Role of cash in conditional cash transfer programmes for child health, growth, and development: an analysis of Mexico's *Oportunidades*

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Summary

Background **Many governments have implemented conditional cash transfer (CCT) programmes with the goal of improving options for poor families through interventions in health, nutrition, and education. Families enrolled in CCT programmes receive cash in exchange for complying with certain conditions: preventive health requirements and nutrition supplementation, education, and monitoring designed to improve health outcomes and promote positive behaviour change. Our aim was to disaggregate the effects of cash transfer from those of other programme components.**

Methods **In an intervention that began in 1998 in Mexico, low-income communities (n=506) were randomly assigned to be enrolled in a CCT programme (*Oportunidades*, formerly *Progresa*) immediately or 18 months later. In 2003, children (n=2449) aged 24–68 months who had been enrolled in the programme their entire lives were assessed for a wide variety of outcomes. We used linear and logistic regression to determine the effect size for each outcome that is associated with a doubling of cash transfers while controlling for a wide range of covariates, including measures of household socioeconomic status.**

Findings **A doubling of cash transfers was associated with higher height-for-age *Z* score (β 0·20, 95% CI 0·09–0·30; p<0·0001), lower prevalence of stunting (–0·10, –0·16 to –0·05; p<0·0001), lower body-mass index for age percentile (–2·85, –5·54 to –0·15; p=0·04), and lower prevalence of being overweight (–0·08, –0·13 to –0·03; p=0·001). A doubling of cash transfers was also associated with children doing better on a scale of motor development, three scales of cognitive development, and with receptive language.**

Interpretation **Our results suggest that the cash transfer component of *Oportunidades* is associated with better outcomes in child health, growth, and development.**

Introduction

Worldwide, more than 200 million children under the age of 5 years are not fulfilling their potential for growth, cognition, or socioemotional development.[1] Infants and toddlers growing up in poverty are exposed to poor sanitation, large family size, lack of psychosocial stimulation, and fewer household resources.[2] As they grow up, children living in poverty in the developing world are likely to have substantially lower wages than do healthier adults,[3] and are thus less likely to be able to provide increased stimulation and resources for their own children, thereby perpetuating the effect of poverty.[4] Early childhood is a period of rapid change and physiological development and is thus a period critical for intervention.[5]

The question of how best to intervene to improve child health and wellbeing is of paramount importance.[6] Many governments in developing countries, particularly in Latin America, have turned to conditional cash transfer (CCT) programmes to address the larger issue of poverty alleviation.[7] In traditional cash transfer or welfare programmes, families receive cash benefits because the household falls below a certain income cutoff or lives within a geographically targeted region, and these are the only criteria determining eligibility for participation. In CCT programmes, however, families receive a cash payment only if they comply with a set of certain requirements. For example, most CCT programmes distribute benefits conditional on mandatory attendance at preventive health-care services and health and nutrition education sessions designed to promote positive behavioural changes, and some programmes also require school attendance for school-age children.[8] In other CCT programmes, fortified food or micronutrient supplements are distributed to vulnerable subgroups in the population (eg, pregnant women and young children), which is conditional on the same factors as the cash transfer. The conditional nature of the benefits separates CCT programmes from other cash or in-kind distribution programmes. There are several CCT programmes already in place in Latin America, including *Oportunidades* (previously *Progresa*) in Mexico, *Bolsa Alimentação* in Brazil, *Red de Protección Social* in Nicaragua, *Programa de Asignación Familial* in Honduras, *Familias en Acción* in Columbia, *Subsidio Unico Familiar* in Chile, and the Program of Advancement through Health and Education in Jamaica.[9] A CCT programme is also currently being planned for implementation in New York City.[10]

CCT programmes have the simultaneous goals of immediate poverty reduction—through cash transfers

that can be spent without restrictions—and long-term poverty reduction through human capital development, defined as investing in a person's health, knowledge, and skills.[9] Children are often the focus of the human capital investments, with the intention of giving children the tools with which to break the inter-generational transfer of poverty.[4] CCT programmes use cash transfers as incentives for parents to invest in their children's health and wellbeing so that their children will have the capabilities to be able to escape poverty when they reach adulthood.[11]

There is substantial evidence that, in the short term, CCT programmes improve health and nutritional outcomes for children early in life,[12–14] and that these outcomes are achieved in part due to increased use of preventive services mandated by programme participation.[8] However, no studies to date have looked at the effect of CCT programmes on child cognitive, language, or motor development. Additionally, no analyses of CCT programmes thus far have been able to disaggregate the mechanisms by which such programmes could affect outcomes. Investigators have only been able to compare programme participation with non-participation and have not been able to separate the effect of the cash transfer on the desired outcome from the effect of other programme components. Understanding the pathways by which CCT programmes could be operating could guide policy makers who are faced with the challenge of how to design the most effective and cost-effective interventions.

