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The Importance of Cash in Conditional Cash Transfer Programs for Child Health, Growth and Development::

An Analysis of Mexico's *Oportunidades*

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Abstract

Background—Many governments around the world have implemented conditional cash transfer (CCT) programs with the goal of improving options for poor families through interventions in health, nutrition and education. Families enrolled in CCT programs receive cash in exchange for complying with "conditionalities" – preventive health requirements and nutrition supplementation, education and monitoring designed to improve health outcomes and promote positive behavior change. A great challenge in evaluating the effectiveness of CCT programs has been disaggregating the effects of the cash transfer component from that of the conditionalities.

Methods—In an intervention that began in 1998 in Mexico, low-income communities (n=506) were randomly assigned to be enrolled in a CCT program (*Oportunidades*, formerly Progresa) immediately or 18 months later. In 2003, children (n=3793), aged 24–72 months who had been enrolled in the program their entire lives, were assessed for a wide variety of outcomes. The analyses reported here separated out the association of the cash transfer component of *Oportunidades* with several outcomes in children from the program conditionalities, while controlling for a wide range of covariates including many measures of household socio-economic status.

Findings—An increase in the cash transfer to the household was associated with higher height-for-age z-score and hemoglobin concentration, lower prevalence of stunting, and lower prevalence of

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Author Contributions:
All authors had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors were involved in study concept and design, acquisition of data, analysis and interpretation of data, statistical analysis, obtaining funding, providing administrative, technical and material support. The first author drafted the manuscript, and the other authors provided critical revision of the manuscript for important intellectual content.

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overweight. Children in families whose households received a greater quantity of cash also performed better on a scale of motor development (McCarthy Test of Children's Abilities), three scales of cognitive development (sub-scales of the Woodcock-Muñoz, including working memory), and receptive language (Test de Vocabulario en Imágenes Peabody).

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

Keywords

child development; child health; stunting; conditional cash transfer programs; randomized experiment; income; poverty alleviation; parental investment; human capital

INTRODUCTION

The first paper in a recent Child Development series in the *Lancet* estimated that over 200 million children under 5 years worldwide are not fulfilling their potential for growth, cognition, or socio-emotional development.[1] Infants and toddlers growing up in poverty are exposed to poor sanitation, large family size, lack of psycho-social 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 healthier adults,[3] and are thus less likely to be able to provide increased stimulation and resources for their own children, thereby perpetuating the cycle of the impact of poverty.[4] Early childhood is a period of rapid change and physiological development and thus, is a period critical for intervention.[5]

The question of how best to intervene to improve child health and well-being is of paramount importance.[6] Many governments in developing countries, particularly in Latin America, have turned to conditional cash transfer programs (CCT) to address the larger issue of poverty alleviation.[7] In traditional cash transfer or welfare programs, families receive cash benefits because the household falls below a certain income cut-off or lives within a geographically targeted region, and these are the only criteria determining eligibility for participation. In CCT programs, however, families receive a cash payment only if they comply with a set of certain requirements. For example, most CCT programs distribute benefits conditional on mandatory attendance at preventative health care services and health and nutrition education sessions designed to promote positive behavioral changes, and some programs also require school attendance for school-age children.[8] In other CCT programs, there is also the distribution of fortified food and/or micronutrient supplements for vulnerable sub-groups in the population (e.g. pregnant women and young children), which is conditional on the same factors as the cash transfer. It is exactly the conditional nature of the benefits that separates CCTs from other cash or in-kind distribution programs. There are several CCT programs 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 *Program of Advancement through Health and Education* in Jamaica.[9] A CCT is also currently being planned for implementation in New York City.[10]

CCTs have the simultaneous goals of 1) immediate poverty reduction – through cash transfers that can be spent without restrictions – and, 2) 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] CCTs 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, CCTs 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 program participation.[8] However, no published studies to date have looked at the impact of CCTs on child cognitive, language or motor development. Additionally, no analyses of CCTs thus far have been able to disaggregate the mechanisms by which CCTs could affect outcomes. In other words, investigators have only been able to compare program 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 program components. Understanding the pathways by which CCT programs could be operating could guide policy makers who are faced with the challenge of how to design the most effective and cost-effective interventions.

In the analyses reported here, we examine the effect of the cash component of a large scale CCT program, Mexico's *Oportunidades* program. This paper does not compare children in treatment and control groups (a difference in program exposure of only 18 months), a design that would answer the question "what is the total impact of the program?" Rather, we ask the question "what is the impact of transferring larger amounts of cash holding the other aspects of the program constant?" To answer this question, we take advantage of the variation in total cumulative amounts of cash received by the families (determined by randomized year of program incorporation and family demographic structure) and explore the relationship between cumulative cash transfers over the course of the program and child growth, health and development outcomes. The variation in cash transfers is the amount of cash that a family received since starting the program, and was determined by the product (interaction) of how long they have been on the program and the rate of accumulation of the cash. How long they have been on the program is determined by the randomization into the early versus late starting group. The rate of accumulation is determined by the number and grade/sex makeup of school age children at baseline.

