez L., The influence of health care on contraceptive acceptance in rural Mexico, *Studies in Family Planning*, 1987, 18(3):144-156

Powell-Jackson, T., & Hanson, K. (2012). Financial incentives for maternal health: Impact of a national programme in Nepal. *Journal of Health Economics*, *31*(1), 271–284. https://doi.org/10.1016/j.jhealeco.2011.10.010

Pullum, T. W., Casterline, J. B., and Juarez, F. (1985). Changes in fertility and contraception in Mexico, 1977-1982. *International Family Planning Perspectives*, 11(2), 40–47. https://doi.org/10.2307/2948117

Randive, B., Diwan, V., & De Costa, A. (2013). India's conditional cash transfer programme (the JSY) to promote institutional birth: Is there an association between institutional birth proportion and maternal mortality? *PLoS ONE*, *8*(6). https://doi.org/10.1371/journal.pone.0067452

Renfrew, M. J., McFadden, A., Bastos, M. H., Campbell, J., Channon, A. A., Cheung, N. F., Silva, D. R., Downe, S., Kennedy, H. P., Malata, A., McCormick, F., Wick, L., & Declercq, E. (2014). Midwifery and quality care: findings from a new evidence-informed framework for maternal and newborn care. *Lancet*, 384(9948), 1129–1145. https://doi.org/10.1016/S0140-6736(14)60789-3

Rivera, J. A., Sotres-Alvarez, D., Habicht, J.-P., Shamah, T., & Villalpando, S. (2004). Impact of the Mexican program for education, health, and nutrition (Progresa) on rates of growth and anemia in infants and young children: A randomized effectiveness study. *JAMA*, *291*(21), 2563. https://doi.org/10.1001/jama.291.21.2563

Rodríguez-Aguilar, R. (2018). Maternal mortality in Mexico, beyond millennial development objectives: An age-period-cohort model. *PLOS ONE*, *13*(3), e0194607. https://doi.org/10.1371/journal.pone.0194607

Roth, J. (2019). *Pre-test with caution: Event-study estimates after testing for parallel trends*.

Saha, U.R. & van Soest, A. (2013), Contraceptive use, birth spacing, and child survival in Matlab, Bangladesh. *Studies in Family Planning*, 44: 45-66. https://doi.org/10.1111/j.1728-4465.2013.00343.x

Sarma, R., & Choudhury, L. (2014). Infant and child mortality at district level of India: A modified Brass approach. *Middle East Journal of Age and Ageing*, *11*(2), 29–34. https://doi.org/10.5742/MEAA.2014.92400

Schober, G. S. (2020). *Conditional vs. unconditional antipoverty programs in Mexico* [Policy brief]. Baker III Institute for Public Policy of Rice University. https://www.bakerinstitute.org/research/conditional-vs-unconditional-antipoverty-programs-mexico/

Segura-Pérez, S., Grajeda, R., & Pérez-Escamilla, R. (2016). Conditional cash transfer programs and the health and nutrition of Latin American children. *Rev Panam Salud Publica*, 40(2),124-137.

Sekhri, S., & Debnath, S. (2014). Intergenerational consequences of early age marriages of girls: Effect on children's human capital. *The Journal of Development Studies*, *50*(12), 1670–1686. https://doi.org/10.1080/00220388.2014.936397

Sepúlveda, J., Bustreo, F., Tapia, R., Rivera, J., Lozano, R., Oláiz, G., Partida, V., García-García, L., & Valdespino, J. L. (2006). Improvement of child survival in Mexico: The diagonal approach. *Lancet*, *368*, 11.

Shaheen, R., de Francisco, A., El Arifeen, S., Ekström, E.-C., & Persson, L. A. (2006). Effect of prenatal food supplementation on birth weight: An observational study from Bangladesh. *The American Journal of Clinical Nutrition*, *83*(6), 1355–1361. https://doi.org/10.1093/ajcn/83.6.1355

Skoufias, E. (2005). PROGRESA and its impacts on the welfare of rural households in Mexico (*Research Report 139).* Retrieved from International Food Policy Research Institute website: https://www.ifpri.org/publication/progresa-and-its-impacts-welfare-rural-households-mexico-0

Skoufias, E., Davis, B., & de la Vega, S. (2001). Targeting the poor in Mexico: An evaluation of the selection of households into PROGRESA. *World Development*, *29*(10), 1769–1784. https://doi.org/10.1016/S0305-750X(01)00060-2

Skoufias, E., & McClafferty, B. (2001). *Is PROGRESA working? Summary of the results of an evaluation by IFPRI* (Discussion Paper No.118). Retrieved from International Food Policy Research Institute website: https://www.ifpri.org/publication/progresa-working-summary-results-evaluation-ifpri

Spoorenberg, T. (2015). *Evaluation and analysis of fertility data*. Regional workshop on the production of population estimates and demographic indicators, Addis Ababa. Retrieved from https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/unpd_ws_201510_ppt_fertility.pdf

Stecklov, G., Winters, P., Stampini, M., & Davis, B. (2005). Do conditional cash transfers influence migration? A study using experimental data from the Mexican PROGRESA program. *Demography*, *42*(4), 769–790. https://doi.org/10.1353/dem.2005.0037

Stecklov, G., Winters, P., Todd, J., & Regalia, F. (2007). Unintended effects of poverty programmes on childbearing in less developed countries: Experimental evidence from Latin America. *Population Studies*, *61*(2), 125–140. https://doi.org/10.1080/00324720701300396

Sullivan, J. M. & Tureeva, N. K. (2004). Infant and child mortality. In Ministry of Health of the Republic of Uzbekistan (Ed.), *Uzbekistan health examination survey 2002*. (pp. 77-85). Retrieved from. http://www.measuredhs.com/pubs/

Susuman, A. S. (2012). Child mortality rate in Ethiopia. *Iranian Journal of Public Health*, *41*(3), 9–19.

