Introduction

Conditional cash transfer (CCT) programs were first introduced in Brazil and Mexico more than a decade ago and have since spread around the world to more than 80 countries. CCT programs aim to alleviate current poverty and, in addition, to reduce future poverty by augmenting human capital levels of children and youth from poor families and thus increasing their lifetime earnings potential. The pioneering Mexican Progresa/Oportunidades (currently named Prospera) program began in 1997 and rapidly grew to include 2.6 million families by the year 2000 and currently reports about 6 million beneficiary families. Monetary transfers to the household are conditional to children's school attendance and the regular clinic attendance of household members. The program was subject to a well-known experimental evaluation in the early years of the program evaluating education, health and consumption/income effects of the program.

While a number of short-term studies on the impacts of CCTs on the health of children exist (See Parker & Todd, 2017), there is a surprising lack of longer-term studies on health impacts. In this paper, we study the long-term effects of the Mexican conditional cash transfer program on neonatal, infant and under-five child mortality. We combine data on mortality using vital statistics with administrative information on program beneficiaries at the municipal level to estimate program impacts.

The only previous study we are aware of on this topic is Barham (2011) who estimates program impacts on infant mortality in the year 2001, four years after the program began and reports quite large reductions (17%) in under-five infant mortality, arguing the reductions are primarily due to reductions in intestinal and respiratory diseases and to alleviation of nutritional deficiencies. Barham's analysis covers only the first few years of the program. Additionally, while using vital statistics data to measure child mortality, she undertakes no correction for under-reporting. Since under-reporting of child mortality is likely to be more severe in poorer areas, precisely where higher proportions of households become beneficiaries, her estimates may be overestimates of the impact on mortality.[1]

Our paper makes several contributions to the literature. First, we provide the first long term effects of conditional cash transfer programs on child mortality. Our empirical strategy allows us to also estimate short term effects and compare how short term and long-term effects may differ. Second, we account for under-reporting in the estimation of child mortality. Third, given the program's emphasis on gender, we provide estimates by gender, analyzing whether differential impacts on mortality by gender exist.

Program Description

The Progresa/Oportunidades program began just subsequent to a major macroeconomic crisis in Mexico in 1995 in which real GDP fell by 6 percent, contributing to a context where government officials began to seek greater efficiency in anti-poverty spending. Progresa/Oportunidades was financed from the elimination of general food subsidies (principally to tortillas and milk), as part of a move towards implementing more narrowly targeted anti-poverty programs. The majority of the budget for food subsidies was generally directed towards urban areas and so the elimination of food subsidies and the effective substitution of Progresa/Oportunidades represented a major shift in anti-poverty spending in Mexico from primarily urban to primarily rural (Levy, 2006). The targeting of the poor and the empirical determination of the program eligible population were also integral parts of the development of Progresa/Oportunidades. The program began operating in small rural communities in 1997, and gradually expanded to urban areas in 2000 and 2001. It remains predominantly a rural program with about 70% of all beneficiaries in 2013 from rural areas. As of 2017, the program covers six million households, about 20% of all households in Mexico.

As previously noted, the program's principal innovation is to condition monetary transfers on human capital investment. In particular, it provides cash payments to families that are tied to children regularly

[1] Other studies of short run impacts of conditional cash transfers in other countries generally show decreases in childhood mortality (Glassman, et al., 2013; Guanais, 2013; Rasella, et al., 2013; Shei, 2013). None of these studies have taken into account under-reporting.

attending schools and to family members visiting health clinics for checkups. Additionally, nutritional supplements are given to pregnant women and to children under the age of 5. Program take-up was exceedingly high when the program first began in rural areas, with 97 percent of families who were offered the program electing to participate.

The program conditions cash payments to families on children regularly attending schools and on family members visiting health clinics for checkups. Specific monthly grant amounts range in 2017 from 175 pesos in the third grade of primary to 980 pesos for boys and 1120 pesos for girls in the third year of senior high school (grades 10-12). The monthly HH amount linked to health clinic attendance is 335 pesos. The average family in Progresa receives about 800 pesos monthly. The program is means tested, with both geographic and household-level targeting. All monetary grants are given to the mother or female head of the family. (The exchange rate is 18 pesos per dollar in 2017.)

Data and Research Methods

We exploit the roll-out of the programs by municipality and cohort variation with administrative information of the proportion of individuals receiving *Progresa* in the municipality linked to information on mortality gathered from the INEGI website (Instituto Nacional de Estadistica y Geografia). The main identification strategy relies on difference in difference estimations using variation in program receipt across municipalities and time (Parker & Vogl, 2018).