All of the households included in the analysis have complied with *Oportunidades's* requirements (i.e., were never taken off of the program for non-compliance), but some have received higher cumulative cash transfers because they were living in communities randomized to begin receiving transfers earlier and/or accumulating cash at a faster rate because they had more school aged children at baseline. Our analysis is much more analogous to a "dose-response" analysis rather than a "treatment-control" comparison. We hypothesized that higher cumulative cash transfers to households would be associated with modest improvements across a range of growth and development outcomes in children.

METHODS

Mexico established its CCT program *Oportunidades* 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 program of its kind, and is a model for programs throughout the world. In part, this is due to the investment made by the Mexican Government in external evaluations of the program 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]

Oportunidades enrollment

Oportunidades established program eligibility in two stages in rural areas.[16] First, the program identified underserved or marginalized communities and then identified low-income households within those communities. Selection criteria for marginalized communities were based on the proportion of households living in very poor conditions, identified by using data from the 1997 census (*Conteo de Población y Vivienda*). For the selection of eligible

households within marginalized communities, *Oportunidades* a socio-economic census, which was used to classify households as eligible for treatment or ineligible using a proxy means test (PMT). All eligible households living in treatment localities were offered *Oportunidades* a majority (90%) enrolled in the program. Once enrolled, households received benefits according to their baseline household composition for a minimum of a three-year period conditional on meeting the program requirements, after which they were re-evaluated for eligibility.

Oportunidades benefits

The cash transfer benefit from *Oportunidades* comes in two forms (Box 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 in third grade in primary school 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 in the total transfer received per household, equivalent to having three children in early primary school.

Oportunidades program conditionalities require that children receive regular medical check-ups. In addition, all pregnant and lactating women and children 6 to 23 months of age receive a fortified food supplement as do children from 24 and 60 months with low weight (see Box 2). Before providing cash to the households, *Oportunidades* that households actually completed the required health care visits and school attendance. About 1 percent of households are denied the cash transfer for non-compliance.

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

Evaluation and analytic design

The analysis reported here 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 randomized phasing in of the program at the community level and the baseline demographic structure of the household. The randomization (described in further detail below) meant that households in early treatment communities had been accumulating transfers for about 18 months longer than households in later treatment communities. In addition, households with more children in school and enrolled in higher grades, or more female children in higher grades, had higher transfer amounts and therefore accumulated transfers faster than similar households with fewer children in school or with more male children in higher grades.

A randomized evaluation design was originally implemented by the Mexican Government to conduct a rigorous impact evaluation of *Oportunidades*. Due to budgetary and logistical constraints, the Government was unable to enroll all eligible families simultaneously and needed to phase in enrollment over an 18 month period. The actual cluster randomization used was dictated in part by Government restrictions on the level of randomization. The Government rules of operation written into the legislation authorizing the program in 1997 dictated that the

program would first incorporate poor families living in rural communities with a population between 500 and 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, which implied that whole villages would be either treatments or controls. The government agreed to a stepped wedge design in that once it chose which villages were eligible for the next two years, we could randomly decide which ones were incorporated first (treatments, or "early intervention") and which ones were incorporated later (controls, or "later intervention").

Then, minimum sample sizes were determined based on power calculations to be able to observe a 10 percent difference in outcomes (e.g. height, school enrollment, and change in socio-economic status measured by per capita consumption) accounting for the inter-cluster correlation introduced by the village level randomization. The government then said that they wanted to increase the number of treatment villages in order to obtain better information on operations leading us to approximately double the number of treatment villages. Once the number of villages was agreed upon, a random sample of villages stratified by state in proportion to state size was drawn. The villages were then randomized within each state stratum into control and treatment groups. There was no within village sampling; rather, a census of households of the villages was surveyed.

Thus, at the inception of the program, the government randomly chose 320 "early intervention" and 186 "late intervention" communities in seven states for a total of 506 experimental communities (Figure 1). Random assignment was generated at the community level without weighting using randomization commands in STATA; 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 roll-out was not made public.

This sample of communities is representative of the *Oportunidades* rural beneficiary communities and was well balanced suggesting that the randomization was effective in generating truly exogenous variation in the two groups.[17] Eligible households in early intervention communities began receiving benefits in April of 1998, and eligible households in later intervention communities were not incorporated until November of 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, in spite of the fact that the recruitment rates were different between the groups, the outcomes should not have been affected by this difference.

Data Sources and Sample

In 2003 we went back to a sub-set of the original 506 communities (all those with more than 10 children under 5 years old) and conducted 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 socio-economic 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 program; thus all children in the sample were 24–72 months old. All of the families were beneficiaries at that time, but the families in the early treatment group had been beneficiaries of the program for approximately 18 months previously.

