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# Cash Component of Conditional Cash Transfer Program Is Associated with Higher Body Mass Index and Blood Pressure in Adults[1,2]

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## Abstract

The cash component of *Oportunidades*, a large conditional cash transfer (CCT) program in Mexico, has previously been shown to be associated with better outcomes for child growth and development. The objective of this analysis was to determine whether the cash transfers were also associated with positive outcomes for adult health. *Oportunidades* was originally randomized across 506 rural (<2500 inhabitants) communities assigned to immediate incorporation into the program in 1997 or incorporation 18 mo later. Adults ($n = 1649$ early, $n = 2039$ late intervention) aged 18–65 y were then assessed in 2003. All of the households included in the analysis reported here complied with *Oportunidades's* requirements for the entire period, but some received higher cumulative cash transfers because they were living in communities randomized to begin receiving transfers earlier and/or they accumulated cash at a faster rate because they had more school-aged children at baseline. Our primary findings were that a doubling of cumulative cash transfers to the household was associated with higher BMI ($\beta = +0.83$, 95% CI 0.46, 1.20; $P < 0.0001$), higher diastolic blood pressure ($\beta = +1.19$, 95% CI 0.09, 2.29; $P = 0.03$), and higher prevalence of overweight [odds ratio (OR) = 1.41, 95% CI 1.18, 1.67; $P < 0.0001$), grade I obesity (OR = 1.41, 95% CI 1.14, 1.75; $P = 0.002$), and grade II obesity (OR = 1.57, 95% CI 1.05, 2.36; $P = 0.03$), while controlling for a wide range of covariates, including household composition at baseline. *Oportunidades* has been portrayed as a model for CCT programs worldwide, but the results reported here support the notion that the cash component of *Oportunidades* may be negatively associated with some adult health outcomes. J. Nutr. 138: 2250–2257, 2008.

## Introduction

The most recent National Nutrition and Health Survey (NNHS)[6] in Mexico, conducted in 2006, reported a combined prevalence of overweight and obesity of 66.7% in adult men and 71.9% in women (1) and these prevalence rates reflect similar trends throughout Latin America and the developing world (2–5). In addition, the results of the NNHS showed that 83.6% of women and 63.8% of men had a waist circumference larger than recommended. The NNHS results confirmed previous findings showing a high prevalence of diabetes (6), hypertension (7), and dyslipidemia (8) in Mexico, as well as the presence of other risk factors for cardiovascular disease, including high rates of tobacco use (9). A great challenge in a country undergoing nutrition transition, such as Mexico, is that it faces the simultaneous burden of undernutrition and obesity (10–12). In a context such as this, many resources relating to public health nutrition are still being used for the prevention of undernutrition and anemia rather than for addressing obesity or hypertension (13).

Mexico's *Oportunidades* program (previously *Progresa*), a conditional cash transfer (CCT) program, was initiated in 1997 to reduce poverty in both the immediate term and the longer term (14,15); the initial goal of *Oportunidades* was to improve outcomes for children and the program has achieved that objective (16). We have previously shown that adults who participated in *Oportunidades* for 3.5–5 y had a lower prevalence of obesity and hypertension compared with those who had not been exposed to the program (17). However, it is not clear how the various components of *Oportunidades*, i.e. the cash transfer or the "conditionalities" (health-promoting behaviors) that participants must comply with to obtain the cash, are independently associated with adult health outcomes. Although there are potential benefits of the conditionalities in *Oportunidades* for health outcomes, the potential role of cash transfers in adult health has been debated (18,19).

There are many reasons to hypothesize that the cash received as part of the *Oportunidades* program, by acting as an incentive or by simply increasing resources to the family, could positively influence adult health. First, families only receive the cash if they

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[6] Abbreviations used: CCT, conditional cash transfer; DBP, diastolic blood pressure; IV, instrumental variable; NNHS, National Nutrition and Health Survey; OLS, ordinary least squares; OR, odds ratio; SBP, systolic blood pressure.
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comply with *Oportunidades* requirements, which are that adults have annual appointments at health clinics for check-ups and attend nutrition and hygiene seminars. These requirements by definition increase exposure of adults to health clinics and health care professionals, which could give them more knowledge about the importance of nutrition, physical activities, and prevention of chronic diseases. In addition, the nutrition and hygiene seminars could give adults direct education and guidance on nutrition and healthy behaviors. Second, the increased income provided by *Oportunidades* could allow households to purchase a greater diversity of foods, which is an association that has been seen with income in Korea (20). Increasing income could allow for the purchase of higher quality items such as meat, milk, eggs, vegetables, and fruits, which could contribute to improved health outcomes in adults (21). Analyses conducted after *Oportunidades* had been in operation only a few years suggest that beneficiary families were indeed purchasing a greater quantity of fruits, vegetables, and animal products than were comparison families (22,23).