	Transfer amount (in pesos per month, unless otherwise indicated)
Third grade student (amount paid for each)	60
Fourth grade student	70
Fifth grade student	90
Sixth grade student	120
Seventh grade student, male	175
Eighth grade student, male	185
Ninth grade student, male	195
Seventh grade student, female	185
Eighth grade student, female	205
Ninth grade student, female	225
Additional first term payment number 1, per student	80, one time payment
Additional first term payment number 2, per student	40, one time payment
Additional second term payment, per student	150, one time payment
Food for household	90
Cap (not including additional term payments)	550

100 pesos is equivalent to about US$9·30.

Table 1: **Amounts paid to *Oportunidades* beneficiaries by age-group in 1997 Mexican pesos**

Our aim was to determine the effect of the cash component of *Oportunidades* while holding all other aspects of the programme constant. We took advantage of the variation in total cumulative amounts of cash received by the families (determined by year of programme incorporation and family demographic structure) to explore the relation between cumulative cash transfers received over the course of the programme and child growth, health, and development outcomes.

Methods

Procedures

Oportunidades was established in 1997 with the dual goals of alleviating immediate suffering and breaking the intergenerational transmission of poverty by inducing parents to invest in their children's development. *Oportunidades* is the largest conditional cash transfer programme of its kind, and is a model for programmes throughout the world. In part, this is a result of the investment made by the Mexican government in external assessments of the programme and in the extensive dissemination of the results.[15] In 2004, the budget for *Oportunidades* was $2·2 billion for a total coverage of 4 million families;[9] by 2007, this had reached $3·7 billion to cover over 5 million families.

Programme eligibility was established in two stages in rural areas.[16] First, underserved or marginalised communities were identified. Selection criteria for marginalised communities were based on the proportion of households living in very poor conditions, identified from data from the 1997 census. Low-income households within those communities were identified on the basis of a socioeconomic census, which was used to classify households as eligible for treatment or ineligible by use of a proxy means test. All eligible households living in treatment localities were offered *Oportunidades*; 90% enrolled in the programme. Once enrolled, households received benefits according to their baseline household composition for a minimum of 3 years, conditional on meeting the programme requirements, after which they were re-assessed for eligibility.

The cash transfer benefit from *Oportunidades* comes in two forms (table 1). The first is a monthly fixed stipend conditional on family members obtaining preventive medical care and is intended for families to spend on more and better food to improve nutrition. The second type of transfer comes in the form of educational scholarships and is given to families of children starting the third grade in primary school, and is conditional on children attending school a minimum of 85% of the time and not repeating a grade more than twice. Beneficiary children also receive money for school supplies once or twice a year. The size of the education stipend is larger at higher grades and is also higher for girls because the government wanted to encourage older girls, in particular, to stay in school. There is an upper limit to the total

Panel: Package of health services and frequency of health clinic visits required by *Oportunidades* by age-group

Children and adolescents

- Prenatal care, growth monitoring, immunisations, management of diarrhoea and acute respiratory infections, antiparasitic treatment
- Under 4 months: three check-ups, at 7 and 28 days and at 2 months
- 4–23 months: six check-ups, at 4, 6, 8, 10, 12, and 18 months
- 2–19 years: two check-ups per year, every 6 months
- From 6–23 months: all children received nutritional supplement
- From 24–60 months: children received nutritional supplement as indicated by low weight-for-age

Pregnant and lactating women

- Prenatal care, birth attendance, post-partum care
- Pregnant women: five prenatal check-ups and nutritional supplementation
- Post partum: two check-ups at days 7 and 28 post partum and nutritional supplementation

Adults (men and women)

- Prevention and control of hypertension and diabetes mellitus, community-based training on healthy lifestyles, screening for cervical cancer
- 18–49 years: two check-ups per year, every 6 months
- 50 years or more: one check-up per year

transfer received per household, equivalent to having three children in school.

Oportunidades requires that children receive regular medical check-ups. Additionally, all pregnant and lactating women and children aged 6–23 months receive a fortified food supplement, as do children aged 24–60 months with low weight (panel). Before providing cash to the households, *Oportunidades* verifies that households have actually completed the required health-care visits and school attendance. About 1% of households are denied the cash transfer for non-compliance.

The health and education components of *Oportunidades* are strongly enforced since these are conditions for continued receipt of benefits. The programme has a modern and efficient information system that permits rapid follow-up of individual beneficiaries who are non-compliant with these components. With a number of controls in place through these systems, any fraud on the part of providers (eg, falsified attendance cards) can be detected easily. However, there is no way in this type of large programme assessment to guarantee that the quality of these components was similar in all communities.