Outcome Measures

Physical growth and health—Height and weight were assessed for all children by personnel trained and standardized according to international recommendations using standard techniques and regularly calibrated portable scales and stadiometers.[19,20] Repeat

measurements were taken from approximately 2% of the sample to monitor quality control. Standardized height-for-age z-scores (HAZ) and percentiles were calculated using publicly available software from the World Health Organization.[21] Linear growth faltering, or stunting, was defined as having HAZ less than −2, which indicates that the child's height is at least 2 standard deviations below the age and sex specific reference median. BMI percentile was calculated in accordance with standard procedures, and children were then classified as overweight if they were above the 85th percentile. Hemoglobin concentration was assessed on a capillary sample using a portable photometer (β-Hemoglobin, HemoCue Inc, Ängelholm, Sweden). Mothers were asked to report on the number of sick days that the child had experienced in the month previous to the survey.

Motor development—Gross motor development was assessed for children older than 36 months using a sub-scale 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 sub-scale 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" (e.g. whether the child could stand on one foot) and "endurance" (e.g. how long the child could stand on one foot), and results are reported separately for these measures.

Cognitive development—Cognitive development was assessed for children older than 36 months using three sub-scales (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 evaluate 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 born with low birth weight.[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 development—Language was assessed for children over 36 months using the Test de Vocabulario en Imágenes Peabody (TVIP), the 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 TVIP has been widely used to evaluate the language development of Spanish-speaking preschool children, and older students.[28,29] Scores were log-transformed due to positive skew.

Primary Independent Variable

Cumulative cash transfers were used as the primary independent variable. As described above, the variation in cumulative cash transfers came from the interaction of randomly assigned timing of initial program enrolment, and baseline household demographic structure. The amount of cash accumulated over the entire period of time enrolled in the program 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, such as the previous month. Over the course of the period of *Oportunidades* program participation described in this paper, a family with three children that had been part of the early intervention would have received the most cumulative amount of cash, whereas a family with only one child that had been part of the late intervention would have received the least (Figure 2).

Covariates

Interviews were conducted with the mother or primary caregiver of each child to obtain information regarding the following covariates, which were chosen due to their well-established contributions to child growth and development outcomes.[2]

Child-level data—Age and sex were obtained for all children from birth records. In order 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 24–30 months (i.e. indicator variables were boys 31–36 mo., boys 37–48 mo., etc. and girls 24–30 mo., girls 31–36 mo., etc.).

Maternal characteristics—Maternal age, education, and height were obtained. As a proxy for maternal intelligence, which is an important contributing factor for child development, we used the TVIP to measure working vocabulary of the caregiver.[30]

Household-level socio-demographic data—The following household-level information was obtained at baseline: composition of the household (i.e. age and sex of all family members), father's education, number of people in the household, whether an indigenous language was spoken in the home, presence of electricity and water in the household and number of small and draft animals owned. A baseline asset index was created using 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 SES.[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 the *Oportunidades* program, which was included in the statistical models in two month increments. This variable was added to control for the possibility that parental behavior may have been influenced by time participating in *Oportunidades* before the child assessed in this evaluation had been born.

Statistical Analysis

The aim of the analysis reported here was to test whether receiving more money (higher cumulative transfers) in the *Oportunidades* program was associated with improvements in child growth, health and development outcomes. We achieved this objective by restricting 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 program over the entire life of the child, with variation only in the length of time on the program and the cumulative amount of the transfers that have been received. The analysis therefore, does not test for impact of the program among beneficiaries compared to 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 rather than to a treatment-control analysis.

The key outcome variables in our regression analyses were: physical growth and health (height for age z-score, probability stunted, BMI percentile, probability overweight, hemoglobin concentration and sick days), motor development (two scales, one assessing skill and the other assessing endurance), cognitive development (long term memory, short term memory and visual integration), and language development.

Cumulative cash transfers were our primary independent variable. Using linear and logistic regressions, adjusted for sampling design and clustering, we regressed the outcome measures

against cumulative cash transfers and all of the covariates described above. These covariates included: individual child-level characteristics (age/ sex groupings) and maternal characteristics (education, height, and TVIP score). Covariates also included baseline household characteristics (from 1997), including household size, demographic structure (e.g. number of children and adults of various age groupings), characteristics of head of household (ethnicity, education), housing characteristics (whether household had electricity and piped water), and household assets (ownership of animals, land, and other big and small assets).

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 with family composition effects. In addition, by controlling for length of time the household had been on the program, we adjusted for the possibility that an individual child may 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 described above. Since the program 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. The majority of the control variables required less than 5% replacement, but father's education and five household SES variables (water, electricity, land owned, draft animals owned and small animals owned) were replaced in 15% of the 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 15000 Mexican pesos (806 to 1612 US dollars) – which represents a move from approximately the 50th to the 75th percentile of total cumulative transfers.