However, the countervailing possibility is that the cash supplements could be associated with negative outcomes. First, cash acts as an incentive for households to consume the nutritional supplements provided as part of the *Oportunidades* conditionalities. These high-energy supplements are targeted for undernourished children but are delivered to the household and could potentially be redistributed to other family members. Some have speculated that supplementary feeding programs have the risk of exacerbating obesity in the context of nutritional transition (24–26), although there is no evidence to suggest that this redistribution is occurring in *Oportunidades*. Second, there is the possibility that increased income allows households to purchase a greater quantity of high-fat and energy-dense foods; this pattern has been shown in longitudinal analyses of income and dietary consumption data in China (27,28). In low-income adults in Mexico, higher socioeconomic status has been associated with increased overweight and obesity, an association partially mediated by alcohol and carbonated beverage consumption (29), which are factors that could themselves exacerbate problems of obesity or chronic disease (30,31). The analysis conducted after *Oportunidades* had been in operation only a few years also found that beneficiary families consumed a greater amount of energy than nonbeneficiary families and this change alone could be associated with weight gain (22,23). Similar analyses of the CCT program in Colombia showed higher energy consumption in CCT households compared with families not receiving benefits (32,33).

The goal of this article was to examine the impact of transferring larger amounts of cash to households within *Oportunidades* while holding other aspects of the program constant. We took 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 explored the association between cash transfers accumulated over the course of the program and adult health outcomes. All of the households included in the analysis had complied with *Oportunidades's* requirements (i.e. were never removed from the program for noncompliance), but some had received higher cash transfers because they were living in communities randomized to begin receiving transfers earlier and/or they accumulated cash at a faster rate because they had more school-aged children at baseline. Our analysis was analogous to a dose-response analysis rather than a treatment-control comparison; a similar approach was used to examine the cash component of *Oportunidades* and its association with child development outcomes (34). The findings reported here could provide critical guidance relating to CCT program design for countries, such as Mexico, India, China, South Africa, and Brazil, undergoing rapid epidemiologic and nutrition transition.

## Methods

*Intervention.* The design of *Oportunidades* has been described in detail elsewhere (35–38). Program benefits were distributed only if children, pregnant women, lactating women, and other family members complied with a wide array of requirements for preventive health care, nutritional supplementation, and educational enrollment, which have also been described previously (34). In short, the cash transfer benefit from *Oportunidades* is available in 2 forms: a fixed monthly stipend conditional on family members obtaining preventive medical care and an educational scholarship that is given to families of children starting in the 3rd grade 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 per year. There is an upper limit in the total transfer received per household, equivalent to having 3 children in early primary school. Receiving the cash payments is contingent on adults attending biannual health check-ups and participating in regular educational sessions at which health, hygiene, nutrition issues, and best practices are discussed. There are a variety of other program requirements pertaining to health and nutrition for infants and young children. According to *Oportunidades* administrative records, $<1\%$ of the population was denied cash transfers due to lack of compliance. This level of compliance was maintained via a modern and efficient information system that permits rapid follow-up of individual beneficiaries who are noncompliant. With the multiple controls in place through these systems, any fraud on the part of providers (e.g. falsified attendance cards) is easily detected and participants are expelled from the program if they are noncompliant. That said, there is no way in this type of large program evaluation to guarantee that the quality of these control mechanisms was similar across communities.

*Experimental design.* Our analysis takes advantage of the randomized evaluation and stepped wedge design initially implemented by the Mexican government to conduct a rigorous impact evaluation of *Oportunidades*. In 1997 the government randomly chose 320 treatment and 186 control communities in 7 states for a total of 506 experimental communities (**Fig. 1**) (36). Random assignment was generated without weighting using randomization commands in STATA, giving each community an equal chance of being included. None of the sites were told they would be participating in the study and information regarding timing of roll-out was not made public. A preintervention eligibility census was conducted in 1997 and included only a minimal assessment of household socioeconomic status; no anthropometric or biological data were collected at baseline. Eligible households in early intervention communities began receiving benefits in April 1998; eligible households in the late intervention communities were not incorporated until 18 mo later (November 1999).

For the assessment of households in 2003, only those with at least 1 child aged 0–5 y were selected from the larger communities (defined as having $\geq$10 children in this age range). From these households, at least 1 woman $>$18 y old (usually the child's mother or primary guardian) was assessed, in addition to any other adult home at the time of the visit and $>$30 y old. Approximately 93% of the households identified to be assessed during the census were located, and of these, 99% took part in the survey described here.

*Data collection and measures.* All assessments occurred in the participant's home. Height, weight, and blood pressure were obtained in duplicate using standard techniques by survey personnel (39), the majority of whom were trained nurses. If the 2 measurements were $>5\%$ apart for any outcome, survey personnel obtained a 3rd measure and used the 2 closest measurements. The interviewers were not privy to information regarding community assignment to early or late intervention.

