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Original Article

Health effects of 'Juntos', a conditional cash transfer programme in Peru

José E. Pérez-Lu[*], Cesar Cárcamo[*], Arijit Nandi[†,‡] and Jay S. Kaufman[†,‡]

[*] *School of Public Health, Universidad Peruana Cayetano Heredia, Lima, Peru,* [†] *Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Montreal, Québec, Canada, and* [‡] *Institute for Health and Social Policy, McGill University, Montreal, Québec, Canada*

Abstract

In some countries, conditional cash transfer (CCT) programmes show an impact on maternal and child health. Juntos, the CCT programme in Peru, has been evaluated several times operationally, but seldom for maternal and child health outcomes. The objective of this study is to evaluate the impact of Juntos on children under 6 years, pregnant women and mothers of children under 17 years. Outcomes evaluated included (1) anaemia in women and children; (2) acute malnutrition in children; (3) post-partum complications in mothers; and (4) underweight and overweight in mothers. We identified Juntos eligible respondents from the Demographic and Health Surveys of Peru for years 2007 to 2013. Propensity score matching was used to identify comparable treatment and control groups, including eligible respondents enrolled in Juntos vs. those not enrolled in Juntos (individual-level analysis), as well as eligible respondents living in Juntos districts vs. those not residing in Juntos districts (district-level analysis). We then used generalized linear models to estimate prevalence ratios. Individual level analysis showed that Juntos reduced underweight in women (PR:0.39, 95%CI:0.18 – 0.85) and anaemia in children (PR:0.93, 95%CI:0.86 – 1.00). In the district level analysis, the programme was associated with a reduction of overweight in women (PR:0.94, 95%CI:0.90 – 0.98) and acute malnutrition in children (PR:0.49, 95%CI:0.32 – 0.73), but an increase in the prevalence of anaemia in children (PR:1.09, 95%CI:1.01 – 1.17). We found that Juntos had an effect on maternal and child health indicators, but further studies are required to overcome some limitations encountered here.

Keywords: propensity score matching, conditional cash transfer programmes, child care, nutritional status, malnutrition, anaemia, Health Policy.

Correspondence: José E. Pérez-Lu, School of Public Health, Universidad Peruana Cayetano Heredia, Lima, Peru. E-mail: jose.perez.l@upch.pe

Introduction

In recent years countries such as Colombia, Nicaragua, Honduras, Brazil, Argentina, Ecuador, Turkey and Peru have implemented conditional cash transfer (CCT) programmes (Baird *et al.* 2011; Owusu-Addo & Cross 2014). These programmes try to break the cycle of poverty by delivering a periodic cash payment to families in poverty in order to enhance human capital in vulnerable young people (Hidalgo 2008). In order to receive payments, beneficiary families have to comply with some requirements. CCT programmes have shown an impact on indicators of education, health and child labour (Behrman *et al.* 2009; Fiszbein *et al.* 2009; Francke & Cruzado 2009; Handa *et al.* 2009; Gaarder *et al.* 2010; Baird *et al.* 2011).

The CCT programme in Peru is called 'Juntos' (a Spanish word meaning 'together'). This programme began in 2005 in 70 districts. This number gradually grew to 1097 districts in 2013 (60.1% of the 1838 districts in Peru), and currently benefits over 500 000 households (Perova & Vakis 2009a; Sánchez & Jaramillo 2012a). The programme's goal is to reduce poverty and break its transmission from one generation to the next. To reach this goal the programme provides cash transfers of 100 Peruvian Nuevos Soles (PEN) or US$35 per month to qualifying households (Jones *et al.* 2007; Alcázar 2009). In addition, the programme improves human capital by promoting education and access to health services (Escobal & Benites 2012; Guzmán & Bethsabé 2013).

Beneficiary districts were selected based on five criteria: (i) exposure to violence as a consequence of

the 1986–1992 guerilla war; (ii) high proportion of the population with unsatisfied basic needs; (iii) high levels of economic inequality; (iv) high levels of chronic child malnutrition; and (v) high rates of extreme poverty (Díaz *et al*. 2009; Sánchez & Jaramillo 2012b). The inclusion criteria for individual households are that the household must have at least one pregnant woman or at least one child less than 17 years old. The programme was implemented first in the districts with the worst indicators (Segovia 2011; Guzmán & Bethsabé 2013).

Households can stay in the programme as long as (i) they include a pregnant woman or at least one child no older than 16 years; (ii) the pregnant woman attends her antenatal care visits or the child is brought for health checkups at the health centre (Aramburú 2010; Perova & Vakis 2012; Sánchez & Jaramillo 2012a). In addition, if there are children between 6 and 16 years old, they have to attend school on at least 85% of scheduled days (Vargas 2011; Guzmán & Bethsabé 2013).

The Juntos programme has been evaluated several times using qualitative methods. These evaluations found an improvement in the quality of the meals received, a decrease in poverty and an increase in the use of health centres. In addition, the beneficiaries improved their agricultural activities and their children reported pressure to have better grades at school. The programme is also appreciated by the community because it allows mothers to participate in commercial activities and children to obtain their national identification cards (Jones *et al*. 2007; Alcázar 2009; Díaz *et al*. 2009; Perova & Vakis 2009b; Segovia 2011).

Other evaluations demonstrated good compliance with the requirements of the programme: school attendance, health checkups for children and at least six antenatal care visits for pregnant women. Moreover, children under 5 years old had lower risk of getting sick and having extreme chronic malnutrition, but not total chronic malnutrition. The findings were related to the level of education of mothers and the amount of time enrolled in the programme (Trivelli & Díaz 2010; del Pozo & Guzmán 2011; Escobal & Benites 2012; Perova & Vakis 2012). These evaluations did not assess indicators of nutrition and health other than chronic malnutrition.