Ethical Review

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

Role of the Funding Source

None of the funders 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.

RESULTS

Households had an average of over six members, with between one and two children under five, and at least two older children and two working-age adults (Table 1). Approximately one-third of the mothers and fathers had not completed primary school, and at least one individual spoke an indigenous language in over 50% of the households. Maternal scores on the working vocabulary test were low (mean = 79.6) in comparison with the expected standardized mean of 100. Families at baseline owned small amounts of land, and the minority (34.2%) had piped water on their land. The majority owned small animals (78.7%), and had electricity in the home (74.2%).

In the analysis reported here of follow-up data collected in 2003, n=3793 children ranging in age from 24–72 months (mean age was 53.9 ± 16.8 mo.) were included; approximately half of the children were female (Table 2). Children had a mean height-for-age z-score (HAZ) of −1.4, the prevalence of stunting was 28.0%, and the prevalence of overweight was 20.6% (Table 3). Children had a mean hemoglobin concentration of 12.0 g/dl and 1.4 sick days in the week previous to the survey.

In the multi-variate regressions, increased cumulative income transfers were associated with better outcomes in most domains analyzed, including measures of physical size (height-for-age, stunting, and overweight), hemoglobin concentration, long term memory, short term memory, visual integration and language development (Table 4). Specifically, a doubling of cumulative cash transfers to the household was associated with an increase in 0.16 standard deviations in HAZ (95% CI: 0.08, 0.24, $P<0.0001$) and a 9% lower prevalence of stunting ($P<0.0001$). A doubling of transfers was also associated with a 6% lower prevalence of overweight ($P=0.001$) and a non-significant decrease in BMI for age percentile (β=−1.95, 95% CI: −4.08, 0.17, $P=0.07$). Greater cash transfers were also associated with higher hemoglobin concentrations (β=0.13, 95% CI: 0.01, 0.24, $P=0.03$).

A doubling of cash transfers was associated with improvements in one of the two measures of motor development (endurance) (β=0.71, 95% CI: 0.63, 1.26, $P=0.01$), in addition to long term memory (β=0.11, 95% CI: 0.05, 0.17, $P<0.0001$), short term memory (β=0.10, 95% CI: 0.06, 0.13, $P<0.0001$), visual integration (β=0.09, 95% CI: 0.05, 0.13, $P<0.0001$) and language development (β=0.19, 95% CI: 0.12, 0.25, $P<0.0001$). There was no association between increased cash transfers and sick days or with the skill component of motor development.

As for other variables included as controls in the model, mother's TVIP (vocabulary) score was significantly associated with all measures of physical health and development as was household size (data not shown). Number of years on the program was not associated with any of the outcomes, nor did its exclusion from the multi-variate model modify the relationship between transfers and outcomes. Indigenous language spoken, a proxy measure for ethnicity, was not significant in the analyses, and neither was father presence, mother's education, father's education, or any other measure of household socio-economic status (e.g. electricity, land, animals or appliances owned). All models had an R^2 of over 20%.

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 and hemoglobin concentration, decreased prevalence of stunting and overweight, and increased performance on one scale of motor development, all cognitive function sub-scales and language development. The findings were significant after adjusting for baseline family structure and socio-economic status, in addition to a wide range of family, household and community covariates. This study is the first of its kind to evaluate the impact of the cash component of a CCT program in a middle-income developing country on such a wide range of child health and development outcomes. The analysis contributes to the growing evidence that CCT programs are positively associated with child well-being. The analysis is unique in that we are able to take advantage of the large range of total cumulative transfers given to families to evaluate the association between the amount of money received by the family and an array of developmental and functional outcomes in children.

Linear growth and stunting

Increased cash transfers were associated with improvements in height-for-age and decreased prevalence of stunting. Participation in the *Oportunidades* program has previously been found to have a positive impact of child growth with approximately 1 cm difference between program participants and non-participants seen at 2 years of age.[13,14,36,37] These previous evaluations reported the short-term impact of *Oportunidades* on child growth and, given that they compare beneficiaries with non-beneficiaries, provide a mean overall estimate of the program's impact. The analysis reported here provides some insight into the potential variation of impact within the beneficiary population and suggests that one of the sources of that variation may 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 impact of the program on child growth and development.

Given that all children in our analysis were on the program for their entire lives and that we controlled for the household's exposure to the program conditionalities by adjusting for the number of years the family had been on the program, it is unlikely that the associations described here are due to differences in exposure to the other health and nutrition components of the program (e.g. access to the fortified food, or prenatal and early childhood health care services) that could have influenced growth or development. It is possible that household size could have changed in response to the program, or that the early intervention and late 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 the *Oportunidades* program did not have any impact 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 two years of life. In a controlled trial in Guatemala, consumption of a food supplement not unlike that distributed by *Oportunidades* was associated with a 3 cm increase in child height at three 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 influence nutrition outcomes) have been conducted 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 previously documented are likely to influence the consumption of the fortified food, including the presence of other children in the household and family socio-economic status. Since the time that the study reported here took place, the *Oportunidades* program has been making major investments to strengthen its health and education requirements.[41]

It is probable that any impact of larger transfers on child growth occurred during the critical period for growth (gestation and the first two years of life) and that the association documented here reflects the lasting benefit of better growth during that period. We have previously documented that the impact of the *Oportunidades* on child growth is greater in younger children.[42] Given previous experience,[43] we expect little impact of *Oportunidades* on child growth after that period.