A randomised assessment design was originally implemented by the Mexican government to rigorously evaluate the effect of *Oportunidades*. The government was unable to enrol all eligible families simultaneously because of budgetary and logistic constraints, and needed to phase in enrolment over an 18-month period. The actual cluster randomisation used was dictated in part by government restrictions on the level of randomisation. Rules written into the legislation authorising *Oportunidades* in 1997 dictated that the programme would first incorporate poor families living in rural communities with a population of 500–2500 residents. For cost reasons and concerns about social unrest, the government decided that the minimum level of intervention would be at the village level and not at the household level. The government agreed to a stepped wedge design—ie, once it chose which villages were eligible for the next 2 years, we could randomly decide which ones were incorporated first (treatment, or early intervention) and which ones were incorporated later (control, or later intervention).

Minimum sample sizes were determined on the basis of power calculations to be able to observe a 10% difference in outcomes (eg, height, school enrolment, and change in socioeconomic status measured by per-head consumption) accounting for the inter-cluster correlation introduced by the village level randomisation. The government then said that they wanted to increase the number of treatment villages to obtain better information on operations, leading us to approximately double the number of treatment villages. Once the number of villages was agreed, a random sample of villages stratified by state in proportion to state size was drawn. Villages were then randomised within each state stratum into control and treatment groups. There was no within village sampling; rather, a census of households in the villages was done.

Thus, at the inception of the programme, the government randomly chose 320 early intervention and 186 late intervention communities in seven states (figure 1). Random assignment was generated at the community level without weighting by use of randomisation commands in Stata version 2.0; thus, each of the communities was given equal chance of being included. None of the sites was told they would be participating in the study, and information regarding timing of rollout was not made public.

This sample of communities is representative of the *Oportunidades* rural beneficiary communities and was well balanced in terms of baseline socioeconomic and demographic characteristics, suggesting that the randomisation was effective in generating truly exogeneous variation in the two groups.[17] Eligible households in early intervention communities began receiving benefits in April, 1998, and eligible households in later intervention communities were not incorporated until November, 1999. Although recruitment rates were different in these communities, the households within the communities did not differ in terms of any measured characteristics.[18] Thus, despite recruitment rates being

different between the groups, the outcomes should not have been affected by this difference.

Our analysis took advantage of the variation across a large group of children in the amount of cash given to the households in which they were living. The variation in cumulative transfers was derived from two sources: the randomised phasing in of the programme at the community level and the baseline demographic structure of the household. The randomisation meant that households in early treatment communities had been accumulating transfers for about 18 months longer than had households in later treatment communities. Additionally, households with more children in school and enrolled in higher grades, or more female children in higher grades, received higher amounts and therefore accumulated transfers faster than did similar households with fewer children in school or with more male children in higher grades.

The *Oportunidades* evaluation was approved by the research, biosecurity and ethics commissions at the National Institute of Public Health in Mexico and the Committee for the Protection of Human Subjects at the University of California at Berkeley. In each round of the assessment, participants were invited to participate after receiving a detailed explanation of the survey objectives, procedures, risks, and benefits and if they agreed, were asked to sign an informed consent declaration.

Data collection

Between September and December, 2003, we went back to a subset of the original 506 communities that included all communities in which there were more than ten children under 5 years old and did a comprehensive survey. We merged these data with the amount of money actually transferred to households, based on *Oportunidades* administrative records, and with pre-intervention household socioeconomic and demographic data from the 1997 survey. In the analysis reported here, we only included children who were born after November, 1999, when all households had been enrolled in the programme; thus all children in the sample were 24–68 months old. All the families were beneficiaries at that time, but the families in the early treatment group had been beneficiaries of the programme for about 18 months previously.

Height and weight were assessed for all children by use of standard techniques and regularly calibrated portable scales and stadiometers.[19,20] All personnel were trained according to international recommendations. Repeat measurements were taken from about 2% of the sample to monitor quality control. Standardised height-for-age *Z* scores and percentiles were calculated as per WHO guidelines.[21] Linear growth faltering, or stunting, was defined as having height-for-age *Z* score of less than –2, which indicates that the child's height is at least two standard deviations below the age and sex specific reference median. Body-mass index (BMI) percentile was calculated in accordance with standard procedures, and children were then classified as being overweight if they were above the 85th percentile. Haemoglobin concentration was assessed on a capillary sample with a portable photometer (β-haemoglobin, HemoCue Inc, Ängelholm, Sweden). Mothers were asked to report the number of sick days that the child had had in the 4 weeks before the survey.

