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Abstract[*]

Iron deficiency anemia is the most prevalent nutritional deficiency in the world, affecting more than 2 billion people in developing countries. We show that a modest cash transfer substantially reduced anemia among women of reproductive age in rural Ecuador.

JEL Classification: I1, I3

Keywords: cash transfers, anemia, health status

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1. Introduction

In this note, we use data from a randomized experiment to analyze the impact of a program which makes modest cash transfers on the incidence of anemia among women of childbearing age in poor households in rural Ecuador. Virtually every country in Latin America has a cash transfer program. In many cases, including in Ecuador, Brazil, Colombia, and Mexico, the cash transfer program is the biggest safety net program in the country, covering millions of poor households and accounting for as much as half a percentage point of GDP (Fiszbein and Schady, 2009).

Iron deficiency anemia is the most prevalent nutritional deficiency in the world. The World Health Organization estimates that over 2 billion people in the developing world suffer from anemia because of iron deficiency (FAO/WHO, 1992; World Health Organization, 2009). Prevalence rates are thought to be particularly high among pregnant women and young children.

Severe anemia substantially increases the risk of death during pregnancy and childbirth (Rush, 2000), and the World Health Organization estimates that it contributes to 20% of maternal deaths (World Health Organization, 2009). Anemia during pregnancy may also have negative consequences for children after birth. Children born to anemic mothers are more likely to have low birthweight, and to be born with low levels of iron (Bondevik et al., 2001; Friedman et al., 2009; Levy et al., 2005). Anemia in infancy has been identified as a risk factor for infant mortality (Van Eijk et al., 2007).

Traditionally, efforts to combat anemia in developing countries have focused on fortification or iron supplementation. A distinguished panel of economists rated the provision of micronutrients, in particular the provision of dietary supplements to combat anemia, as the second most cost-effective intervention in development, after policies to combat the spread of HIV/AIDS (Copenhagen Consensus, 2008).

2. Intervention, data, and identification strategy

Ecuador has a long tradition of making cash transfers to poor households. The program we study in this paper, known as the *Bono de Desarrollo Humano* (BDH) covers approximately 40% of the population of Ecuador. It is thus proportionately larger than any other cash transfer program in Latin America, including the well-known (and much-studied) PROGRESA program in

Mexico, and *Bolsa Familia* in Brazil. During the period we study, the BDH made transfers of US $15 to eligible households on a monthly basis. (Ecuador adopted the US dollar as national currency in January 2000.) These transfers account for approximately 10% of the total consumption of the average recipient household, are made to women, and come with no strings attached (Fiszbein and Schady, 2009).

Ecuador is divided into provinces, cantons, and parishes. The BDH evaluation was carried out in six of the 22 provinces in Ecuador—three coastal provinces and three provinces in the highlands. Within these provinces, all rural parishes were assigned to treatment and control groups by a randomized lottery.[1] A baseline survey was collected between October 2003 and March 2004. After the baseline survey was completed, households newly-eligible for transfers because of their low scores on the proxy means test in parishes that won the BDH lottery were immediately cleared for transfers, while households in parishes that lost the lottery were held back for two years. A first follow-up survey was conducted between September 2005 and January 2006. At the time of this survey, 84% of households in the parishes that won the lottery, but less than 4% in parishes that lost the lottery, had received BDH transfers. Take-up among eligible households was therefore high, and contamination of the control group minimal.[2]

Households in control parishes were made eligible to receive transfers in February 2006, after the completion of the first follow-up survey. However, it appears that many households in the original control parishes did not realize that they could now receive transfers. A second follow-up survey was collected between May and July 2008. At the time of this survey, 85% of households in parishes that won the original lottery, but only 48% of those in parishes that lost