Overweight, BMI and hemoglobin

There was a positive association between higher cash transfers and lower prevalence of overweight. The mechanism by which money from the *Oportunidades* transfers may influence BMI in children will require further investigation. All families had access to the health and nutrition education and program services, and it is therefore unlikely that this component of the program resulted in greater knowledge and practices related to weight control. Short term findings from the *Oportunidades* program evaluation suggest that families spend an average of 70% of the cash transfer on "better quality" calories, including greater expenditures on meat and fruits and vegetables.[44] It is possible that calories from lower energy dense foods replaced consumption of higher energy dense foods resulting in a lower total intake over the course of the day.

Our findings showing the association between increased cash to the household and improved hemoglobin concentration in the children suggest that the children may have had access to, and consumed, a greater quantity of iron-rich foods. 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. It is possible that larger transfers to the household over the relatively long period of observation here may have resulted in differences in access to resources that promote physical activity, such as 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.

Cognitive, motor and language development

The associations between cash transfers and the cognitive and language development outcomes were small, which is similar to what has been found in studies in the US looking at the impact of income on child development outcomes.[25,45–48] Nonetheless, the relevance of this comparison may be questionable given the non-comparability of the populations and the diverse nature of the interventions. Studies in the developing world aiming to improve cognitive development in very low income populations have focused on nutritional interventions[49] or on early childhood development interventions,[50] and evidence of an association between income change and developmental outcomes in this context is scarce. The findings reported here are also small when 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 in which we have shown highly significant results – short term, or working, memory (a measure of executive function) and language – have been identified through neurologic studies to be the most sensitive to differences in SES.[51,52] Future research should further explore the relationship between SES change in and child development in this context.

Possible mechanisms

The cash component of CCTs could improve growth, health and development outcomes for children living in extreme poverty via two primary pathways.[53] 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 (e.g. refrigerators, improved floor 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.[53,54]

The second primary pathway through which income could influence child development would be by improving the psychological well-being of family members and thereby improving the care, support and nurturance provided to the children in the household.[25,48] Given 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 influenced outcomes. Future research should be designed in such a way as to explore these potential pathways.

Limitations

Our paper evaluates a program at scale operated by a government agency and not a small scale academically-driven intervention. Thus, it was more similar to an effectiveness trial than an efficacy trail and we had to live within the operational constraints of the implementing agency.

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 impact of income on child development.[25,48] Children with more stimulating caregivers and those who live in rich, responsive environments are more cognitively advanced at the start of school than 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.[55]

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 less cash transfers over the entire observation period. However, the original categorization into treatment groups (early versus late incorporation into the program, one of the sources of variation in accumulated transfers) was determined randomly and the groups were well balanced at baseline for a number of socio-economic and demographic variables that may be related to parenting and stimulation (e.g. household size, housing quality, assets).

We used tests to assess cognition and language ability that are ordinarily used in highly standardized laboratory conditions, which is another concern. However, there is no reason to believe that there would have been systematic testing bias towards either the early or late intervention groups, given that interviewers were blind to household assignment. In the analyses reported in this paper, we are exploring the relationship between cash transfers and growth and development deficits. We did not want this objective to be confounded by any differences in the age (and therefore severity of the deficit). It has been well documented that in poor populations with a high prevalence of stunting, Z-scores continue to decrease from birth to 24 mo of age, with a small further drop between 24 and 36 mo of age, and after 36 months, the indicator tends to level off.[56] Therefore the most appropriate approach is first to make the outcome age independent (i.e., Z-score) then adjust for age in the model, which we were able to do for the growth indicators. Thus, a further limitation is that we were not able to take this approach with the cognitive or language development outcomes because this would have required using inappropriately standardized norms (e.g. from populations that are non-comparable with the population tested here).

An additional limitation is that all children came from communities with greater than 10 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 program households adhered to the program requirements, but we do not have actual data on compliance. None of our models exceeded an R^2 of 20%, 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.

Conclusions

Our results suggest that the household cash transfer component of a large-scale, CCT program in Mexico is associated with critically important child health, growth and development outcomes, including height-for-age, hemoglobin concentration, stunting, overweight, several measures of cognitive development, and language development. The findings support the idea that one of the primary mechanisms by which the *Oportunidades* program is achieving its objectives in these domains is through the cash transfer.