The objective of this study was to determine if Juntos had an impact on anaemia in women and children, acute malnutrition in children, post-partum complications, and underweight and overweight in women using data from the Peruvian Demographic and Health Surveys (DHS). In addition, we explored if participants in Juntos complied with the requirements to stay in the programme.

Participants and methods

Study design

Using serial cross-sectional surveys we evaluated the programme's impact using two methods: individual-level and district-level analyses. For the individual-level analysis, we estimated the effect of participating in Juntos by comparing outcomes for eligible mothers and children enrolled in the Juntos programme (treated group) with outcomes for eligible respondents who were not enrolled in the programme (control group). This analysis was restricted to the 481 districts where Juntos was offered during the study period (2009 – 2012). Juntos enrolment within these districts was not randomly determined, and was probably affected by characteristics other than the programme's listed requirements for participation. These characteristics may have influenced the health outcomes of interest for this study.

To account for this potential confounding, we also conducted a district-level analysis that compared outcomes for eligible mothers and children living in districts where Juntos was offered (treated group) to eligible respondents in districts where Juntos was not offered (control group). This analysis estimated the

Key messages

- Propensity score matching provides a better balance of measured covariates to reduce bias.
- Participants who were offered the Juntos program generally complied with conditions for staying in the program.
- Juntos appears to have reduced underweight and overweight in women, and anemia and acute malnutrition in children.
- There was less acute malnutrition but more anemia among children living in Juntos districts than in other districts, but these differences existed and were even larger prior to the implementation.

effect of offering the Juntos programme for eligible mothers and children irrespectively of whether they were actually enrolled, and is thus analogous to an intention-to-treat (ITT) analysis, where participants are analysed based on allocation arm rather than on whether or not they received the intervention. We estimated the effect of the Juntos programme at the district level in spite of the fact that not all eligible households within the district were direct beneficiaries of the programme. This ITT estimate is not only more appropriate because it captures the real world effect on communities in which uptake is less than 100%, but also because it captures the indirect benefits that occur when nonparticipants are affected by participants, rather than being directly affected by the programme themselves. To identify comparable controls in both analyses, we used propensity score matching, based on the distributions of measured characteristics posited to confound the effect of the treatment.

Study setting

The World Bank considers Peru as a higher-middle income country, but there is still a big gap between the richest and the poorest in the country ('Country and Lending Groups | Data' 2013). Poverty and poor health outcomes are concentrated in rural areas. Anaemia in children and pregnant women are prevalent in the country. In 2014, the prevalence of anaemia in children under 5 years was 46.8% and in rural areas was 68.4%. In addition, the prevalence of anaemia in pregnant women was 53.6% in the Andes and 70.1% in the Peruvian Amazon Jungle (Becerra *et al.* 1998; Munares-García *et al.* 2012). Underweight is also prevalent in Peru, with a prevalence of 11.9%. Overweight and obesity are an emerging problem, reaching a prevalence of 62.3% in some subpopulations. Acute malnutrition in children is fortunately declining across Latin America, but in Peru, there are areas with a prevalence of 2.1% (Tazza & Bullón 2006; Mispireta *et al.* 2007; Sobrino *et al.* 2014).

Study participants

We used data from the Peruvian DHS. These repeated cross-sectional surveys have been administered annually by the National Institute of Statistics and Informatics (INEI) in Peru since 2005. The DHS collects information on socio-demographic characteristics, fertility and reproduction, access to and use of health services, health and health behaviours and other characteristics, including a 5-year birth history, from a nationally representative sample of women between 15 and 49 years of age. Respondents are selected using a multistage stratified sampling design. Trained interviewers and standardized assessment tools and instruments are used to increase the quality and comparability of data collected across regions and waves (Instituto Nacional de Estadística e Informática 2012; Loret de Mola *et al.* 2014).

We created four separate samples of participants for our individual- and district-level analyses of maternal and child health outcomes. For the individual-level analysis we used information collected between 2009, when information on enrolment in Juntos was added to the DHS, and 2012. For the district-level analysis we used information collected between 2007 and 2013. In both cases, we restricted the analyses to participants meeting the inclusion criteria for Juntos (Table SI in appendix). We used indicators of poverty at the individual-level because these were available and provide much finer adjustment for confounding than district-level indicators. For women, this included those who were in poverty (located in the second lowest quintile by income) or extreme poverty (located in the lowest quintile by income) who were head of household or partner of the head of household, and who were pregnant or caregivers of a child less than 17 years of age. For children in intervention districts, this included those living in households in poverty or extreme poverty, who were the child of the head of household and who were born after the programme was implemented in their district of residence. In the district-level analysis, the children in the control group included those born after the programme was implemented in the country, but who lived in non-intervention districts.

Measures

Exposure

In the individual-level analysis, the treatment variable was enrolment or not in the Juntos programme, which was determined using the participant's response to a

specific question in the DHS questionnaire. For the district-level analysis, the treatment variable was living or not in a district where Juntos was already implemented in the year the survey was conducted.