Primary outcome measures were BMI (defined as weight in kg divided by the square of height in m), overweight ($25 \leq$ BMI), obesity grade I ($30 \leq$ BMI), obesity grade II ($35 \leq$ BMI) (40), diastolic blood

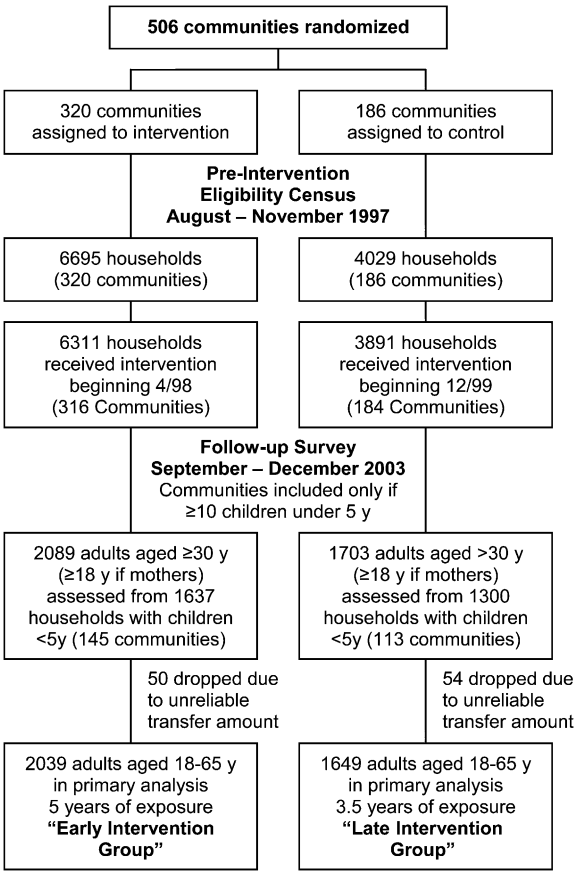


**FIGURE 1** Flow chart of study participation.

pressure (DBP), systolic blood pressure (SBP), and current uncontrolled hypertension (DBP ≥ 90 mm Hg or SBP ≥ 140 mm Hg) (41). Self-reported distance that a person could walk without tiring was included as an outcome measure as a proxy measure for self-reported health.

Questionnaires were administered by trained survey personnel to obtain information about a wide range of individual- and household-level characteristics and many of the questions were adapted from modules of the Demographic and Health Surveys (42). The questionnaires were developed through an extensive process of piloting, focus groups, and cognitive testing, with an emphasis on testing the effectiveness of questions within the context of poverty and low literacy. The following issues were addressed in the questionnaires: demographic characteristics, educational attainment, assets (large and small household assets, and vehicles), household construction (presence of dirt floor, electricity, or bathroom), land and animals owned, household composition (age and sex of all household members), marital status (married/cohabitating or unmarried/living alone), and indigenous ethnicity (whether an indigenous language is spoken by the head of household). All survey instruments are publicly available (43).

To obtain information at the household level regarding cash transfers to each household, we merged the 2003 survey data with administrative records from *Oportunidades* that recorded the amount of money actually transferred to households. To control for baseline conditions in our statistical models, we also merged information from the original census conducted in 1997. This early census contained information about household demographic structure as well as socioeconomic status but did not contain any anthropometric measures.

*Ethical review.* The *Oportunidades* evaluation was approved by the ethics committees at the National Institute of Public Health in Mexico and the University of California, Berkeley. Participants were invited to participate in the evaluation after receiving a detailed explanation of the survey procedures and were asked to sign an informed consent declaration at that time.

*Statistical analyses.* We compared the baseline characteristics (e.g. household size, household assets) of the early incorporated sample with the later incorporated sample using the Wald test, with communities set as the primary sampling units.

Next, the impact analysis was conducted with the primary aim to test whether receiving more money (higher cumulative transfers) in the *Oportunidades* program was associated with differences in adult obesity, hypertension, and self-reported physical activity. The analysis did not test for impact of the program among beneficiaries compared with nonbeneficiaries but rather whether there was an association between greater amounts of cash received and adult health outcomes; this analytical framework is analogous to a dose-response analysis. The key outcome variables were: BMI, SBP, DBP, ability to walk without tiring, probability overweight or obese, and probability hypertensive. All analyses were conducted using random effects models in STATA v.9.2, and standard errors were adjusted for inter-cluster correlation.

Using ordinary least squares (OLS) linear and logistic regression, we estimated the separate effect of cumulative cash transfers on adult health outcome measures while controlling for a wide range of covariates, including a variable representing time entering the program. The variation in cumulative cash transfers came from the interaction of the randomized phasing-in of the program (early vs. late) and the variation in baseline demographic structure of the household. For example, over the course of the *Oportunidades* program participation described in this article, a family with 3 children that was part of the early intervention would have received the most cumulative amount of cash, whereas a family with only 1 child that was part of the late intervention would have received the least.