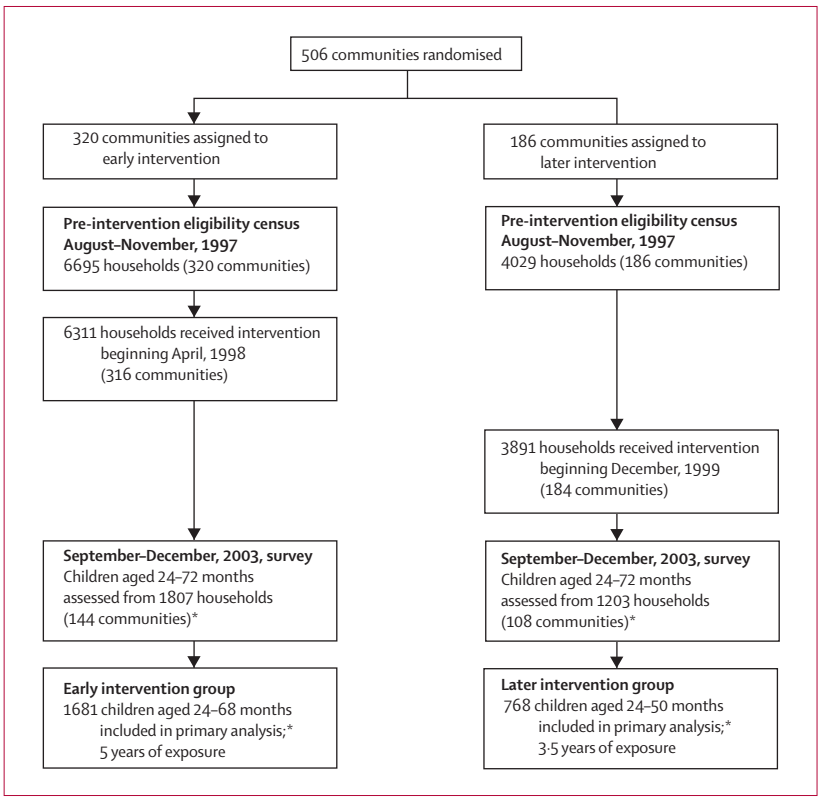

Figure 1: **Study design**
*Communities only included in 2003 survey if they included at least ten children under 5 years old; children included in analysis if they had been on *Oportunidades* programme since birth.

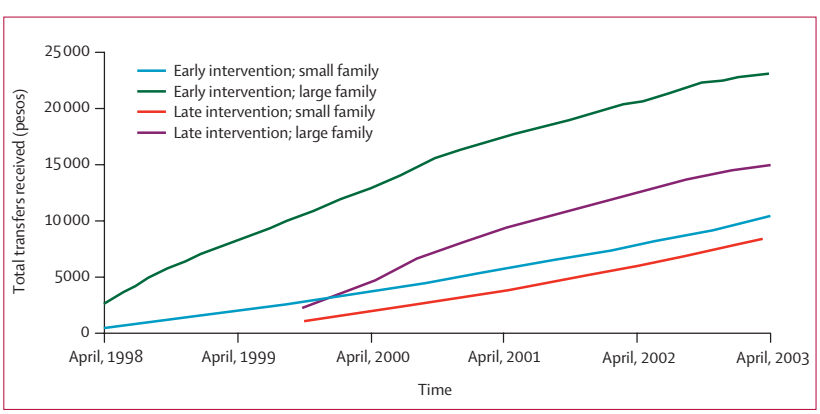

Figure 2: **Simulation of a scenario specifying projected *Oportunidades* cumulative cash transfers for large and small families**
*Small family is defined as having only one child who turned 6 years old in 1997, and large family as one in which there are three children, including two boys aged 10 and 12 and one girl aged 8 (as of 1997). The early intervention group began receiving cash transfers in April, 1998, and the late intervention group began receiving transfers in November, 1999. The survey described here took place from September to December, 2003.

Gross motor development was assessed for children older than 36 months with a subscale of the McCarthy scales of children's abilities, a comprehensive battery that offers a broad picture of a child's abilities.[22] The gross motor subscale required the child to walk in a straight line, stand on one foot, and walk backwards, among other tasks. The measures were divided into skill (eg, whether the child could stand on one foot) and endurance (eg, how long the child could stand on one foot); results for these measures will be reported separately.

Cognitive development was assessed for children older than 36 months with three subscales (long-term memory, short-term or working memory, and visual integration) from the Spanish language version of the revised Woodcock-Muñoz test.[23] The scales have been used to assess effects of early childhood nutritional interventions and early health insults on cognitive development in children,[24] and were selected because they have shown sensitivity to an income intervention in low-income families,[25] and to outcomes in children with low birthweight.[26] Scores were log-transformed due to positive skew. For the cognitive and language development measures, we spent considerable resources piloting and adapting the tests, training the interviewers, and maintaining a high degree of quality and inter-rater reliability.