Outcomes

The DHS collects information about maternal and child health. For mothers, outcomes included anaemia and measured height and weight. Height and weight were used to calculate body mass index (BMI) and to classify respondents as underweight (BMI $\leq$ 18.5) or overweight (BMI $\geq$ 25) following the World Health Organization (WHO) International Classification system (Guilbert 2003). For children, outcomes included the incidence of complications after delivery, anaemia on women and children and acute malnutrition, defined as having a measured weight-for-height less than two standard deviations from the mean for normal children based on WHO growth standards (WHZ < -2) (Tazza & Bullón 2006). Haemoglobin levels were measured by DHS with the HemoCue system. This is a simple and reliable test that uses photometric detection. Haemoglobin levels were then adjusted by altitude of residence. Anaemia was defined as adjusted haemoglobin levels below 11 g/dL. Trained personnel measured haemoglobin in participants, and height and weight in children (Instituto Nacional de Estadística e Informática 2015).

To evaluate compliance with conditions for staying in the programme, we included a variable for being born and having checkups at a health centre. In addition, we included compliance with current vaccination requirements (BCG, DPT, polio and measles).

Covariates

We accounted for potential confounding by calculating a propensity score based on maternal, child and household-level characteristics. Maternal characteristics included age at interview, height, educational attainment, literacy and reproductive characteristics, including the total number of children born and giving birth to more than two children in the past 5 years. Child characteristics included age at interview and height and weight at birth. Household characteristics included rural vs. urban residence, number of household members, household poverty and experiencing a child death in the family. We also controlled for year of interview, categorized as 2009–2010 compared to 2011–2012 in the individual analysis; and 2007–2009 vs. 2010–2013 in the district level analysis. The characteristics of the Juntos programme did not change significantly between these years. Categorizing year of interview dichotomously produced better matching in the propensity score. We did not include time of enrollment in JUNTOS because it was collinear with the variable 'year of interview'.

Statistical analyses

We used propensity score matching to (i) achieve balance in the distributions of measured covariates between the treatment and control groups and (ii) avoid extrapolation by limiting inference to regions of 'common support'. This involves an iterative process that begins with the estimation of the propensity score. For the individual-level analyses, the propensity score was defined as the predicted probability of enrollment in Juntos, estimated separately for mothers and their children, as a function of the measured maternal, child and household-level characteristics defined above. For the district-level analyses, the propensity score was defined as the predicted probability of living in a Juntos district, estimated separately for mothers and children, conditional on the same measured covariates.

The main advantages of using propensity score matching are the opportunity for non-parametric contrasts and flexible modelling of potential confounding in the first stage of the propensity score model. Another distinct advantage is the allowance for balance checks. It is true that the analytic sample tends to be reduced to the matched observations, but this is not necessarily a weakness. Indeed, for heterogeneous effect estimates, this helps minimize bias in the estimate of a specific target-population effect estimate. One may pay a price for this improved validity in the form of reduced precision, but in our large data set, it is arguably better to aim for a more unbiased estimate, rather than a more precise one.

We estimated propensity scores using multivariable logistic regression models and then matched on the propensity score. A multilevel analysis permits variance

decomposition and the estimation of effects of covariates at both levels. However, random intercept models require exogeneity of exposure as an identifying assumption, and we have substantial background knowledge to suggest that this assumption would be violated in this case, because individuals participate in Juntos for reasons that are not reflected in measured covariates.

The aim of matching is to achieve 'conditional exchangeability', which was manifest as balance, as indicated by a lower standardized mean difference in measured covariates between the treatment and control groups. We assessed several matching algorithms, including matching with or without replacement, matching each exposed observation to one or more than one control and matching with or without a caliper, and we also allowed for transformations of and interactions between covariates. Matching each treated observation to control observations within a 10% caliper of the estimated propensity score with replacement provided the best balance of covariates. The matching ratio (whether 1:1 or some other ratio, 1:M) simply reflects the best balance achieved for the target population for the causal question. For example, if one wants to answer the causal question about the exposed population in relation to the counterfactual that these same individuals had not been exposed, then one should indeed use all exposed individuals, matched to one or more unexposed observations. The advantage of 1:M over 1:1 is simply the use of more of the unexposed observations, and therefore some improvement in precision, but it does not affect the validity of the results.

For the construction of the propensity score, we included variables that were related to the outcome of interest, but excluded variables that were a consequence of the exposure. When selecting variables for propensity score analyses, it is recommended to include confounders, specifically characteristics that are common causes of the exposure and outcome. Additionally, including variables unassociated with the exposure has been shown to increase the precision of estimates if they predict the outcome (the same logic applies in a randomized trial). Variables that are a consequence of the exposure (e.g. mediators) should never be included because they could induce bias because of collider stratification or result in an underestimate of the total effect (Brookhart *et al*. 2006). We did not include district as a matching covariate as the sample size for each district was small.

We estimated the effect of Juntos on maternal and child health in the matched subsets on the prevalence ratio scale by regressing each outcome on the treatment using generalized linear models (GLM). For the district-level analyses, these models were fitted with robust variance to account for the clustering of observations within districts (Williams 2000). Additionally, because matching with replacement allows for some observations to enter the analysis more than once, these analyses frequency weighted control observations by the number of times they were selected as a match (Dehejia & Wahba 1998). To evaluate the differences between Juntos and non-Juntos districts in the prevalence of outcomes prior to the implementation of Juntos, we compared prevalence proportions from 2007 (pre-implementation) and 2013 (post implementation).

All statistical analyses were conducted using Stata version 12.1. Propensity score methods were applied using Stata's -psmatch2- command (Nichols 2007).