Cumulative transfers are determined by multiplying the amount paid per period times the number of periods enrolled in the program; the amount paid per period is a linear function of household demographics, but cumulative transfers are the product of time enrolled in the program and transfers received per period, which is determined by demographics. It should be noted that the amount of transfers correlates with household size but does not depend on household size. The largest part of transfers comes from *becas* (educational funds), which depend on number of and age and sex of the children in school. Thus, the amount of transfers is not a linear function of the household size.

Our estimation models controlled for baseline household demographic characteristics, i.e. gender, number, and age of children and whether they were enrolled in school. Thus, by controlling for household participants at baseline, the analyses controlled for the possibility that program participation could have provided an incentive to change behavior. We also controlled for current demographic structure (number and ages of all household members), characteristics of head of household (ethnicity, education), baseline housing characteristics (whether household had a dirt floor, bathroom, or electricity), and baseline household assets (ownership of animals, land, and other large and small assets). Because 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. No missing values were replaced for the outcome variables included in the analyses.

After conducting the standard OLS regressions to examine the association between cash transfers and adult health, we replicated the analyses using an instrumental variable approach for the following reason. Actual transfers to each household depend on the age and sex of the children in the household and the household's compliance with the requirements of the program. Thus, compliance is likely to be an endogenous variable, correlated with some behaviors of the households, which could also potentially influence the outcome variables. For example, transfers to the household increase if more school-aged children go to school, but this means that those children would be going to school rather than working to generate household income. Thus, there is potentially a direct effect of the household cash transfers on program compliance and, thus, an issue of reverse causality emerges.

To overcome the endogeneity of the actual transfers, we used administrative data to calculate potential cumulative transfers and used this as an instrumental variable (IV) for actual transfers based on the baseline demographic information of the households. IV methods have been used for several decades in econometrics (44,45) and have more

recently been adopted by public health researchers and epidemiologists (46–51).

The requirements for using an IV approach are as follows: if U is the set of all variables that affect X (actual cash transfers received) and Y (adult health outcomes), then Z (the IV: potential cumulative cash transfers) must be: *1*) independent of U; *2*) associated with X; and *3*) independent of Y given X and U; potential cash transfers fulfill all necessary criteria (47). Using an IV analysis can be considered to be observationally equivalent to the "intention to treat" analysis in a randomized controlled trial, because it assumes the absence of alternative pathways and effect modification (52). If X is used to estimate treatment received [this could be micronutrient supplementation, for instance (47)] whether or not a person receives treatment would be affected, but not fully determined, by Z, "treatment assignment." In this case, the IV analysis allows for a way to control for confounding. IV analyses have also been used in cases where exogenous factors such as climate change (49), topography (53), distance to a hospital (46), or Medicaid eligibility criteria (50) were used as instruments for other variables that were endogenous to the outcome.

Our results from the IV analysis showed no major differences from the standard OLS approach. Thus, to simplify the presentation of results, we present only the OLS findings. Effect sizes in the tables are presented as the change in outcome associated with a doubling of cash transfer from approximately the median to the 75% percentile. Coefficients are also presented representing the effect of program participation for an extra 18 mo (i.e. the difference between early and late program enrollment, which was randomly determined).

## Results

Adults from the early and late treatment groups were well matched according to a wide range of individual and household variables (**Table 1**), which is consistent with early reports of the success of the randomization of the program (38). The only significant difference between the groups was the cumulative amount of cash the household had received.

The mean BMI was >25, the standard cut-off to define overweight (**Table 2**), and about one-third of the adults had current, uncontrolled hypertension. Despite these findings, self-reported fitness was moderately high, with a mean of 4 km that adults reported being able to walk without tiring.

Doubling the cumulative cash transfer to the household was associated with higher BMI ($\beta = +0.83$, 95% CI 0.46, 1.20; $P < 0.0001$) and higher DBP ($\beta = +1.19$, 95% CI 0.09, 2.29; $P = 0.03$) for males and females (**Table 3**). There were no significant associations between cash transfer and SBP or self-reported ability to walk without tiring. Greater receipt of cash was also associated with higher prevalence of overweight [odds ratio (OR) = 1.41, 95% CI 1.18, 1.67; $P < 0.0001$], grade I obesity (OR = 1.41, 95% CI 1.14, 1.75; $P = 0.002$), and grade II obesity (OR = 1.57, 95% CI 1.05, 2.36; $P = 0.03$) in sexes combined (**Table 4**). In women, receipt of larger cash transfers was also associated with higher prevalence of current hypertension (OR = 1.28, 95% CI 1.00, 1.66; $P = 0.05$).