Language was assessed for children over 36 months with the *Test de Vocabulario en Imágenes Peabody*, a Spanish language version of the Peabody picture vocabulary test,[27] which contains 125 items that have been carefully selected through rigorous item analysis for their universality and appropriateness to Spanish-speaking communities. The vocabulary test has been widely used to assess the language development of Spanish-speaking preschool children and of older students.[28,29] Scores were log-transformed due to positive skew.

Cumulative cash transfers were used as the primary independent variable. The variation in cumulative cash transfers came from the interaction of randomly assigned timing of initial programme enrolment and baseline household demographic structure. The amount of cash accumulated over the entire period of time enrolled in the programme was used instead of cash transfers in the last month because cumulative transfers better reflect the exposure of the child to cash during critical periods for growth and development than does cash received in a specific short-term period. Over the course of the period of *Oportunidades* described here, a family with three children that had been part of the early intervention group would have received the most cumulative amount of cash, whereas a family with only one child that had been part of the later intervention group would have received the least (figure 2).

Interviews were done with the mother or primary caregiver of each child to obtain information with regard to a number of covariates, which were chosen due to their well-established contributions to child growth and development outcomes.[2] Age and sex were obtained for all children from birth records. To allow for non-linear effects, age and sex were included in all analyses as 11 dummy variables in reference to the baseline of boys aged 24–30 months (ie, indicator variables were boys 31–36 months old, boys 37–48 months old, etc, and girls aged 24–30 months, girls aged 31–36 months, etc). Data for maternal age, education, and height were also obtained. As a proxy for maternal intelligence, which is an important contributing factor for child development, we used the language test to measure working vocabulary of the caregiver.[30]

Household-level information was obtained at baseline, including composition of the household (ie, age and sex of all family members), father's education, number of people in the household, whether the head of the household spoke an indigenous language, presence of electricity and water in the household, and number of small and draft animals owned. A baseline asset index was created on the basis of the presence or absence of blender, refrigerator, gas heater, hot water heater, radio, stereo, television, video, washer, fan, car, and van. These variables have been shown to provide good estimations of the economic concept of consumption, the gold standard measure of socioeconomic status.[31,32] Principal components analysis, a standard data reduction technique, was used to consolidate the asset variables into one measure,[33,34] and the first principal component was retained.[35]

The final household-level variable included in the analysis was household time participating in *Oportunidades*, which was included in the statistical models in 2-month increments. This variable was added to control for the possibility that parental behaviour could have been affected by time participating in *Oportunidades* before the child assessed in this evaluation had been born.

Statistical analysis

Our aim was to determine whether receiving more money (higher cumulative transfers) in *Oportunidades* was associated with improvements in child growth, health, and development outcomes. To achieve this objective, we restricted our sample to children who had been *Oportunidades* beneficiaries their whole lives. Thus, all families were exposed to the health and nutrition-related benefits of the programme over the entire life of the child, with variation only in the household's length of time on the programme and the cumulative amount of the transfers that have been received. The analysis therefore, does not test for the effect of the programme between beneficiaries compared with non-beneficiaries but rather whether there is an association between greater amounts of cash received and child outcomes; this analytical framework is more analogous to a dose–response analysis than to a treatment–control analysis.

By use of linear and logistic regressions, adjusted for sampling design and clustering, we regressed the outcome measures against cumulative cash transfers and the covariates described above. We also controlled directly for

the number of household members and proportion of children in each age category at baseline to ensure that the cumulative cash transfer variable was not confounded by family composition effects. Additionally, by controlling for length of time the household had been in the programme, we adjusted for the possibility that an individual child might have benefited from changes at the household level that could have occurred before the child was born. We also controlled for a wide range of household-level and community-level variables, as described above. Since the programme was implemented at the community level there could have been inter-cluster correlations between villages, so we clustered at the community/village level. Missing values for control variables were replaced with community means in regression analyses. Most of the control variables required less than 5% replacement, but father's education and five household variables of socioeconomic status (water, electricity, land owned, draft animals owned, and small animals owned) were replaced in 15% of cases. No missing values were replaced for the outcome variables included in the analyses.

We report primary results as effect size for each outcome associated with a doubling of cash transfers from the median of 7500 to 15 000 pesos (equivalent to an increase from US$806 to $1612), which represents a move from about the 50th to the 75th percentile of total cumulative transfers.

Stata version 9.2 was used for the statistical analyses.

Role of the funding source

None of the funding sources had any role in the design and conduct of the study; collection, management, analysis, and interpretation of the data, or in the preparation, review, or approval of the manuscript. All authors had full access to all of the data in the study. The corresponding author had final responsibility for the decision to submit for publication.

