The impact of cash transfers to poor women in Colombia on BMI and obesity: prospective cohort study

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Abstract

Introduction—Prevalence of obesity is rising in Latin America, is increasingly affecting socially disadvantaged groups, particularly women. Conditional cash transfers are recently established welfare interventions in the region. One, *Familias en Accion*, transfers ~20% of average monthly income to women in Colombia's poorest families. Previous work has found that families buy more food as a result.

We tested the hypothesis that participation in *Familias* would be associated with increasing body mass index (BMI) in participating women

Methods—Women from participating areas and control areas (matched on environmental and socioeconomic criteria) were surveyed in 2002 and 2006. Pregnant, breast-feeding or women aged<18 or with BMI<18.5kg/m^2 were excluded. The sample comprises 835 women from control and 1238 from treatment areas. Because some treatment areas started *Familias* shortly before baseline data collection, a dummy variable was created that identified exposure independent of time-point or area. Follow-up was 61.5%.

BMI was measured by trained personnel using standardized techniques. Overweight was defined as BMI>25kg/m^2 and obesity as >30kg/m^2. The effect of *Familias* was estimated using linear regression (or logistic regression for dichotomous outcomes) in a double-difference technique, controlling for several individual, household and area characteristics, including parity and baseline BMI, using robust standard-errors clustered at area-level in an intention-to-treat analysis.

Results—At baseline, women's mean age was 33.3 years and mean BMI 25.3kg/m^2; 12.3% women were obese. After adjustment, exposure to *Familias* was significantly associated with increased BMI (β=0.25, 95% CI 0.03, 0.47; p=0.03). Age (β=0.09; 95%CI 0.06, 0.13; p<0.001) and household wealth (β=0.78; 95%CI 0.41, 1.15; p<0.001) were also positively associated with BMI. *Familias* was also associated with increased odds of obesity (O.R.=1.27 95%CI 1.03, 1.57; p=0.03), as was age (O.R.=1.04; 95%CI 1.02, 1.06; p=0.001).

Conclusion—Conditional cash transfers to poor women in Colombia are independently associated with increasing BMI and obesity risk. Although conditional cash transfers are generally regarded as popular and successful schemes, parallel interventions at individual, household and community level are needed to avoid unanticipated adverse outcomes.

1. Introduction

Colombia, as elsewhere, is experiencing rapidly increasing rates of obesity. Of particular concern is the disproportionate burden of disease suffered by the socioeconomically disadvantaged: amongst women aged 15-49 in the lowest national wealth quintile, prevalence increased from 10.8 to 15.0% between 2005 and 2010, compared to a marginal increase from 12.0 to 12.6% in women in the highest quintile[1].

The country ranks 79 on the human development index with a per capita GDP of $9800USD. Socioeconomic inequity is a particular problem: 45.5% of Colombians live below the poverty line and Gini coefficient in 2009 was 0.587, the highest in South America[2]. *Familias en Acción* is a government programme that attempts to redress this situation. Known as a "conditional cash transfer scheme (CCTS)", eligible families receive 40,000 pesos (around US$15) per month if they have children aged 0 to 7, as long as they ensure up to date immunisation and regular health checks. Additional payments of 14,000 pesos (around US$5.5) are made for each child regularly attending primary school and 28,000 pesos (around US$11) for each child regularly attending secondary school (transfer amounts are those current at the time of this study). *Familias* began in 2002; as of 2010, some 2.6 million families were enrolled[3].

CCTS such as *Familias* are increasingly prominent welfare programmes across the world, operating in over 20 countries[4]. A study of the Mexican CCTS showed that greater programme exposure was associated with weight gain in participating adults, although unexposed adults were not included in this study[5]. Prior work has shown that participation in *Familias* is associated with approximately a 15% increase in household income and a commensurate increase in spending on food compared to unexposed controls[6]. We tested the hypothesis that participation in *Familias* was associated with increased body mass index in women.