Sensitivity analyses

We conducted sensitivity analyses to test the robustness of our main findings in the district-level analysis. The first analysis was restricted to the participants that lived in a district with information on our outcomes before implementation in 2007. Because the prevalence of chronic malnutrition was a criterion used to select a district for receipt of the Juntos programme, we added the prevalence of chronic malnutrition of children in the district before the implementation of the programme to the estimation of the propensity score. In the second analysis, we conducted a propensity score matched analysis for each outcome using the prevalence of the outcome in each district before the implementation of the programme (i.e. for women, the prevalence of anaemia, underweight and overweight, and for children, the prevalence of acute malnutrition, anaemia and complications after delivery in year 2000).

We did not perform any adjustments or imputations for missing data because most (97.5%) missing values were for outcome variables (anaemia, underweight,

overweight, acute malnutrition and complication after delivery).

The Institutional Review Board at Universidad Peruana Cayetano Heredia reviewed and approved this study.

Results

Descriptive analysis

For the individual-level analysis, we identified 93 564 women and 38 336 children under 6 years of age in the datasets for years 2009–2012. Similarly, for the district-level analysis the dataset contained 141 476 women and 57 629 children under 6 years of age for years 2007–2013. After applying the inclusion criteria for enrolment in Juntos, our individual-level analysis included 7441 women and 21 589 children and our district-level analysis included 38 526 women and 32 515 children. From these samples we excluded observations with missing information on key covariates, resulting in final subsets of 7155 and 17 193 women and children, respectively, for the individual-level analysis and 35 468 and 23 467 women and children, respectively, for the district-level analysis.

Table 1 shows the participants' characteristics for women and children before and after propensity score matching. Throughout the study period, 50.1% (3588/7155) of the mothers interviewed reported participating in Juntos, and 6.1% reported being pregnant for the individual level-analysis (5.5% in the district-level analysis). Before matching, there were imbalances in the distributions of potentially confounding characteristics between the treatment and control groups. For the individual-level analysis subset, women were older, less educated and less literate among Juntos beneficiaries compared to controls. On average, beneficiary mothers had also given birth to more children, both overall and in the past 5 years, compared to controls. At the district level, those living in Juntos districts were poorer, more likely to reside in a rural area and more likely to report a child death in the family. Qualitatively similar differences were observed prior to matching in the district-level subset when we compared women and children living in districts where Juntos was offered to controls in districts where it was not.

Propensity score matching

We matched treated and control observations with a similar propensity for receiving the treatment, which reduced observations in the individual-level subsets from 7155 to 5143 for women and from 17 193 to 5083 for children. More observations were dropped among non-Juntos children because their characteristics did not match those of children enrolled in Juntos, who were the target population the programme. Similarly, the district-level subsets were reduced from 17 193 to 5083 for women and from 23 467 to 10 058 for children. After matching, the distributions of propensity scores for the treated and control groups in the individual-level and district-level (Fig. 1) subsets were similar through restriction to regions of common support. A comparison of the standardized mean differences before and after matching (Table 1) showed that matching on the propensity score nearly eliminated imbalances in the distributions of measured confounders between treated and control women and children in the individual-level and district-level samples (Fig. 2). In the individual-level subset, the standardized mean difference across covariates was reduced after matching from 32.7 to 1.7 for women and from 28.0 to 1.3 for children. In the district-level sample, the standardized mean difference was reduced from 25.9 to 0.5 for women and from 28.4 to 0.8 for children (Table 1).

Main effect estimates

Analyses of the individual-level samples showed that enrolment in Juntos was associated with a lower prevalence of underweight relative to normal weight for women [prevalence ratio (PR) = 0.39, 95% confidence interval (CI) = 0.18 – 0.85, Table 2] and anaemia for children (PR = 0.93, 95%CI = 0.86 – 1.00). In the district-level analysis, living in a Juntos district was associated with a lower prevalence of overweight (PR = 0.94, 95%CI = 0.90 – 0.98) relative to normal weight for women, and acute malnutrition in children (PR = 0.49, 95%CI = 0.32 – 0.73); however, residence in a Juntos district was associated with a 9% increase in the prevalence of anaemia in children (PR = 1.09, 95%CI = 1.01 – 1.17). There was no association with complications after delivery in the individual

Table 1. Characteristics of the individual and district level samples of women and children, before and after matching