Results

Baseline data for households are shown in table 2. On average, households had more than six members, with one or two children under the age of 5 years, two older children, and two working-age adults. About a fifth of mothers and a fifth of fathers had not completed any school, and the head of about half the households spoke an indigenous language. Maternal scores on the working vocabulary test were low compared with the expected standardised mean of 100. Families at baseline owned small amounts of land, and about a third had piped water on their land. Most households owned small animals, and about three-quarters had electricity in the home. At follow-up in 2003, we surveyed 252 communities, with 2449 children ranging in age from 24 to 68 months (figure 1); about half the children were female (table 3). Data for dependent variables are shown in table 4.

In the multivariate regressions, increased cumulative income transfers were associated with better outcomes in most domains analysed (table 5). A doubling of cumulative cash transfers was associated with an increase in height-for-age Z score ($p<0\cdot0001$) and a lower prevalence of stunting ($p<0\cdot0001$). A doubling of transfers was also associated with a lower prevalence of being overweight ($p=0\cdot001$), and there was a decrease in BMI for age percentile ($p=0\cdot04$).

A doubling of cash transfers was associated with improvements in endurance ($p=0\cdot001$), long-term memory ($p=0\cdot002$), short-term memory ($p<0\cdot0001$), visual integration ($p=0\cdot02$), and language development ($p<0\cdot0001$; table 5). There was no association between increased cash transfers and the number of sick days in the 4 weeks before the survey, with the skill component of motor development, or with haemoglobin concentration.

Of the variables included as controls in the model, mother's vocabulary score was significantly associated with most measures of physical health and development, as was household size (data not shown). The number of years on the programme was not associated with any of the outcomes, nor did its exclusion from the multivariate model modify the relation between transfers and outcomes (data not shown). Indigenous language spoken, a proxy measure for ethnicity, was not significant in the analyses, nor was father presence, mother's education, father's education, or any other measure of household socioeconomic status (eg, electricity, land, animals, or appliances owned; data not shown). Most models had an R^2 of over 20%.

	Baseline data*
Household size (N=2449)	6·6 (2·3)
Current household composition	
Children (0–5 years)	1·8 (0·9)
Children (6–17 years)	2·3 (1·6)
Working age adults (18–49 years)	2·2 (0·9)
Other adults (50 years or older)	0·4 (0·7)
Indigenous language spoken by head of household	1171/2449 (48%)
Father present in household	2111/2441 (86%)
Father finished some primary school	2109/2441 (86%)
Mother finished some primary school	1989/2449 (81%)
Maternal height (cm; N=2446)	148·3 (5·5)
Maternal vocabulary score (N=2445)	79·0 (18·4)
Land owned (hectares; N=2425)	1·5 (2·4)
Piped water on family land	858/2425 (35%)
Own at least one draft animal	808/2425 (33%)
Own other (small) animals	1887/2425 (78%)
Had electricity in home	1753/2425 (72%)
Asset index value (N=2425)†	0·0 (1·0)

Data are n/N (%) or mean (SD). *Baseline data refer to information collected in 1997 or retrospectively about 1997. †Composed by use of principal components analysis.

Table 2: **Baseline characteristics of households of children included in analyses**

	Value
Age (months)	42·3 (10·5)
24–30	397 (16%)
31–36	429 (18%)
37–48	948 (39%)
49–60	499 (20%)
61–72	176 (7%)
Sex	
Female	1205 (49%)
Male	1244 (51%)

Data are mean (SD) or n (%).

Table 3: **Characteristics of children included in analyses (N=2449)**

	Value
Physical growth and health	
Height-for-age *Z* score	–1·4 (1·2)
Stunted (height-for-age *Z* score <–2)	28·7%
BMI for age percentile	60·4 (26·8)
Overweight or obese (BMI/age >85%)	22·1%
Haemoglobin (g/L)	118·5 (14·6)
Sick days in the 4 weeks before the survey	1·5 (3·2)
Motor development	
Skill	6·1 (2·9)
Endurance	11·0 (7·2)
Cognitive development	
Long-term memory†	1·9 (0·8)
Short-term memory†	2·8 (0·7)
Visual integration†	2·1 (0·6)
Language development	
Peabody score†	1·9 (0·8)
Amount of transfers	
Total deflated amount, 1998–2003, pesos‡	8122 (4745–14 838)

*Data are mean (SD) or %, except where indicated. †Log of raw score displayed and used in analyses. ‡1000 pesos equals about US$93; data are median (IQR) because of positive skew.