[1] Parishes are the smallest administrative unit in the country. The lottery resulted in a sample of 51 “treatment” and 26 “control” parishes, including approximately 18,000 families that were newly-eligible for the BDH program—see Paxson and Schady (2007), especially p. 41, for details. The sample of “treatment” municipalities was twice as large as the sample of “control” municipalities because originally two different variants of the program were envisioned — one group would receive transfers that would be conditional on regular visits to health centers, the other would receive transfers with no strings attached. In practice, all transfers were unconditional — there was only a single treatment arm. The sample for the evaluation of the BDH was limited to newly-eligible families—families that were deemed eligible for transfers by program administrators based on their score on a proxy means test, but who had not received transfers from the BDH or from a program that preceded it, the *Bono Solidario*, prior to the evaluation. The six provinces where the evaluation was carried out were not selected randomly—rather they were chosen because the incorporation of new families into the program had not started when baseline data were collected.

[2] The data we use for this paper are part of the evaluation of the BDH on health status and child development in rural areas (see Fernald and Hidrobo, 2011; Paxson and Schady, 2007, 2010). A different experiment, with random assignment at the individual (rather than village) level has been used to analyze the BDH effects on schooling (Schady and Araujo, 2008), child labor (Edmonds and Schady, 2012), and food consumption (Schady and Rosero, 2008). The data from this second experiment did not collect data on hemoglobin.

the lottery reported that they received BDH transfers. In all three survey waves, the enumerators were not told whether respondents were part of the sample of lottery losers or winners.

Hemoglobin levels were measured in the field using a finger prick and portable photoreflectometers. Data were collected on children and their mothers. Because higher levels of hemoglobin are required at greater elevation above sea level, we adjusted hemoglobin levels for differences in elevation across parishes prior to analysis using procedures published by the US Center for Disease Control (CDC, 1989); elevation was measured at the household level using handheld Global Positioning System (GPS) units. We use cut-offs determined by the Center for Disease Control in determining anemia.[3] We obtained similar results using the first follow-up survey if, in addition to adjusting hemoglobin status for elevation, we also adjusted for pregnancy status; however, the results we report do not adjust for pregnancy because the second follow-up survey did not ask women whether they were pregnant at the time.

Table 1 shows that anemia is a serious health problem in the population we study: 59% of women were anemic at baseline. The table also shows that random assignment successfully equated the baseline characteristics of lottery winners and losers. The coefficient on the fraction anemic implies a difference of less than one percentage point between lottery winners and losers. There are no differences between lottery winners and losers in terms of age, months since last pregnancy, education, score on a vocabulary recognition test, or the likelihood that a household had access to piped water. There are no differences in the dates at which lottery winners or losers were interviewed, an important consideration if there are seasonal effects in hemoglobin levels — as could be the case, for example, if there were differences over the course of the year in available foodstuffs, or in the incidence of infectious diseases.[4] Attrition (loss to follow-up) is reasonably low in our study. Of the 1702 mothers in the original sample, 176 (10.3%) were missing at first follow-up, and 301 (17.7%) were missing at second follow-up. Attrition in both follow-up surveys is uncorrelated with the random assignment to treatment or control groups.[5]

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[3] Women of childbearing age are considered anemic if their hemoglobin level is below 12 g./dl. These values are based on the 5th percentile from the third National Health and Nutrition Examination Survey (NHANES III), which excluded persons who had a high likelihood of iron deficiency (CDC, 1998). The World Health Organization uses the same cut-off for anemia.

[4] Results are very similar if we conduct the balance tests only on those women with no missing covariate information, which is the sample we use for the regressions that include controls in Table 2 below.

[5] In a regression of a dummy variable for women who attrited between baseline and first follow-up on a dummy for lottery winners, the coefficient on lottery winners is -0.02, with a robust standard error of 0.02; in a comparable regression for women who attrited between the first and second follow-ups the coefficient on lottery winners is also -0.02, with a robust standard error of 0.02.