		Sample characteristics by report of participating in Juntos (individual analysis)				Sample characteristics by residence in a district with the Juntos Program (district level analysis)			
		Before matching		After matching		Before matching		After matching	
		Non beneficiary control ($n = 3567$)	Beneficiary treated ($n = 3588$)	Non beneficiary control ($n = 1563$)	Beneficiary treated ($n = 3580$)	Non beneficiary control ($n = 19\,132$)	Beneficiary treated ($n = 16\,336$)	Non beneficiary control ($n = 7978$)	Beneficiary treated ($n = 16\,264$)
Women	Year of interview, %*	63.3	53.1	54.4	53.0	67.8	78.7	79.0	78.7
	Rural residence: %	82.0	94.4	94.0	94.4	56.0	86.6	86.5	86.6
	Education at least Secondary level, %	45.1	20.5	20.7	20.5	40.9	25.2	25.3	25.3
	Literacy: Able to read, %	86.0	72.3	73.0	72.3	87.3	75.5	75.3	75.5
	More than 2 births in last five years, %	24.2	28.2	28.7	28.2	12.7	14.5	14.4	14.4
	Poverty: Poorest quintile, %	60.2	75.6	75.4	75.5	31.7	62.1	61.5	61.9
	Any child death in the family, %	10.4	20.0	20.0	19.9	18.8	23.7	24.4	23.6
	Current age, mean (sd)	27.5 (7.6)	32.0 (7.1)	32.0 (7.6)	32.0 (7.1)	34.4 (8.3)	35.1 (8.2)	35.2 (8.4)	35.1 (8.2)
	Total children ever born, mean (sd)	2.8 (2.2)	4.2 (2.5)	4.2 (2.4)	4.2 (2.5)	3.6 (2.2)	4.0 (2.4)	4.0 (2.4)	4.0 (2.4)
	Height, mean (sd)	150.0 (5.1)	149.3 (5.0)	149.4 (5.2)	149.3 (5.0)	150.5 (5.2)	149.6 (5.1)	149.5 (5.2)	149.6 (5.1)
	Number of household members, mean (sd)	5.6 (2.3)	5.8 (1.9)	5.6 (1.9)	5.8 (1.9)	4.7 (1.8)	4.9 (1.9)	4.9 (1.9)	4.9 (1.9)
	Mean standardized mean difference (SD)	32.7 (19.3)		1.7 (1.5)		25.9 (20.4)		0.5 (0.5)	
		($n = 12\,975$)	($n = 4218$)	($n = 1617$)	($n = 3466$)	($n = 12\,423$)	($n = 11\,044$)	($n = 3394$)	($n = 6664$)
Children	Year of interview, %*	49.8	51.6	57.4	57.2	68.4	78.6	81.9	81.3
	Rural residence: %	64.0	92.9	94.6	94.7	56.6	86.9	91.4	91.4
	Mother education At least Secondary level, %	46.1	20.7	18.3	19.6	48.6	32.2	26.0	25.7
	Mother Literacy: Able to read, %	87.6	72.1	72.0	71.2	89.2	79.0	75.9	75.4
	Mother has more than 2 births in last five years, %	38.1	42.1	42.8	41.9	35.7	38.8	42.3	42.1
	Poverty: Poorest quintile, %	47.0	75.0	75.0	76.6	37.4	67.4	70.2	70.8
	Any child death in the family, %	11.8	19.7	19.7	19.7	11.9	14.9	17.5	17.4
	Size at birth: smaller, %	26.3	26.8	26.0	27.3	26.0	27.0	26.4	26.3
	Current age of the mother, mean (sd)	28.6 (7.2)	31.7 (7.1)	31.8 (7.4)	31.8 (7.0)	28.9 (7.1)	29.9 (7.5)	31.0 (7.2)	31.1 (7.2)
	Mother total children ever born, mean (sd)	3.2 (2.1)	4.3 (2.5)	4.4 (2.6)	4.4 (2.5)	3.2 (2.1)	3.6 (2.4)	4.1 (2.4)	4.1 (2.4)
	Height of mother in cm, mean (sd)	1503.3 (51.8)	1493.7 (50.6)	1493.5 (51.9)	1493.2 (50.7)	1504.9 (52.1)	1496.5 (50.9)	1493.7 (52.0)	1493.8 (50.2)
	Number of household members, mean (sd)	5.7 (2.3)	5.9 (2.0)	5.9 (2.1)	5.9 (1.9)	5.7 (2.2)	5.8 (2.1)	5.5 (1.9)	5.5 (1.9)
	Current age of the children, mean (sd)	31.9 (15.4)	35.0 (15.2)	32.7 (15.1)	32.9 (14.8)	32.0 (15.4)	32.8 (15.4)	30.7 (15.0)	30.9 (15.2)
	Mean standardized mean difference (SD)	28.0 (20.1)		1.3 (1.1)		28.4 (24.3)		0.8 (0.6)	

*Represent the year of interview categorized as 2009–2010 compared to 2011–2012 in the individual analysis. In the district level analysis it compares 2007–2009 to 2010–2013.

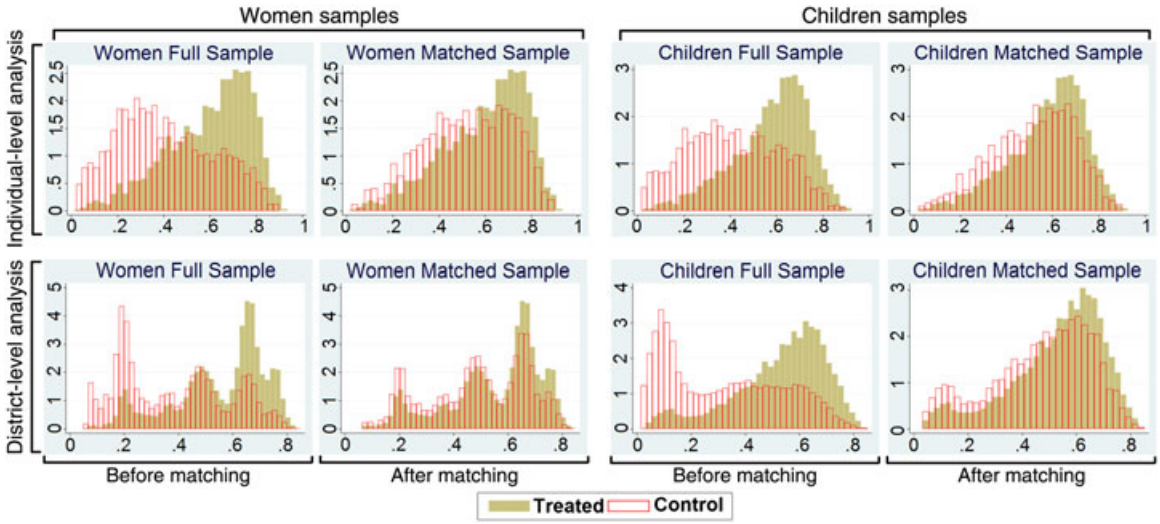

Fig. 1. Histograms showing the distributions of the estimated propensity score for women (left) and children (right) samples in the individual (top) and district level (bottom) analyses, before and after matching. Density (y axis) by propensity score (x axis).