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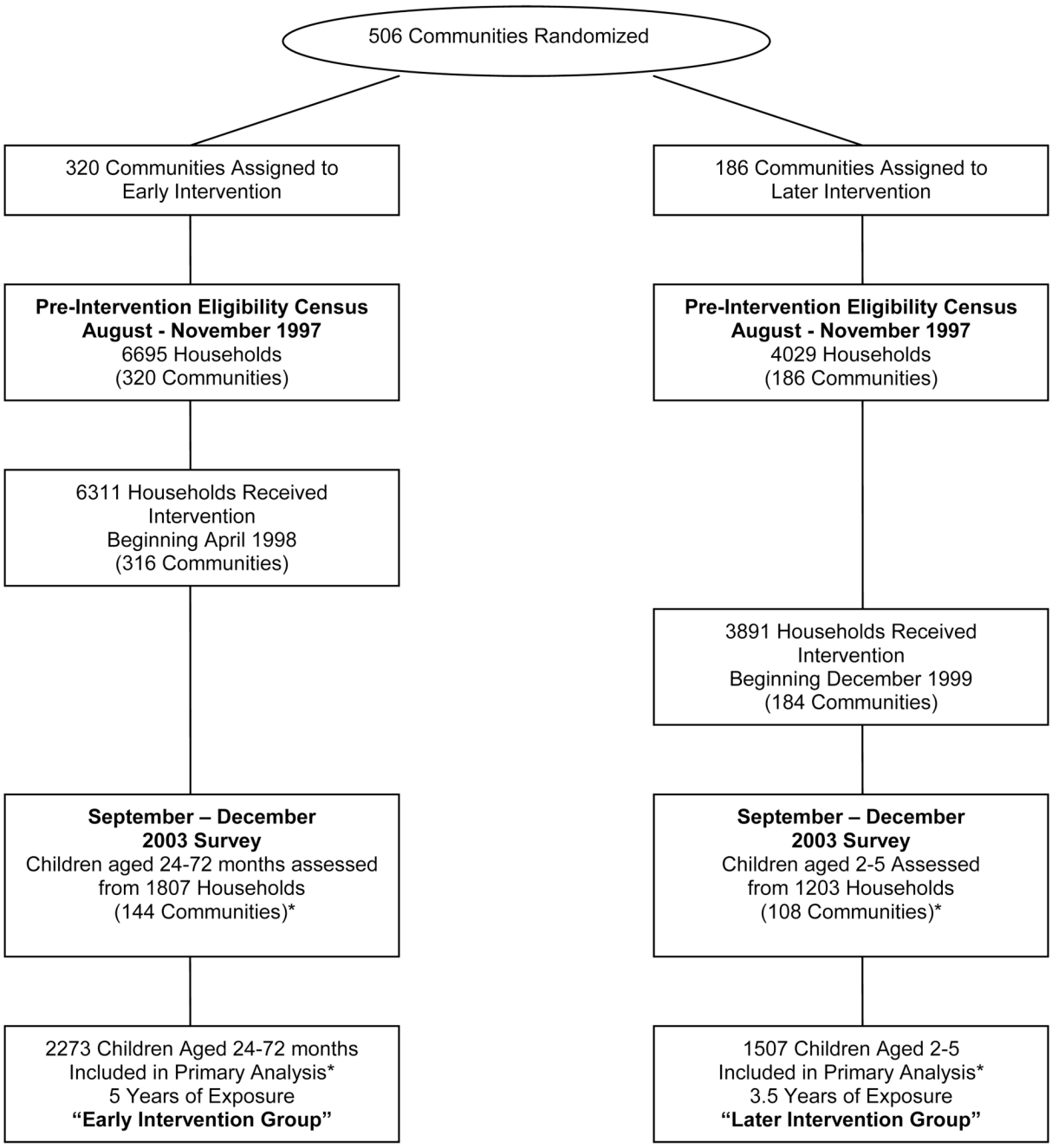

Figure 1.
Study Design
*Communities only included in 2003 survey if included at least 10 children under 5 years old.