In contrast, an additional 18 mo of *Oportunidades* program participation was associated with a greater ability to walk without tiring ($\beta = +0.41$, 95% CI 0.07, 0.74; $P = 0.02$) and, in women, a decreased prevalence of current hypertension (OR = 0.69, 95% CI 0.53, 0.90; $P = 0.002$). There was also a nonsignificant trend for increased program participation to be associated with lower prevalence of grade II obesity (OR = 0.70, 95% CI 0.48, 1.02; $P = 0.06$) and current hypertension (OR = 0.82, 95% CI 0.66, 1.03; $P = 0.08$). In women, there was a nonsignificant trend for increased program participation to be associated with lower BMI ($\beta = -0.46$, 95% CI −0.93, 0.02; $P = 0.06$).

**TABLE 1** Baseline characteristics of adults randomized to early and late enrollment in *Oportunidades*, a CCT intervention[1,2]

| | Timing of intervention | | |
|---|---|---|---|
| Characteristic | Early, $n = 2039$ | Late, $n = 1649$ | $P$[3] |
| Age, *y* | 38.9 ± 9.4 | 38.7 ± 9.5 | 0.81 |
| Age range, *n (%)* | | | |
| 18–30 *y* | 325 (15.9) | 260 (15.8) | 0.90 |
| 30–40 *y* | 837 (41.1) | 677 (41.1) | 0.99 |
| 40–50 *y* | 592 (29.0) | 481 (29.2) | 0.94 |
| 50–60 *y* | 233 (11.4) | 191 (11.6) | 0.90 |
| 60–65 *y* | 52 (2.6) | 40 (2.4) | 0.82 |
| Sex, *n (%)* | | | |
| Female | 1500 (70.8) | 1167 (73.6) | 0.34 |
| Male | 619 (29.2) | 419 (26.4) | 0.51 |
| Education, *n (%)* | | | |
| No formal education | 417 (20.9) | 306 (19.2) | 0.56 |
| Some primary school | 1425 (71.3) | 1151 (72.3) | 0.98 |
| Secondary or above | 156 (7.8) | 136 (8.5) | 0.70 |
| Married, *n (%)* | 1902 (93.3) | 1560 (94.6) | 0.15 |
| Household size, *n* | | | |
| Total | 6.4 ± 2.2 | 6.4 ± 2.2 | 0.71 |
| Children, 0–5 *y* | 1.4 ± 0.04 | 1.4 ± 0.04 | 0.95 |
| Children, 6–15 *y* | 2.3 ± 0.06 | 2.3 ± 0.05 | 0.31 |
| Young adults, 16–22 *y* | 0.6 ± 0.02 | 0.6 ± 0.03 | 0.73 |
| Adults, 23–65 *y* | 2.0 ± 0.02 | 2.0 ± 0.04 | 0.76 |
| Older adults, > 65 *y* | 0.1 ± 0.01 | 0.1 ± 0.01 | 0.59 |
| Indigenous head of household, *n (%)* | 973 (48.8) | 742 (45.9) | 0.72 |
| Education of head of household, *y* | 3.4 ± 2.7 | 3.4 ± 2.8 | 0.77 |
| Education of spouse, *y* | 3.3 ± 2.6 | 3.2 ± 2.6 | 0.74 |
| Land owned, *hectares* | 1.7 ± 2.6 | 1.9 ± 3.1 | 0.51 |
| Own at least 1 draft animal, *n (%)* | 757 (37.1) | 581 (35.2) | 0.60 |
| Own other animals, *n (%)* | 1664 (81.6) | 1360 (82.5) | 0.74 |
| Nonworkers in household, *n* | 3.1 ± 1.7 | 3.0 ± 1.7 | 0.37 |
| Workers in household, *n* | 1.5 ± 1.0 | 1.5 ± 1.0 | 0.26 |
| People in household with disability, *n* | 0.04 (0.20) | 0.03 (0.18) | 0.35 |
| Having dirt floor in home, *n (%)* | 1484 (72.8) | 1242 (75.6) | 0.48 |
| Having bathroom in home, *n (%)* | 1107 (54.4) | 971 (58.9) | 0.35 |
| Having electricity in home, *n (%)* | 1402 (68.8) | 1187 (72.0) | 0.56 |
| Large assets, *n*[4] | 0.7 ± 0.8 | 0.6 ± 0.8 | 0.31 |
| Small assets, *n*[5] | 1.0 ± 0.8 | 0.8 ± 0.8 | 0.10 |
| Vehicles, *n* | 0.02 ± 0.15 | 0.02 ± 0.16 | 0.79 |
| Total amount of cash transferred in *Oportunidades* program, pesos[6] | 16,411 ± 8210 | 13,145 ± 6759 | <0.001 |

[1] Values are means ± SD or *n* (%).
[2] Data refer to baseline information collected in 1997 or retrospectively about 1997.
[3] Wald test was performed with communities set as primary sampling units.
[4] Large assets include TV, washer, gas heater, and refrigerator.
[5] Small assets include blender, boiler, radio, stereo, video, and fan.
[6] 1000 pesos equals approximately $93 US.