2. Methods

2.1 Design, setting and participants

Familias was implemented at area-level: Colombia comprises 1,060 municipalities, 622 of which met all of the following four qualifying criteria: (i) less than 100,000 inhabitants and not a district capital; (ii) sufficient education and health infrastructure to enable participants to comply with the programme's conditions; (iii) a bank to enable cash transfers to programme participants and (iv) administrative office with up-to-date census, welfare and service infrastructure data. All 622 implemented *Familias* and are henceforth termed 'treatment' areas. Post-hoc analysis demonstrated that the most common reason for not qualifying was absence of a bank. An evaluation sample was constructed by randomly selecting 57 treatment areas from the 622 implementing the programme. These were

matched with 65 control areas within 25 strata based on region, health/education infrastructure, population, land area and quality of life score, based on routine government data.

Households eligible for *Familias* are those from Colombiás lowest income sextile (identified by routine government data) with children under-17, living in treatment areas. Approximately 100 eligible households were randomly sampled from each treatment and control area, generating an analytic sample of 11,428 households.

Within each household, height and weight were measured in children aged under-7 and their biological mothers. We report outcomes for this group of women, restricting the sample to women aged 18 or older who were completely observed at baseline and follow-up. Women underweight (BMI <18.5kg/m^2) at baseline and pregnant or breastfeeding women at either study phase are excluded.

Data were anonymised and ethical approval from University College London was obtained. Participants signed consent to participate in the study and data were anonymised prior to analysis.

2.2 Explanatory, outcome and mediating variables

Three surveys took place between mid-2002 and early 2006. This analysis reports data from the first and third surveys. Treatment/control status was determined from programme administrative records.

Height and weight were measured by 18 trained fieldworkers using a protocol based on established manuals[7], with standardised measuring boards (Shorr Productions, Olney, Maryland USA) and electronic scales (Seca 770, Vogel & Halke, Hamburg, Germany). BMI was calculated and analysed as a continuously distributed outcome. "Overweight" (BMI 25kg/m^2) and "obese" (BMI 30kg/m^2) were analysed as dichotomous outcomes. Cases with missing anthropometrics at baseline or follow-up were deleted list-wise from the sample and patterns of missingness explored.

The conceptual framework established by Friel et al.[8] was used to inform the selection of further co-variates. As well as individual-biological factors such as food intake and energy expenditure, this model emphasizes the social determinants of obesity such as income, education, living conditions, social capital, remoteness and infrastructure. The model is particularly sensitive to health inequity and the shifting burden of obesity towards poorer households, hence is apt given *Familia* objectives.

At the individual level, age and parity were treated as continuous variables. Completed formal education was categorized as 'primary education incomplete', 'primary education complete', 'secondary education complete' or 'higher education'. Community participation was treated as a dummy variable, equal to 1 if the woman reported participation in any sporting, religious, civic or political organization in the past six months. At the household level, household size (persons) and crowding (persons per room) were treated as continuous variables. Household wealth was proxied from total household spending in the past two weeks and log-transformed. Presence of piped water and rural/semi-urban location (referring to the presence of facilities such as a town hall, a school or health centre in contrast to more remote communities) were treated as dichotomous variables. Individual and household-level covariates were self-reported. At the area-level, population (from 2000 census figures) and number of families eligible for *Familias* were log-transformed. Proportion of houses with piped water (taken from household surveys) and log-ratio of doctors to population were included as markers of infrastructure, as was presence of a bank since this was known to be

the most common criterion on which treatment and matched control areas differed (both obtained from local facilities surveys undertaken as part of the evaluation). Average travel-time to the nearest medical centre (from household surveys) was included as a proxy for remoteness. Quality of life score (taken from a routine national survey asking about local amenities) and average log-household wealth were included as additional area-level co-variates.