Szreter, S. (2007). The right of registration: Development, identity registration, and social security—A historical perspective. *World Development*, *35*, 67–86. https://doi.org/10.1016/j.worlddev.2006.09.004

Thapar, N., & Sanderson, I. R. (2004). Diarrhoea in children: An interface between developing and developed countries. *Lancet (London, England)*, *363*(9409), 641–653. https://doi.org/10.1016/S0140-6736(04)15599-2

Tirado-Alcaraz, J. A. (2014). Investments in human capital: Long-term effects of Progresa-Oportunidades on poverty and migration in rural Mexico. *Journal of Social Research & Policy*, *5*(2), 23–37.

Todd, P. E., & Wolpin, K. I. (2006). Assessing the impact of a school subsidy program in Mexico: Using a social experiment to validate a dynamic behavioral model of child schooling and fertility. *American Economic Review*, *96*(5), 1384–1417. https://doi.org/10.1257/aer.96.5.1384

Tomé, P., Reyes, H., Piña, C., Rodríguez, L., & Gutiérrez, G. (1997). Características asociadas al subregistro de muerte en niños del estado de Guerrero, México. *Salud Pública de México*, *39*(6). https://doi.org/10.1590/S0036-36341997000600005

United Nations Children's Fund. (2019). *A profile of child marriage and early unions in Latin America and the Caribbean* (Report No. UNICEF/UN0277956). Retrieved from United Nations Children's Fund website: https://www.unicef.org/lac/en/reports/profile-child-marriage-and-early-unions

United Nations General Assembly. (2000). *United Nations millennium declaration*. Retrieved from https://www.ohchr.org/EN/ProfessionalInterest/Pages/Millennium.aspx

United Nations Inter-agency Group for Child Mortality Estimation. (2021). *Under five mortality rate*. https://childmortality.org/data/Mexico

United Nations Population Fund (2005). State of world population 2005: The promise of equality-gender equity, reproductive health and the millennium development goals, New York: UNFPA.

United Nations World Population Prospects (2019). Adolescent fertility rate. Retrieved from https://population.un.org/wpp/

United Nations. (1982). *Model life tables for developing countries* (United Nations Publication No. E.81.XIII.7). United Nations.

United Nations. (1983). *Manual X: Indirect techniques for demographic estimation.* (ST/ESA/SER.A/81). United Nations, Department of Economic and Social Affairs.

United Nations. (1990). *Step-by-step guide to the estimation of child mortality* (Population Studies No. 107). United Nations.

United Nations. (2019a). *The 2019 revision of world population prospects*. United Nations, Department of Economic and Social Affairs, Population Division. https://population.un.org/wpp/

United Nations. (2019b). *World Fertility Data 2019* (POP/DB/Fert/Rev2019). United Nations, Department of Economic and Social Affairs, Population Division. https://www.un.org/en/development/desa/population/publications/dataset/fertility/wfd2019.asp

Urquieta, J., Angeles, G., Mroz, T., Lamadrid-Figueroa, H., & Hernández, B. (2009). Impact of Oportunidades on skilled attendance at delivery in rural areas. *Economic Development and Cultural Change*, *57*(3), 539–558. https://doi.org/10.1086/596598

Vapattanawong, P., Hogan, M. C., Hanvoravongchai, P., Gakidou, E., Vos, T., Lopez, A. D., & Lim, S. S. (2007). Reductions in child mortality levels and inequalities in Thailand: Analysis of two censuses. *The Lancet*, *369*(9564), 850–855. https://doi.org/10.1016/S0140-6736(07)60413-9

Verhulst, A. (2016). Child mortality estimation: An assessment of summary birth history methods using microsimulation. *Demographic Research*, *34*(39), 1075–1128. https://doi.org/10.4054/DemRes.2016.34.39

Wilson, K., & Wakefield, J. (2020). Child mortality estimation incorporating summary birth history data. *Biometrics*, 77(4), 1456-1466. https://doi.org/10.1111/biom.13383

Yimamu, E. (1990). Problems of selecting a plausible fertility measure for Addis Ababa (based on the 1984 census data). *International Statistical Review = Revue Internationale De Statistique*, *58*(3), 191–200.

Zar, H. J., & Mulholland, K. (2003). Global burden of pediatric respiratory illness and the implications for management and prevention. *Pediatric Pulmonology*, *36*(6), 457–461. https://doi.org/10.1002/ppul.10345