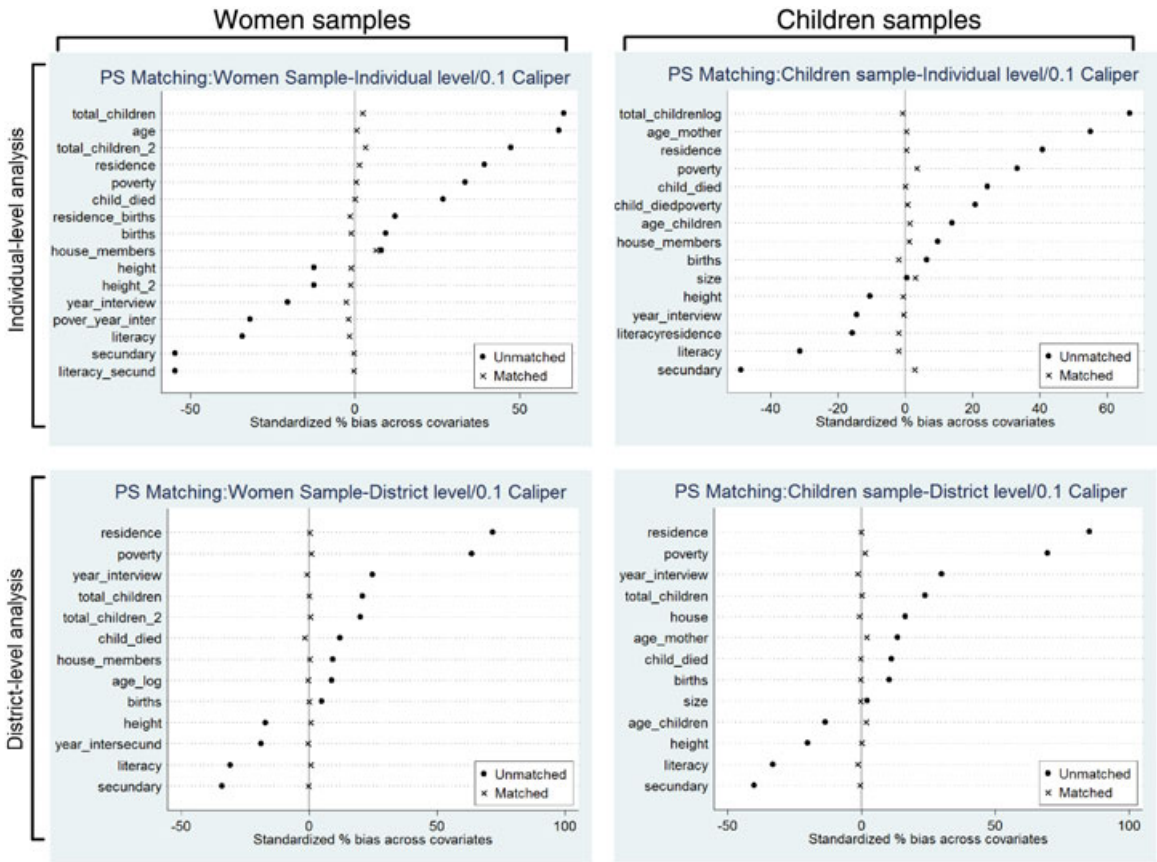

Fig. 2. Diagrams showing the standardized mean differences for each covariate before and after matching (1:m nearest neighbour matching using a caliper of 0.10) in the individual (top) and district-level (bottom) analyses of women (left) and children (right).

Table 2. Prevalence ratios from individual- and district-level analyses

	Individual level analysis		District level analysis	
Mothers	Prevalence ratio (95%CI) $n = 5143$	p	Prevalence ratio (95%CI) $n = 24\,242$	p
Anaemia	0.89 (0.79–1.00)	0.058	1.00 (0.92–1.08)	1.000
Underweight	0.39 (0.18–0.85)	0.018	0.69 (0.46–1.04)	0.079
Overweight	1.06 (0.98–1.15)	0.173	0.94 (0.90–0.98)	<0.001
Children	Prevalence ratio (95%CI) $n = 5083$	p	Prevalence ratio (95%CI) $n = 10\,058$	p
Acute malnutrition	1.19 (0.57–2.46)	0.644	0.49 (0.32–0.73)	0.001
Anaemia	0.93 (0.86–1.00)	0.040	1.09 (1.01–1.17)	0.035
Complications after delivery	0.92 (0.81–1.05)	0.225	0.96 (0.86–1.07)	0.437

(PR = 0.92, 95%CI = 0.81–1.05) or district-level analyses (PR = 0.96, 95%CI = 0.86–1.07, Table 2).

A comparison of data from 2007 for Juntos and non-Juntos districts showed that the difference in overweight among women described above was even greater prior to the implementation of Juntos. Similarly, the observed district-level differences in anaemia in children after Juntos were greater prior to Juntos (Table 3).