## Discussion

We have shown here with a randomized design that the cash transfer component of the large-scale, Mexican CCT program, *Oportunidades*, was associated with higher BMI, overweight, obesity, and current hypertension in participants, whereas greater exposure to the program conditionalities (e.g. preventative health check-ups and health seminar attendance) was associated with better adult health outcomes. The analysis reported here is among the first to attempt to disentangle the

**TABLE 2** Health outcomes of adults enrolled for at least 3.5 years in *Oportunidades*, a CCT intervention, at follow-up[1]

| | $n = 3263$[2] |
|---|---|
| BMI, *kg/m²* | 25.9 ± 4.5 |
| Weight status, *%* | |
| Overweight[3] | 53.9 |
| Obesity grade I[4] | 17.5 |
| Obesity grade II[5] | 4.5 |
| SBP, *mm Hg* | 121.7 ± 16.0 |
| DBP, *mm Hg* | 81.0 ± 13.1 |
| Uncontrolled hypertension,[6] *%* | 32.5 |
| Self-reported distance can walk without tiring, *km* | 4.4 ± 4.3 |

[1] Values are means ± SD or %.
[2] Sample sizes are smaller for diastolic and systolic pressure data and prevalence of hypertension due to missing data.
[3] Overweight: BMI ≥ 25 kg/m².
[4] Obesity grade I: BMI ≥ 30 kg/m².
[5] Obesity grade II: BMI ≥35 kg/m².
[6] Uncontrolled hypertension: DBP > 90 mm Hg or SBP > 140 mm Hg.

effect of increasing income from the effect of required behavioral change in a CCT program on critical health outcomes in adults.

There are many possible explanations for why higher cash influx into a household could be associated with increased BMI, prevalence of overweight, obesity, and current hypertension in adults. Access to increased economic resources may allow people to purchase and consume more high energy beverages or snack foods, which could then contribute to weight gain; similarly, increased income could also allow adults to purchase cigarettes, which could then contribute to hypertension. Throughout the developing world, intakes of cereals, fruits, and vegetables are decreasing simultaneously with increasing intakes of fat, animal products, and sugar (27,54,55). In Mexico, traditional diets are being replaced by diets including more fat and simple carbohydrates, even in very isolated populations (56,57). National trends in Mexico suggest that the increased prevalence of overweight and obesity from 1992 to 2000 could be explained by the increased availability of energy during this time (58). Between 1992 and 2000 in Mexico, energy intake per capita per day consumed from carbonated soft drinks increased by 50% and was not as sensitive to increasing prices as other commodities were, suggesting that people have a high willingness to pay for carbonated sugar beverages despite rising prices. Consumption of sugar beverages and alcohol in this population has been implicated as a possible variable mediating the association between increased socioeconomic status and higher BMI in adults (29).

An analysis of the short-term impact of *Oportunidades* on household economic status concluded that households receiving benefits from the beginning of the program obtained 7.1% more total daily energy than those households enrolled 18 mo later; these findings suggest the participating families were using a substantial portion of the cash transfer to purchase more food rather than other goods or services (22,23). An even greater difference was found when comparing Colombian recipients of a CCT program with nonrecipients; however, the differences in consumption were primarily focused on goods for children (32). Although we are not able to comment on the role of dietary quality or diversity given the lack of data relating to this issue, we suspect that the increased consumption of low-quality energy and high-fat foods consumed in greater quantities by adult program participants with access to greater economic resources could have contributed negatively to adult health in our sample; future research should address this critical area.

The cash transfer component of *Oportunidades* has previously been shown to be associated with small but significant improvements across several domains of child development, including reduced childhood overweight (34). Given the increase of caloric availability at the household level, it is unclear why cash coming into the household would be associated with lower BMI-for-age in children when it is associated with higher BMI in adults. The short-term impact study mentioned above from the *Oportunidades* program evaluation showed that families were spending ~70% of the cash transfer on "better quality" energy sources, including greater expenditures on meat, fruits, and vegetables (22,23). Thus, it is possible that adults purchased and provided foods with greater nutrient density for their children while consuming foods of lower nutrient density for themselves. Or it is possible that the cyclical nature of the increased