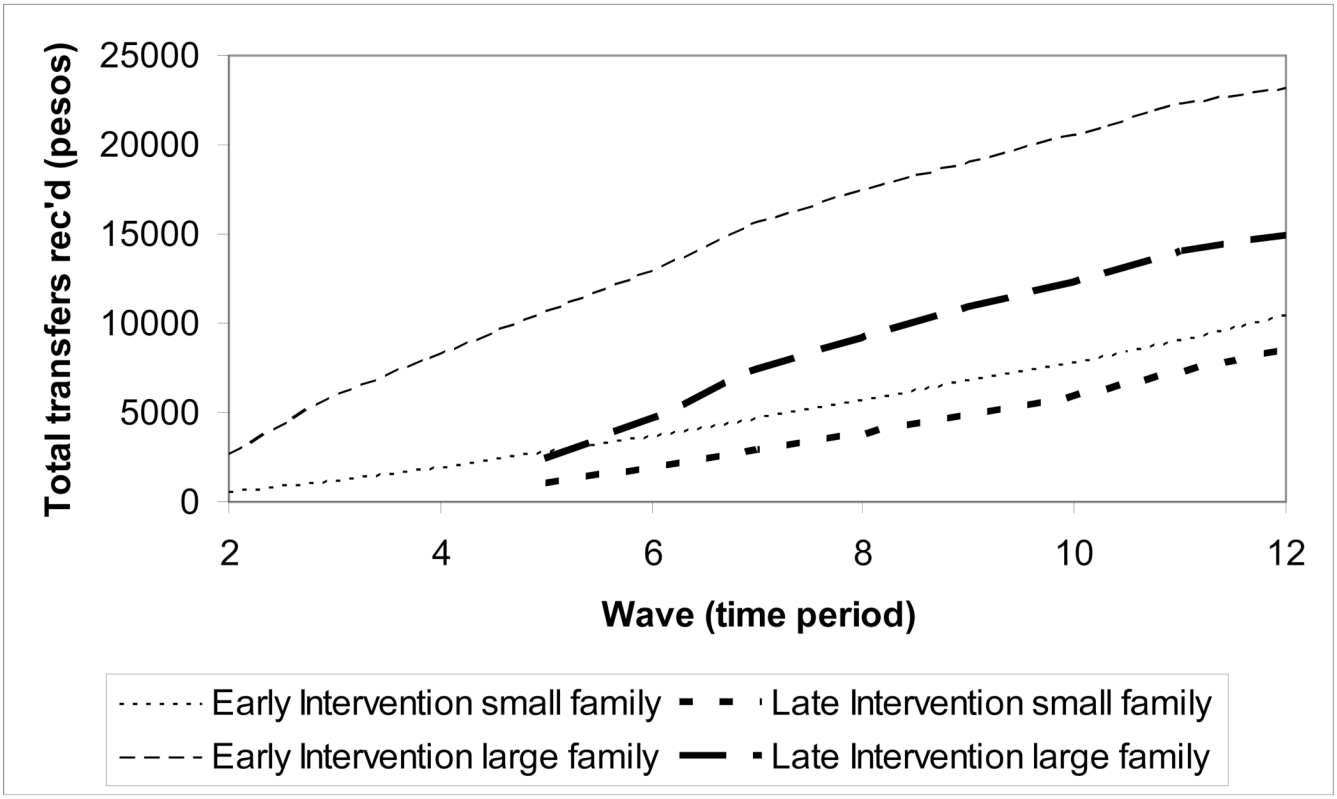

Figure 2.
Scenario specifying projected *Oportunidades* cumulative cash transfers for simulated large and small families.*
* Small family is defined as having only one child who turned 6 years old in 1997, and large family as one in which there are three children, including two boys aged 10 and 12 and one girl aged 8 (as of 1997). The "Early Intervention" group began receiving cash transfers in April of 1998 (Wave 2), and the "Late Intervention" group began receiving transfers in October 1999 (Wave 5). The survey described in this paper took place after Wave 12.

Table 1

Characteristics of Households of Children Included in Analyses*

Characteristics	Mean (SD) or No. (%)
Household size (total # of members)	6.5 (2.3)
Current household composition	
Children, 0–5 yr	1.7 (0.9)
Children, 6–17 yr	2.3 (1.6)
Working age adults, 18–49 yr	2.2 (0.9)
Adults, 50+ yr	0.4 (0.7)
Indigenous ethnicity of head of household	1750 (46.8%)
Father finished primary school	3084 (81.3%)
Mother finished primary school	3099 (81.7%)
Maternal height, cm.	148.4 (5.5)
Maternal vocabulary score (TVIP)	79.6 (18.2)
Land owned at baseline, hectares	1.62 (2.6)
Piped water on family land at baseline	1344 (35.7%)
Own at least one draft animal at baseline	1288 (34.2%)
Own other (small) animals at baseline	2963 (78.7%)
Had electricity in home at baseline	2794 (74.2%)
Asset Index value at baseline‡	0.01 (0.96)

* Baseline data refer to information collected in 1997 or retrospectively about 1997. N between 3755 and 3793.

‡ Composed using principal components analysis (PCA), which is a statistical technique for data transformation from a large collection of possibly correlated variables into a smaller number of variables, or principal components. In general, the first principal component accounts for the largest amount of variability in the data. The PCA generated here was comprised of the following components: baseline (1997) household ownership of blender, refrigerator, gas heater, hot water heater, radio, stereo, television, video washer fan, car, and van. For the analysis reported here, the first principal component was retained and included in the analyses.