The comparison with pre-intervention prevalence provides relevant evidence in support of our results (Table 3). Before the implementation of the programme, there was an absolute difference of 17.6% in the prevalence of childhood anaemia between intervention and non-intervention districts. This difference was reduced to 11.7% after Juntos implementation. For underweight the pre-intervention difference was only 0.2% and in the opposite direction, and went up to only 0.9%, which are small differences compared to anaemia in children. For overweight the difference went down from only 3.9 to 2.0% (again, with higher prevalences in the non-Juntos districts).

Sensitivity analysis

The introduction in the propensity score model of a grouped variable measuring the prevalence of chronic malnutrition in children in the district before implementation of the programme did not change the point estimates for the main effect by more than 11%. The increase in the width of the confidence intervals can probably be attributed to the reduction in sample size. After restricting the analysis to participants who lived in districts with information on pre-intervention outcomes the sample size was reduced from 24 242 to 4324 records for women, and from 10 058 to 1556 records for children. Moreover, the addition of the prevalence for each indicator before implementation of the programme in the propensity score did not affect the point estimates for the main

Table 3. Characteristics of districts before (2007) and after (2013) implementation of Juntos

	District did not implement Juntos		District implemented Juntos	
	2007	2013	2007	2013
	Prevalence % (95%CI)	Prevalence % (95%CI)	Prevalence % (95%CI)	Prevalence % (95%CI)
Mothers	$n = 108$		$n = 25$	
Anaemia	25.3 (22.8–27.8)	18.9 (16.6–21.1)	29.8 (23.2–36.4)	25.2 (20.0–30.4)
Underweight	1.8 (1.1–2.4)	1.9 (1.4–2.4)	1.6 (0.2–2.9)	1.0 (0.3–1.6)
Overweight	51.3 (48.4–54.1)	58.0 (55.6–60.5)	47.4 (40.5–54.3)	56.0 (51.7–60.3)
Children	$n = 103$		$n = 25$	
Acute malnutrition	2.0 (0.5–3.4)	0.6 (0.2–0.9)	1.2 (0.0–2.5)	0.7 (−0.5–1.9)
Anaemia	36.0 (30.4–41.5)	33.5 (29.8–37.1)	53.6 (43.5–63.6)	45.2 (36.4–54.0)
Complications after delivery	35.3 (31.2–39.4)	32.0 (28.6–35.3)	29.4 (24.0–34.8)	27.4 (21.2–33.7)

effect. The reduction of the sample size from 24 242 to 13 818 records for women and from 10 058 to 4619 records for children is responsible for the observed widening of the confidence intervals, and the loss of statistical significance for the observed differences (Table SII in appendix).

The analysis of compliance using both the individual- and district-level data shows that significantly more participants exposed to Juntos or living in Juntos districts complied with conditions for staying in the programme. Among children, the prevalence ratios for having been born at a health centre were 1.23 (95%CI: 1.15–1.31) and 1.18 (95%CI: 1.07–1.31), and for having checkups were 1.27 (95%CI: 1.22–1.32) and 1.27 (95%: 1.19–1.34), in the individual and district level analyses, respectively. In the case of vaccination, the prevalence ratio for receiving BCG in the individual level analysis was 1.06 (95%CI: 1.03–1.08) and in the district level analysis was 1.08 (95%CI: 1.03–1.13). At the individual and district levels, the prevalence ratios for the other vaccines were: 1.08 (95%CI: 1.06–1.11) and 1.05 (95% CI: 1.02–1.08) for DPT 1 (2 months), 1.13 (95%CI: 1.10–1.17) and 1.08 (95%CI: 1.03–1.12) for DPT 2 (4 months), 1.07 (95%CI: 1.05–1.10) and 1.06 (95%CI: 1.02–1.10) for polio 2 (4 months), 1.21 (95%CI: 1.16–1.26) and 1.13 (95%CI: 1.07–1.19) for DPT 3 (6 months), 1.17 (95%CI: 1.12–1.21) and 1.13 (95%CI: 1.08–1.19) for polio 3 (6 months), and 1.10 (95%CI: 1.06–1.13) and 1.07 (95%CI: 1.03–1.11) for measles (12 months).

Discussion

This is the first study to demonstrate an impact of Juntos, a CCT in Peru, on maternal health outcomes. It is also the first to explore the effect of the programme on childhood anaemia, acute malnutrition and complications after delivery. This study demonstrates that among residents of Juntos districts that fulfil the criteria for participation in this programme, actual participation was associated with lower frequency of underweight in mothers and anaemia in children. A marginally significant reduction of anaemia was also found in mothers. Additionally, we demonstrated that when comparing eligible residents of Juntos districts with eligible residents of districts that were not included in Juntos, mothers in intervention districts had a lower prevalence of overweight, and children from those districts had less acute malnutrition and anaemia. A marginally significant reduction of underweight among mothers was also observed. Previous qualitative studies showed that participation in this programme improved the quality of the food they purchased (Perova & Vakis 2009b; Segovia 2011). Several studies have demonstrated that CCT programmes improve maternal nutrition in other countries (Mason *et al.* 2012). In addition, improvements in women's nutrition can result in improvements in birth outcomes (Mason *et al.* 2014). The observed lack of an effect of the programme on underweight among women at the district level could be because of the limited penetration of the programme, with coverages ranging from 39.2% to 57.6%, in the eligible population. We decided not exclude pregnant women because it is an inclusion criterion for Juntos. The proportion of women that are pregnant is slightly lower for exposed women, both at the individual (5.3% vs. 6.9%) and district level (5.2% vs. 5.8%). These differences could therefore not explain why the observed prevalence of underweight is lower with Juntos (they would produce a difference in the other direction).