Table 4: **Dependent variables**

	Cumulative cash transfer β (95% CI)*	p value
Physical growth and health		
Height-for-age *Z* score	0·20 (0·09 to 0·30)	<0·0001
Stunted (height-for-age *Z* score <–2)	–0·10 (–0·16 to –0·05)	<0·0001
BMI for age percentile	–2·85 (–5·54 to –0·15)	0·04
Overweight (BMI/age >85%)	–0·08 (–0·13 to –0·03)	0·001
Haemoglobin (g/L)	0·90 (–0·56 to 2·37)	0·23
Sick days in the 4 weeks before survey	–0·24 (–0·58 to 0·10)	0·17
Motor development		
Skill	0·06 (–0·20 to 0·32)	0·67
Endurance	1·15 (0·47 to 1·84)	0·001
Cognitive development		
Long-term memory†	0·12 (0·04 to 0·19)	0·002
Short-term memory†	0·13 (0·07 to 0·19)	<0·0001
Visual integration†	0·08 (0·01 to 0·14)	0·02
Language development		
Peabody score†	0·18 (0·08 to 0·27)	<0·0001

*Effect size for each outcome associated with a doubling of cash transfers from the median of 7500 to 15 000 pesos. †Log of raw score used in analyses. ‡N ranges from 1573 to 2402 because cognitive, language, and motor outcomes were collected for children ≥36 months, and physical measures were collected for all children aged ≥24 months.

Table 5: **Effect of doubling cash transfers in *Oportunidades* on developmental outcomes in children (24–68 months) 5·5 years after programme inception‡**

Discussion

Our results suggest that larger cumulative transfers to the household as part of the *Oportunidades* intervention in Mexico were associated with significantly better outcomes in many aspects of child physical, cognitive, and language development. These outcomes include increased height for age, decreased BMI for age percentile, decreased prevalence of stunting and being overweight, and increased performance on one scale of motor development, all cognitive function subscales, and language development. The findings remained significant after adjustment for baseline family structure and socioeconomic status, in addition to a wide range of family, household, and community covariates. Our data thus contribute to the growing evidence that CCT programmes are positively associated with child wellbeing.

Participation in *Oportunidades* has previously been found to have a positive effect on child growth, with a difference of about 1 cm between programme participants and non-participants seen at 2 years of age.[13,14,36,37] These assessments reported the short-term effect of *Oportunidades* on child growth and, since they compare beneficiaries with non-beneficiaries, provide a mean overall estimate of the programme's effect. Our analysis provides some insight into the potential variation of effect within the beneficiary population and suggests that one of the sources of that variation could be the amount of cash received by the family. Although the magnitude of the findings reported here is small, we expect that this is an underestimation of the full effect of the programme on child growth and development.

Since all children in our analysis were on the programme for their entire lives and because we controlled for the household's exposure to the programme requirements by adjusting for the number of years the family had been on the programme, the associations described here are unlikely to be caused by differences in exposure to the other health and nutrition components of the programme (eg, access to the fortified food, or prenatal and early childhood health-care services) that could have affected growth or development. Household size could have changed in response to the programme, and it is possible that the early intervention and later intervention groups differed in terms of current household size, indicating that we should have controlled for current household size rather than household size at baseline. However, we replicated our analyses adjusting for current household size instead of baseline, and there were few differences in the findings (data not shown). Additionally, there is evidence from a different set of analyses that *Oportunidades* did not have any effect on fertility or childbearing.[38]

Unfortunately, we do not have information on individual consumption of the fortified food by children during the critical period for child linear growth, including gestation and the first 2 years of life. In a controlled trial in Guatemala, consumption of a food supplement similar to that distributed by *Oportunidades* was associated with a 3 cm increase in child height at 3 years of age.[39] Although we cannot rule out the

possibility that total transfers in *Oportunidades* are somehow correlated with use of the fortified food during early childhood, we have no reason to believe that this correlation exists. As part of other studies, extensive analyses of the use of the nutritional supplements (the component of *Oportunidades* most likely to affect nutrition outcomes) have been done and have shown no significant differences over time or by region of the country in their acceptance or use.[40] Furthermore, the models reported here adjust for factors that we have shown previously to probably affect the consumption of the fortified food, including the presence of other children in the household and family socioeconomic status.[40] Since 2003, when we collected the data presented here, *Oportunidades* has been making major investments to strengthen its health and education requirements.[41]

The effect of larger transfers on child growth could have occurred during the critical period for growth (gestation and the first 2 years of life), and the association documented here could reflect the lasting benefit of better growth during that period. We have shown previously that the effect of *Oportunidades* on child growth is greater in younger children.[37] In view of previous experience,[42] we expect that *Oportunidades* would have little effect on child growth after that period.

We found a positive association between higher cash transfers and lower prevalence of being overweight. The mechanism by which money from *Oportunidades* could affect a child's BMI will require further investigation. All families had access to health and nutrition education and programme services, and it is therefore unlikely that this component resulted in greater knowledge and practices related to weight control. Short-term findings suggest that families spend an average of 70% of the cash transfer on so-called better quality calories, including greater expenditures on meat, fruits, and vegetables.[43] Calories from foods of lower energy density could have replaced consumption of those of higher energy density, resulting in a lower total intake over the course of the day. However, we have no way to know what the intra-household distribution of the foods was and whether the diets of the children actually changed.