Table 2

Characteristics of Children Included in Analyses (N=3793)

Characteristics	Mean (SD) or No. (%)
Age, months	53.9 (16.8)
24–30	398 (10.5%)
31–36	434 (11.4%)
37–48	981 (25.9%)
49–60	988 (26.1%)
61–72	992 (26.2%)
Sex	
Female	1868 (49.2%)
Male	1925 (50.8%)

Table 3

Dependent Variables*

	Mean (SD) or %
Physical growth and health	
Height for age z-score (HAZ)	−1.4 (1.1)
Stunted (HAZ<−2)	28.0%
BMI for age percentile	59.6 (26.8)
Overweight or obese (BMI/age>85%)	20.6%
Hemoglobin (g/dl)	12.0 (1.5)
Sick days in the wk previous to the survey	1.4 (3.1)
Motor development	
Skill	6.6 (2.9)
Endurance	12.9 (7.7)
Cognitive development	
Long term memory (Woodcock-Muñoz subscale) †	2.5 (2.4)
Short term memory (Woodcock-Muñoz subscale) †	3.1 (2.3)
Visual integration (Woodcock-Muñoz subscale) †	2.4 (1.7)
Language development	
Test de Vocabulario en Imagines Peabody †	2.6 (2.4)
Amount of transfers	
Total deflated amount, 1998–2003, pesos †‡ (median and IQR presented due to positive skew)	7604 (4595, 14394)

*Mean (SD) or % presented except where indicated

†Log of raw score displayed and used in analyses.

‡1000 pesos equals approximately $93 US dollars

Table 4

Effect of Doubling Cash Transfers in *Oportunidades* on Developmental outcomes in Children (24–72 y.o.) Six years after Program Inception*

	Cumulative cash transfer β (95% CI)†	*P*
Physical growth and health		
Height for age z-score (HAZ)	**0.16** (0.08, 0.24)	<0.0001
Stunted (HAZ<−2)	−**0.09** (−0.13, −0.04)	<0.0001
BMI for age percentile	−**1.95** (−4.08, 0.17)	0.07
Overweight (BMI/age>85%)	−**0.06** (−0.10, −0.02)	0.001
Hemoglobin (g/dl)	**0.13** (0.01, 0.24)	0.03
Sick days in the wk previous to the survey	−**0.19** (−0.44, 0.06)	0.14
Motor development		
Skill	**0.03** (−0.15, 0.22)	0.70
Endurance	**0.71** (0.63, 1.26)	0.01
Cognitive development		
Long term memory (Woodcock-Muñoz subscale)‡	**0.11** (0.05, 0.17)	<0.0001
Short term memory (Woodcock-Muñoz subscale)‡	**0.10** (0.06, 0.13)	<0.0001
Visual integration (Woodcock-Muñoz subscale)‡	**0.09** (0.05, 0.13)	<0.0001
Language development		
Test de Vocabulario en Imágenes Peabody (TVIP)‡	**0.18** (0.12, 0.25)	<0.0001

*Adjusted unstandardized coefficients were estimated while controlling for individual-level characteristics (age/ sex groupings) and baseline characteristics (from 1997) of households, including household size, demographic structure (e.g. number of children and adults of various age groupings), characteristics of head of household (ethnicity, education), maternal characteristics (education, height, and PPVT score), housing characteristics (whether household had electricity or water), household assets (ownership of animals, land, and other big and small assets), and total length of time household was enrolled in *Oportunidades*. N ranges from 2913 to 3793 due to the fact that cognitive, language and motor outcomes were collected for children 36–72 months, and physical measures were collected for all children 24–72 months.

†Results reported as effect size for each outcome associated with a doubling of cash transfers from the median of 7500 to 15000 (807 to 1613 US dollars) – which represents a move from approximately the 50th to the 75th percentile of total cumulative transfers.

‡Log of raw score used in analyses.

Box 1

Amounts paid to *Oportunidades* beneficiaries by age group in 1997 Mexican pesos

	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 #1, per student	80 pesos, one time gift
Additional first term payment #2, per student	40 pesos, one time gift
Additional second term payment, per student	150 pesos, one time
Food for household	90
Cap (not including additional term payments)	550

100 pesos equals approximately $9.30 US dollars

Box 2

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

Children/adolescents: prenatal care, growth-monitoring, immunizations, management of diarrhea and acute respiratory infections, anti-parasitic treatment	
Under 4 months	3 check-ups: at 7 and 28 days, and at 2 months
From 4 months to 23 months	6 check-ups: at 4, 6, 8, 10, 12 and 18 months
From 2 to 19 years	2 check-ups per year: every 6 months
From 6 to 24 months	Nutritional supplement, as indicated by low weight-for-age
Pregnant and lactating women: pre-natal care, birth attendance, post-partum care.	
Pregnant	5 prenatal check-ups and nutritional supplementation
Postpartum	2 check-ups: at days 7 and 28 postpartum 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 to 49 years of age	2 check-ups per year: every six months
50 years of age or more	1 check-up per year