Regarding overweight, no effect of the programme was found in the individual analysis. However, there was an effect in the district level analysis. This inconsistency may be explained by a lower prevalence of overweight in target districts observed before the implementation of the programme. Data from Peru show that the prevalence of overweight is higher in the female population not in poverty (Álvarez-Dongo *et al.* 2012).

In the case of anaemia in women, there was no effect of the programme in the individual or district-level analyses. Juntos could prevent anaemia by requiring pregnant women to attend antenatal visits where iron supplementation is provided (Abdullahi *et al.* 2014). As a small proportion (6.1% for the individual level and 5.5% for the district level analyses) of the women included in this study were pregnant, the effect of antenatal visit attendance was probably diluted.

The observed reduction of anaemia in children in the individual-level analysis could result from the required health checkups, where iron supplementation is provided (Dirección General de salud de las Personas

2011). The observed adverse effect on anaemia in the district-level analysis, on the other hand, may be explained by a higher prevalence of anaemia in target districts before the implementation of the programme, and the low penetration of the programme. Alternatively, the apparent increase in anaemia could reflect an increase in the awareness and diagnosis of anaemia because of the required medical contacts for the children in the programme.

In the analysis of acute malnutrition in children, there was no effect in the individual-level analysis but there were differences in the district-level analysis. This could be explained by programme personnel prioritizing families with children with acute malnutrition for participation. This could result in a baseline difference in nutritional status between Juntos and non-Juntos children, that is only reduced after participation in the intervention. The district level analysis corrects this selection bias. We confirmed that the prevalence of acute malnutrition before implementation was higher in Juntos districts (Table 3). The observed improvement in nutritional status correlates with reported improvements in the quality of food ingested, as found by others (Perova & Vakis 2009b; Segovia 2011) and with micronutrient supplements distributed during health checkups of children at health centres (Dirección General de salud de las Personas 2011). However, there are studies that show that micronutrient supplementation delivered as part of CCT programmes does not have an effect on child nutrition (Attanasio *et al.* 2014).

In our analysis, we did not find any effect on post-partum complications in either analysis. We were expecting that mothers and children would have fewer post-partum complications if they had more deliveries at health centres (Table 2).

One limitation of this evaluation is that we did not have enough baseline data on the prevalence of our outcomes in the district level analysis. There is baseline data for only some of the districts included in Juntos. DHS included a random sample of districts, and therefore a district that is included in one round is not necessary included in the next round. This resulted in an important reduction in sample size and power for comparisons. Adjusting for these indicators would result in losses of approximately 82% to 85% of the data and increases in the mean bias after propensity score matching, from 0.5 to 3.42 in the women's database and from 0.8 to 6.6 in the children's database. Although the loss of these respondents reduced our power, it also reflects one of the advantages of the propensity score approach—avoiding extrapolation by limiting analyses to regions of 'common support' and not comparing treated and control observations with very different covariates values. Adjustment by baseline conditions is important, as pre-existing baseline differences could bias our results.

Another limitation of this evaluation is the impossibility of completely removing pre-existing differences between districts. Unlike randomization, propensity score matching only controls for measured differences. Furthermore because of the purposive allocation of the intervention, an observed reduction in a pre-existing difference in an outcome variable could at least be partially explained by regression to the mean if the most severe districts were targeted for the intervention. There was a high degree of selection into this analysis, but that does not necessarily result in selection bias. Nonetheless, if the effect is heterogeneous across different contexts and we have analysed only a subset of observations, then our estimates might indeed lack generalizability or a population-level interpretation. Regression to the mean tends to be an issue when there is measurement error in the indicators. The poorest districts, which were recruited first into the Juntos programme, were stably poor in a way that was more systematic than just a question of measurement error.

A 'difference-in-differences' analysis using another source of data is the natural next step for our study. Data from outpatient clinics routinely collected by the Ministry of Health of Peru by the Health Information System could be a good source for this purpose (Curioso *et al.* 2013).

In concordance with other evaluations of Juntos (Trivelli & Díaz 2010; del Pozo & Guzmán 2011; Escobal & Benites 2012; Perova & Vakis 2012) and evaluations of other CCTs (Carvalho *et al.* 2014; Shei *et al.* 2014), we found good compliance of participants with the programme's participation requirements. We also confirmed the finding of others (Baird *et al.* 2011; Owusu-Addo & Cross 2014; Andersen *et al.* 2015) about the effect of the programme on maternal and child health.

Juntos participants had more deliveries at a health centre, more checkups and more vaccinations. Deliveries at home are associated with perinatal mortality, postpartum morbidities and anaemia in women (McDermott *et al.* 1996; Iyengar 2012), and as part of the health checkup, children are subject to growth monitoring and vaccinations, thus preventing some diseases (Centers for Disease Control and Prevention (CDC) 2013). Additionally, during the checkup, children receive vitamins and iron supplementation (Dirección General de salud de las Personas 2011).

In conclusion, we found evidence that Juntos reduced the risk of underweight in women and anaemia in children at the individual level. We also found a beneficial effect on overweight in women and acute malnutrition in children, but an adverse effect on anaemia in children at the district level.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Contributions

JEP collected, analysed and interpreted the data and wrote the initial draft of the manuscript. CCC, AN and JSK significantly contributed to the design, analysis and report. In addition, they reviewed initial and final drafts of the paper and provided feedback and contributions. All authors critically reviewed and agreed with the final contents.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table SI. Inclusion criteria for individual and district-level evaluations of Juntos

Table SII: Main effect estimates in the district level analysis after adjustment for prevalence of chronic malnutrition in the district before the implementation.