Larger transfers to the household over the fairly long period of observation here might have resulted in differences in access to resources that promote physical activity (eg, clubs, teams, sports equipment), or in changes in time allocation, with more time available for active recreational activities. Unfortunately, the data available do not allow us to verify either of these possibilities at this time and further research is required to understand the association between cash transfer and child weight.

Associations between cash transfers and cognitive and language development outcomes were small, similar to those found in studies in the USA looking at the effect of income on child development outcomes.[25,44–47] Nonetheless, the relevance of this comparison could be questionable in view of the non-comparability of the populations and the diverse nature of the interventions. Studies in the developing world that aim to improve cognitive development in very low-income populations have focused on nutritional interventions[48] or on early childhood development interventions,[49] and evidence of an association between income change and developmental outcomes in this context is scarce. The findings reported here are also small compared with effect sizes reported from interventions specifically targeting child development, such as home visits to support and educate mothers.[6]

Two of the domains of mental development that we found to be positively correlated with cash transfers—short term, or working, memory (a measure of executive function) and language—have been identified by neurological studies to be the most sensitive to differences in socioeconomic status.[50,51] Future research should explore the relation between change in socioeconomic status and child development in this context.

The cash component of CCT programmes could improve growth, health, and development outcomes for children living in extreme poverty via two pathways.[52] First, the additional income to the family could allow parents to have greater purchasing power. Specifically, they could use the cash transfer to purchase more or higher quality food or medicines when necessary. Similarly, they could use the cash to invest in household materials and equipment (eg, refrigerators, improved flooring, and other construction material) that could reduce a child's exposure to infection, all of which could contribute to increased growth and health outcomes. The money could also be used to buy books, newspapers, or age-appropriate toys that could be used to provide cognitive stimulation to children.[52,53]

The second pathway through which income could affect child development would be by improving the psychological wellbeing of family members and thereby improving the care, support, and nurture provided to the children in the household.[25,47] In view of the limitations of the data we have collected, we are not able to comment on the specific pathways by which cash transfers to the family would have affected outcomes. Future research should be designed in such a way as to explore these potential pathways.

One of the main limitations of our study was the lack of a good measure of cognitive stimulation or parental responsiveness. Both stimulation and responsiveness have been shown to be primary mediators of the effect of income on child development.[25,47] Children with more stimulating caregivers and those who live in rich, responsive environments are more cognitively advanced at the start of school than are children in less stimulating homes. Similarly, parents who interact frequently with their children promote their cognitive development as well as their social and emotional development.[54]

Another limitation is that we were unable to adjust for any differences in baseline levels of development or physical size between those who received more or fewer cash transfers over the entire observation period. However, the original categorisation into treatment groups (ie, early versus later incorporation into the programme) was determined randomly and the groups were well balanced at baseline for a number of socioeconomic and demographic variables that could be related to parenting and stimulation (eg, household size, housing quality, assets).

Another concern is that we used tests to assess cognition and language ability that are ordinarily used in highly standardised laboratory conditions. However, there is no reason to believe that there would have been systematic testing bias towards either the early or late intervention groups, since interviewers were masked to household assignment. In the analyses reported here, we explored the relation between cash transfers and growth and development deficits. We did not want this objective to be confounded by any differences in age (and therefore severity of the deficit). That *Z* scores continue to decrease from birth to 24 months of age in poor populations with a high prevalence of stunting has been well documented, with a further small drop between 24 and 36 months; after 36 months the indicator tends to level off.[55] Therefore, the most appropriate approach is first to make the outcome age independent (ie, by use of *Z* score) then adjust for age in the model, which we were able to do for the growth indicators. We were not able to take this approach with the cognitive or language development outcomes because this would have required the use of inappropriately standardised norms (eg, from populations that are non-comparable with the population tested here).

An additional limitation is that all children came from communities with more than ten children, which implies that the children here were possibly not representative of children from smaller rural communities. Also, the analysis depended on the assumption that children from programme households adhered to the programme requirements, but we do not have actual data for compliance. Most of our models had an R^2 between 20% and 30%, which underscores the critical contributions of genetic, environmental, and other factors that we did not measure, which could have contributed to the child health and development outcomes reported here.

In conclusion, our results suggest that the household cash transfer component of a large-scale CCT programme is associated with critically important child health, growth, and development outcomes, including height for age, stunting, being overweight, several measures of cognitive development, and language development. Our findings support the notion that *Oportunidades* is achieving its objectives in these domains via cash transfer.

Contributors

All authors were involved in study concept and design, acquisition of data, analysis and interpretation of data, statistical analysis, obtaining funding, and providing administrative, technical, and material support. LCHF drafted the manuscript, and the other authors provided critical revision of the manuscript for important intellectual content.

Conflict of interest statement

We declare that we have no conflict of interest.

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