Missing hemoglobin data is a second potential source of concern. Relatively few women, corresponding to 4.2% at baseline, 16.8% at first follow-up, and 7.7% at second follow-up are missing hemoglobin data. In every survey wave, missing hemoglobin is uncorrelated with treatment assignment in our data.[6]

3. Results

Given the random assignment by the lottery, identification is straightforward. Intent-to-treat estimates compare outcomes for lottery winners and losers. We also present instrumental variables estimates of the impact of the BDH on the hemoglobin status of women. In these estimates, receiving BDH transfers is instrumented with the random assignment by the lottery.[7] These are the average effects of the treatment on women for whom the probability of receiving transfers was affected by the lottery (Imbens and Angrist, 1994; Angrist et al., 1996).[8] All standard errors adjust for clustering at the level of the parish, the primary sampling unit in the evaluation.

Table 2 presents BDH effects, separately by survey wave (first or second follow-up), outcome (hemoglobin level or anemia), and estimation technique (intent-to-treat or instrumental variables). Results from the first follow-up show that lottery winners had hemoglobin levels that were 0.34 g./dl. higher than lottery losers, and were 13% points less likely to be anemic. The IV results imply increases in hemoglobin levels of 0.39 g./dl. among treated women, and reductions in anemia of 12% points. Results from the second follow-up show that BDH lottery winners had hemoglobin levels that were 0.13 g./dl. higher than lottery losers, although this difference is not significant, and a reduction in anemia of 9% points, a result that is significant at the 6% level. The IV results imply reductions in anemia of 21% points. The results for both survey waves are insensitive to the addition of more or less controls, as expected given the random assignment; they are insensitive to alternative ways of trimming the data (the results in Table 2 trim the top

[6] In a regression of a dummy variable for women who are missing hemoglobin data at baseline on a dummy variable for lottery winners the coefficient on lottery winners is 0.0005, with a robust standard error of 0.13; in a comparable regression at first follow-up, the coefficient on lottery winners is -0.06, with a robust standard error of 0.07; and in a comparable regression at second follow-up the coefficient on lottery winners is -0.001, with a robust standard error of 0.02.
[7] The *t*-statistic on the excluded instrument in the regression with all controls is 26.6 in the first follow-up, and 7.8 in the second follow-up.
[8] As is well known, in a regression without covariates, the IV estimate is equal to the intent-to-treat estimate divided by the difference in the probability of receiving BDH transfers between lottery winners and lottery losers.

and bottom 1 percent of the data on hemoglobin levels, as these appear to be cases of measurement error); finally, the results for the first follow-up survey, but not the second follow-up survey, are also robust to alternative definitions of anemia.[9]

4. Conclusion

Anemia is a serious public health problem for poor people (especially, poor women and children) in the developing world. In the population we study, 59% of women of reproductive age suffer from anemia.

There are a number of papers that analyze the effect of cash transfers on child (rather than adult) health and nutrition in Latin America, including anemia (Gertler, 2004; Hoddinott, 2008; Maluccio and Flores, 2005; Paxson and Schady, 2010), but we are not aware of any studies that focus on the effect of cash transfers on anemia among adults. We show that a modest cash transfer, equivalent to about 10% of the total consumption of the average recipient household, substantially reduced anemia among women of childbearing age in rural Ecuador. We do not know what features of the cash transfer program in Ecuador accounts for the impressive effects on anemia, and suggest that this is an important area for future research.

[9] We considered two alternative definitions of anemia. If, instead of using the cut-off of 12g./dl. we define a woman as anemic when her hemoglobin is below 11 g./dl., 22% of women at first follow-up, and 27% at second follow-up, are anemic. Using this definition, the reduced-form BDH effects on anemia is -0.085 (with a standard error of 0.044) at first follow-up, and -0.059 (with a standard error of 0.054) at second follow-up. If we use a cut-off of 13 g./dl. 60% of women at first follow-up, and 63% at second follow-up, are anemic. Using this definition, the reduced-form BDH effects on anemia is -0.143 (with a standard error of 0.044) at first follow-up, and -0.054 (with a standard error of 0.040) at second follow-up.