**TABLE 3** Impact of cumulative cash transfers and length of enrollment in *Oportunidades* on BMI, blood pressure, and self-reported health in adults (18–65 y) 5.5 y after program inception[1]

| | Estimated impact of cumulative cash transfers[2] | | | Estimated impact of 18 mo more exposure to program | | |
|---|---|---|---|---|---|---|
| | $\beta$ | 95% CI | *P* | $\beta$ | 95% CI | *P* |
| Men and women, $n = 3623$ | | | | | | |
| BMI, *kg/m²* | 0.83 | 0.46, 1.20 | <0.0001 | −0.34 | −0.78, 0.10 | 0.10 |
| SBP, *mm Hg* | 0.25 | −1.02, 1.52 | 0.25 | −0.91 | −2.44, 0.62 | 0.24 |
| DBP, *mm Hg* | 1.19 | 0.09, 2.29 | 0.03 | −0.94 | −2.51, 0.63 | 0.24 |
| Ability to walk, *km* | −0.28 | −0.63, 0.08 | 0.12 | 0.41 | 0.07, 0.74 | 0.02 |
| Women only, $n = 2639$ | | | | | | |
| BMI, *kg/m²* | 0.89 | 0.45, 1.34 | <0.0001 | −0.46 | −0.93, 0.02 | 0.06 |
| SBP, *mm Hg* | 1.16 | −0.35, 2.67 | 0.13 | −1.10 | −2.61, 0.41 | 0.15 |
| DBP, *mm Hg* | 1.60 | 0.27, 2.92 | 0.02 | −1.50 | −3.14, 0.13 | 0.07 |
| Ability to walk, *km* | 0.09 | −0.39, 0.21 | 0.54 | 0.37 | 0.02, 0.72 | 0.04 |

[1] Adjusted coefficients were estimated while controlling for individual-level characteristics (age, sex, education, and marital status) and baseline characteristics (from 1997) of households, including household demographic structure (number and ages of all household members), characteristics of head of household (ethnicity and education), housing characteristics (whether household had a dirt floor, bathroom, or electricity), and household assets (ownership of animals, land, and other large and small assets). Robust standard errors are reported.
[2] Effect reported as change in log-transformed cumulative transfers. Coefficients can be interpreted as the change in the outcome associated with a doubling of cash transfers to the household.

**TABLE 4** Impact of cumulative cash transfers and length of enrollment in *Oportunidades* on overweight, obesity, and hypertension in adults (18–65 y) 5.5 y after program inception[1]

| | Estimated impact of cumulative cash transfer[2] | | | Estimated impact of 18 mo more exposure to program | | |
|---|---|---|---|---|---|---|
| | OR | 95% CI | *P* | OR | 95% CI | *P* |
| Men and women, $n = 3623$ | | | | | | |
| Overweight[3] | 1.41 | 1.18, 1.67 | <0.0001 | 0.93 | 0.76, 1.13 | 0.45 |
| Obesity grade I[4] | 1.41 | 1.14, 1.75 | 0.002 | 0.84 | 0.67, 1.06 | 0.14 |
| Obesity grade II[5] | 1.57 | 1.05, 2.36 | 0.03 | 0.70 | 0.48, 1.02 | 0.06 |
| Current hypertension[6] | 1.17 | 0.96, 1.43 | 0.13 | 0.82 | 0.66, 1.03 | 0.08 |
| Women only, $n = 2639$ | | | | | | |
| Overweight[3] | 1.40 | 1.13, 1.73 | 0.002 | 0.90 | 0.72, 1.13 | 0.38 |
| Obesity grade I[4] | 1.34 | 1.07, 1.68 | 0.01 | 0.81 | 0.64, 1.03 | 0.08 |
| Obesity grade II[5] | 1.36 | 0.90, 2.05 | 0.14 | 0.73 | 0.50, 1.06 | 0.10 |
| Current hypertension[6] | 1.28 | 1.00, 1.66 | 0.05 | 0.69 | 0.53, 0.90 | 0.002 |

[1] Adjusted coefficients were estimated while controlling for individual-level characteristics (age, sex, education, and marital status) and baseline characteristics (from 1997) of households, including household demographic structure (number and ages of all household members), characteristics of head of household (ethnicity and education), housing characteristics (whether household had a dirt floor, bathroom, or electricity), and household assets (ownership of animals, land, and other large and small assets). Robust standard errors are reported.

[2] Effect reported as change in log-transformed cumulative transfers. Coefficients can be interpreted as the change in the outcome associated with a doubling of cash transfers to the household.

[3] Overweight: BMI $\geq$ 25 kg/m$^2$.

[4] Obesity grade I: BMI $\geq$ 30 kg/m$^2$.

[5] Obesity grade II: BMI $\geq$ 35 kg/m$^2$.

[6] Prevalence of uncontrolled hypertension is defined as DBP > 90 mm Hg or SBP > 140 mm Hg.

resources has a different effect on the physiology of children compared with adults. In the United States, for example, Food Stamp Program participation has been shown to increase the likelihood of obesity in adult women (59) but no consistent associations have been shown in children (60). Unfortunately, we have no data that would allow us to comment on the intrahousehold distribution of energy or on the individual response to the cyclic nature of the infusion of *Oportunidades* cash transfers into the home.