The Progresa program begins in 1997. Neonatal, infant and under-five child mortality data for the period 1990-2015 is drawn from the INEGI (the Mexican Institute of Statistics, Geography and Informatics). INEGI is the principal government agency responsible for the Population Censuses and a host of other national surveys. Data on mortality is derived from a certification system provided by the Mexican Ministry of Public Health, which contains information on the municipality where a death occurred and it was reported. Mexico has been using this vital statistics certification system since 1950 to reach international standards set by the World Health Organization (WHO). We construct the number of deaths of the population at the municipality level for each year of our data analysis period. Neonatal, infant, and under-five mortality rates are defined as the number of children who die by the first 28 days of life, exactly 1 year, and 5 years of age per 1,000 live births respectively. For the denominator, we use the size of the population age 0 to 5 in each municipality in the pre-program year 1997 based on Census data from 1995 (not yearly measures of births given that the program may also affect births).

To the mortality dataset, we merge administrative program information on the number of households enrolled in Progresa by year and by municipality, which is supplied by Progresa administrative personnel. With this administrative data, we create a treatment indicator 'program intensity', a ratio of the cumulative number of beneficiary households to the total number of households in municipality in the 1990 census. The analysis is restricted to the set of marginalized (poor) municipalities identified as eligible by Progresa in 1997. We initially propose a one period lagged specification, e.g. assuming the proportion of beneficiaries in the previous period affects mortality in the next period but will experiment with different lag specifications.

We estimate the following equation:

$$Mortality_{mt} = \beta_0 \, program\ intensity_{m,\,t-1} + \delta_m + \gamma_t + \varepsilon_{mt}$$

where *Mortality* is the neonatal, infant, and under-five mortality in marginalized municipality m in time t, and *program intensity* is percent of beneficiary households in m municipality and in time t-1. Fixed effects on municipality (δ_m) and year (γ_t) are included to control for time-variant and time-invariant unobservable variables. The effects of the cash transfer program on each mortality rate is estimated by β_0. We will estimate our equation both for overall mortality and mortality by cause.

Preliminary results

Table 1 presents data on the general economic conditions of the areas of our study pre-program. According to the table, large proportion of the population in the marginalized municipalities have less education and earn low wages, suffering from poor living conditions.

Table 1 Descriptive statistics of the population in marginalized municipalities in Mexico (%)

	Mean (std. dev)	Min	Max	Obs
Illiterate population	33.51 (13.38)	6.42	86.07	1,140
With less than primary education	69.68 (9.69)	40.45	98.55	1,140
Earning less than twice the minimum wage	85.87 (8.50)	27.05	100	1,140
Without a toilet	60.15 (18.58)	3.45	99.64	1,140
Without electricity	36.75 (24.86)	0	100	1,140
Without running water	50.57 (24.11)	0	100	1,140
With dirt floor	62.14 (21.56)	5.25	100	1,140
With crowding[2]	74.10 (8.26)	32.8	100	1,140
In communities with less than 5,000 inhabitants	95.40 (13.69)	2.11	100	1,140

Table 2 reports the preliminary effects of Progresa on neonatal, infant, and under-five mortality in marginalized municipalities, without adjusting under-reporting of mortality. All regressions include municipality and time fixed effects. While column (1) includes all marginalized (poor) municipalities, column (2) and (3) includes only high and very high level of marginality respectively, which is defined by CONAPO (the Mexican Population Council) based on nine municipal-level socioeconomic variables. Column (4) includes all marginalized municipalities but the observations are restricted to the period of 1997-2005, allowing to compare early results with longer term effects on mortality.

In these initial results, we do not find significant effects on neonatal mortality. With respect to infant mortality, we find some long-term negative effects for the subset of municipalities with very high poverty rates but not for the overall set of marginalized municipalities. For under-five mortality, the coefficient of lagged program intensity is -3.06 in all marginalized municipalities, statistically significant at the 5% level, which means a decrease of 3 deaths per 1,000 per live births. During the period of 1997-2005, the program decreases 5-6 deaths per 1,000 per live births, which is larger and more significant.

Table 2 The effects of Progresa on neonatal, infant, and under-five mortality in marginalized municipalities without adjusting under-reporting, Mexico, 1997-2012.