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Table 1: Baseline Characteristics of Lottery Winners and Losers

	Mean: lottery losers	Difference, (standard error), {number of observations}
Women		
Elevation-adjusted hemoglobin level (g./dl.)	11.48	0.15 (0.16) {1325}
Proportion anemic	0.59	-0.009 (0.45) {1325}
Age (years)	23.83	-0.11 (0.28) {1381}
Number of children	1.66	0.02 (0.05) {1382}
Months since last pregnancy	26.8	-0.22 (1.13) {1382}
Years of schooling	6.75	0.16 (0.28) {1378}
Score on vocabulary recognition test	71.4	-1.06 (2.27) {1299}
Household has piped water	0.52	-0.05 (0.10) {1361}
Date of interview		
Day of baseline interview (January 1, 2000=1)	1468	3.18 (7.90) {1382}
Day of 1st follow-up interview (January 1, 2000=1)	2149	8.48 (-7.29) {1382}
Day of 2nd follow-up interview (January 1, 2000=1)	3103	-2.00 (4.55) {1341}

Source: Author´s calculations based on BDH evaluation data
Note: tests of differences adjust for clustering at the parish level.

Table 2: BDH program effects on hemoglobin and anemia

	Intent-to-treat			Instrumental variables		
	(1)	(2)	(3)	(1)	(2)	(3)
Dependent variable: Elevation-adjusted hemoglobin (g./dl.)						
1st follow-up	0.37**	0.36**	0.34**	0.42**	0.41**	0.39**
	(0.15)	(0.14)	(0.13)	(0.18)	(0.17)	(0.16)
	{1139}	{1134}	{1094}	{1118}	{1113}	{1075}
2nd follow-up	0.16	0.15	0.13	0.40	0.37	0.32
	(0.17)	(0.17)	(0.17)	(0.41)	(0.41)	(0.41)
	{1253}	{1243}	{1196}	{1253}	{1243}	{1196}
Controls	No	Yes	Yes	No	Yes	Yes
Baseline Hemoglobin	No	No	Yes	No	No	Yes
Dependent variable: Proportion anemic						
1st follow-up	-0.12**	-0.11**	-0.11**	-0.13**	-0.13**	-0.12**
	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
	{1139}	{1134}	{1094}	{1118}	{1113}	{1075}
2nd follow-up	-0.10*	-0.09*	-0.09*	-0.24**	-0.22*	-0.21*
	(0.05)	(0.05)	(0.05)	(0.12)	(0.12)	(0.12)
	{1253}	{1243}	{1196}	{1253}	{1243}	{1196}
Controls	No	Yes	Yes	No	Yes	Yes
Baseline Hemoglobin	No	No	Yes	No	No	Yes

Source: Author´s calculations based on BDH evaluation data
Note: Coefficients, standard errors adjusted for clustering at the parish level (in brackets) and sample size (in curly brackets). In the instrumental variables regressions, receiving BDH transfers at the time of the survey is instrumented with assignment by the BDH lottery. The t-statistic on the excluded instrument in the regression with all controls (specification 3) is 26.6 in the first follow-up, and 7.8 in the second follow-up. Specifications (1) include no controls; specifications (2) include a cubic in age, the woman's years of schooling, the number of children in the household, and the months since the last pregnancy; specifications (3) supplement this with the baseline elevation-adjusted hemoglobin level. Differences in sample sizes across specifications are a result of missing data on covariates; differences in sample sizes between the intent-to-treat and instrumental variables regressions are a result of missing data on whether or not a woman received BDH transfers (as opposed to being assigned to the treatment group by the lottery). All standard errors adjust for clustering at the parish level. All regressions discard the top and bottom 1 percent of the distribution of hemoglobin.* significant at 10 percent level; ** at 5 percent level.