A different analysis of the association of adult health outcomes and overall *Oportunidades* program participation for 3.5–5 y included a newly recruited "pure" comparison group that had never been enrolled (17). Those findings showed that overall program participation was consistently associated with small but significant benefits for several aspects of adult health. The results reported here suggest that 18 additional months of adherence to *Oportunidades* conditionalities was associated with significantly lower current hypertension in women. Self-reported ability to walk without tiring was also significantly higher with an additional 18 mo on the program, suggesting that one mechanism by which hypertension may have been affected was through physical fitness (61). This proposed mechanism is supported by a recent review of pedometer interventions, which showed that greater pedometer use, and consequently increased physical fitness, was associated with decreased SBP (62). It is also possible that the mandated visits to the doctor and/or mandated attendance at the education sessions could have been mechanisms by which hypertension was reduced through increased education. Dietary intake and smoking habits, other pathways by which hypertension could have been affected, were not recorded in detail and thus we are unable to comment on their potential role. Other interventions targeting hypertension with a greater frequency of home health visits (63) or more intensive nutrition counseling (64) have shown greater reductions in hypertension than we have shown here.

The coefficients estimating the effect of an additional 18 mo on the program on overweight and obesity were not significant, suggesting that preventive health care for an additional year and a half was not sufficient to be associated with more clinically meaningful change. Mandated visits to the doctor are likely to be important in the long term for providing feedback about current health status and access to information about the risks of chronic diseases, and health education sessions are likely to be important for conveying information to adults regarding preventative health.

Several limitations are evident in the study described here. Sampling occurred as part of a large survey, so there were not extensive questions about diet, fitness, or smoking, which could have shed some light on the mechanisms at work. In follow-up studies, we recommend that more detailed individual-level data are collected relating to dietary intake and physical activity, including daily diaries of energy consumption and expenditure; these data could also provide insight into explanations for why findings for adults differ from those of children. In addition, collecting detailed behavior about smoking could be critical for understanding the connections between changes in socioeconomic status and blood pressure in adults.

Due to the rural field conditions in which the survey occurred, it was not possible to obtain more sensitive outcome measures, such as a fasting blood glucose test for diabetes. Future surveys in this population will obtain more detailed analyses particularly focusing on the components of metabolic syndrome, which is characterized by the appearance of metabolic risk factors such as abdominal obesity, atherogenic dyslipidemia, blood pressure, insulin resistance or glucose intolerance, and prothrombotic state or proinflammatory state. Another limitation of the analysis is that the findings may be limited in generalizability because sampling occurred during the day when more women than men were likely to be home and thus men were under-sampled. The adults in this survey were all in households with at least 1 child <5 y old and thus may not be representative of the childless adult population or of parents of older children in Mexico.

We have preintervention information for a large set of demographic and socioeconomic variables but not for any health outcomes; thus, another limitation is that we do not have identical pre- and postintervention data for the sample. However, the sample was randomly assigned to treatment status at

baseline and very well matched in terms of all data available from baseline. Thus, there is no reason to believe that the health outcomes would have been substantially different at baseline. To address this issue in the future, research should assess the associations between the program's cash transfers and longitudinal changes in adult health outcomes.

Another limitation of the study is that the analysis depends on the assumption that all program participants adhered to the program requirements but we do not have actual compliance data. However, given the focus of the *Oportunidades* administrative units on rewarding compliance and the rigor with which they engaged local counterparts (e.g. physicians and teachers) to report on compliance, we are confident that families would not have received their cash transfers if they had not complied with program conditionalities, although we have no way of double-checking whether families actually complied or not. However, future research should examine rates of compliance by participants in addition to quality of care administered by physicians working in *Oportunidades* communities.

It is possible that the associations reported here are due to differences in exposure to the other components of the program such as access to the fortified food supplements, which, although targeted to pregnant women, 0–2-y-old children, and malnourished 3–5 y olds, could have influenced weight gain in adults through leakage. In the early phase of the program, some of the nutrition supplement was reportedly going to children 3–5 y old rather than the targeted 0–2 y olds (65) and there were reports that supplement distribution was uneven (66). Later analyses, however, indicate that leakage of the supplement was less common than originally thought (67) and the *Oportunidades* program has made an effort to address these early problems (68). Furthermore, we do not expect that there were systematic differences in distribution of food supplements between the 2 arms of the trial randomly assigned to begin early or late and this assumption is supported by early reports on distribution of the supplementation (65).

Despite these limitations, this analysis is unique in that it has attempted to unbundle a CCT program to investigate the impact of its individual components on critical areas of adult health. In response to the increasing prevalence of obesity and overweight worldwide, the WHO has put forth a call to action to place overweight, obesity, and associated chronic diseases at the forefront of pubic health issues (69,70). In the future, CCT programs will have to address the issue that cash transfers may be associated with increased BMI, overweight, and hypertension in the adult population. Given that the *Oportunidades* program acts as a model for CCT programs around the world, the Mexican government plays a critical role in setting the stage for the incorporation of chronic disease prevention in CCT programs.


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