	(1)	(2)	(3)	(4)
	All margin	High margin	Very high margin	All margin (1997-2005)
Neonatal mortality (by the first 28 days of life)				
Lagged program intensity	0.0382	-1.126	0.0733	-1.207
	(0.747)	(1.160)	(0.973)	(1.098)
Mean of neonatal mortality in 1996	14.68	15.02	13.82	
Observations	18,233	12,873	5,360	10,255
R-squared	0.123	0.111	0.174	0.190
Infant mortality (by 1 year of age)				
Lagged program intensity	-1.142	-1.686	-2.977**	-2.945*
	(1.042)	(1.585)	(1.480)	(1.575)
Mean of infant mortality in 1996	20.95	20.56	21.91	
Observations	18,233	12,873	5,360	10,255
R-squared	0.191	0.166	0.277	0.271
Under-five mortality (by 5 years of age)				

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

Lagged program intensity	-3.058**	-2.821	-2.921*	-5.647***
	(1.212)	(1.830)	(1.768)	(1.882)
Mean of under-five mortality in 1996	29.92	28.08	34.34	
Observations	18,233	12,873	5,360	10,255
R-squared	0.209	0.178	0.296	0.279

Note: Neonatal, infant, and under-five mortality rates are defined as the number of children who die by the first 28 days of life, exactly 1 year, and 5 years of age per 1,000 live births, respectively. Program intensity is percent of beneficiary households in each municipality in previous year. Column (2) and (3) includes only high and very high level of marginality respectively, according to the definition of CONAPO (the Mexican Population Council) based on nine municipal-level socioeconomic variables. All regressions include municipality and time fixed effects. Robust standard errors are reported in parentheses. *** *p<0.01,* ** *p<0.05,* * *p<0.1*

Table 3 shows the effects of Progresa on under-five mortality by selected causes of death in marginalized municipalities. Column (1) includes all population aged 0-4, while column (2) and (3) includes only female and male, respectively. Without adjusting under-reporting problems, the program leads to decrease in deaths of children aged under five caused by respiratory disease, nutritional deficiencies, infectious diseases, but not in those caused by accidents.

Table 3 The effects of Progresa on under-five mortality by selected causes of death in marginalized municipalities without adjusting under-reporting, Mexico, 1997-2012.

	(1) All	(2) Female	(3) Male
Respiratory diseases			
Lagged program intensity	-0.686*	-0.933*	-0.536
	(0.413)	(0.551)	(0.829)
Mean of dependent variable in 1996	0.0676	0.0675	0.0681
R-squared	0.158	0.105	0.101
Nutritional deficiencies			
Lagged program intensity	-0.864***	-0.603	-1.012*
	(0.313)	(0.392)	(0.524)
Mean of dependent variable in 1996	0.0533	0.0632	0.0427
R-squared	0.102	0.086	0.077
Infectious diseases			
Lagged program intensity	-0.869***	-0.857*	-0.859**
	(0.311)	(0.458)	(0.438)
Mean of dependent variable in 1996	0.0721	0.0706	0.0654
R-squared	0.126	0.093	0.097
Accident			
Lagged program intensity	0.243	0.731	-0.0561
	(0.554)	(0.736)	(0.969)
Mean of dependent variable in 1996	5.543	4.535	5.988
R-squared	0.124	0.095	0.087
Observations	18,233	18,210	18,204
Year FE	yes	yes	yes
Municipality FE	yes	yes	yes

Note: Under-five mortality rates are defined as the number of children who die by exactly 5 years of age per 1,000 live births. Program intensity is percent of beneficiary households in each municipality in previous year. Column (1) includes all population aged 0-4, while column (2) and (3) includes only female and male, respectively. All regressions include municipality and time fixed effects. Robust standard errors are reported in parentheses. *** *p<0.01,* ** *p<0.05,* * *p<0.1*

Next steps

The preliminary results we have just presented generally confirm Barham (2011), in terms of finding important and significant effects in reducing mortality. The next step in our analysis will be to study how estimated impacts may change once we account for the under-reporting of mortality. Under-reporting of child deaths and births frequently happens in rural areas of Mexico (Braine, 2006; Gamlin & Osrin, 2018; Hernández, et al, 2011; Hernández, et al, 2012; Tome et al, 1997). We will estimate child mortality using the indirect Brass method, which has been used for reliable estimates of child mortality in a variety of circumstances, using survey data from the National Survey of Demographic Dynamics.

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