All co-variates were measured at baseline except travel time to medical centre (recorded at first follow-up) and parity (second follow-up). Cases with missing co-variates were deleted list-wise from the sample and patterns of missingness explored.

Measures to ensure reliability of the data included extensive questionnaire piloting and fieldworker training, use of computer assisted personal interview (CAPI) technology, direct observation of ~10% of surveys by quality controllers and repeat measures on a subset of participants. Efforts to minimize attrition included widely publicized support for *Familias* from civic leaders and participants, regular contact with participants via newsletters and a website and efforts to trace households that had moved.

2.3 Statistical analysis

Since a small number of biologically implausible measurements suggested data-entry error, anthropometrics beyond the 1% or 99% centiles at baseline or follow-up were censored.

Differences by attrition are reported in Table 1. Baseline differences by exposure were explored using two-tailed t-test (for differences in means for continuously distributed variables) or chi-squared test (for categorical variables) and are reported in Table 2.

Given non-random programme implementation, a double-difference methodology was employed to estimate programme effects. This model allows for the outcome of interest to differ between treatment and control areas at baseline and for a secular trend in the outcome independent of the programme. Baseline difference in outcome between treatment and control areas is subtracted from the difference at follow-up to create a dependent variable that allows the net effect of the programme to be estimated, as shown in Figures 2-4.

The main assumptions of the double-difference method to produce an unbiased estimator are two-fold: that any secular trend is not substantially different between exposed and unexposed communities and that co-variate values do not change over time. Prior work examining trends in key co-variates immediately prior to inception of *Familias* suggests that the first assumption holds[9]. Regarding the second, co-variates were selected, as far as possible, to be fixed or net-neutral across exposure groups (such as age).

In 25 of the treatment areas, political pressure meant that the programme started some six months before baseline data collection was completed. Thus three types of area can be defined: those where exposure began before baseline data collection ('pre-exposed' areas), those where exposure began after baseline data collection ('exposed' areas) and controls. Discarding women from pre-exposed areas represents a significant data loss of around half the treatment cohort. Instead, the double-difference approach offers a robust method to handle this complication, by creating a dummy variable equal to 1 whenever the programme is operating, independent of time or area.

The regression estimated is:

$$Y_i = \beta_0 + \beta_1 \text{Time} + \beta_2 \text{Com}_i + \beta_3 \text{Familias}_{i,T} + \beta_4 X_i + \varepsilon$$

where

Y_i = outcome of interest for individual i

Time = 0 if baseline, 1 if follow-up

Com_i = 2 if pre-exposed area, 1 if exposed area, 0 if control

$Familias_{i,T}$ = 1 if *Familias* was in operation for individual i at time T, 0 if not

X_i = all (observed) co-variates

ε_i = error term

The coefficient of interest is β_3. This identifies the effect of the *Familias* independent of time or area effects. Baseline BMI followed a normal distribution and OLS regression was used to estimate the effect of the programme on BMI and logistic regression for effects on odds of overweight or of obesity.

Intention-to-treat analyses are reported; that is, households are analysed according to the treatment/control status of their area at baseline, whether or not they took up the offer of *Familias* or whether they changed status between baseline and follow-up. It is known that only around 85% of qualifying households took up the offer of *Familias* and that a small number changed status between baseline and follow-up.

Robust standard errors are reported, clustered at area-level. This is the coarsest and most conservative cluster-level hence it also accounts for non-independence at individual level. Intercooled Stata-11 was used for all analyses.

3. Results

3.1 Participant and sample attrition

Anthropometrics were recorded in 5513 women. Of these, 1347 women from control and 2023 from treatment areas met inclusion criteria. 835 (62.0%) participants from control and 1238 (61.2%, χ^2=0.21, p=0.64) from treatment areas were re-observed at follow-up and form the analytic sample. A participant flow-diagram is given in Figure 1.

Women lost to follow-up were similar in baseline BMI to the analytic sample (25.3 vs 25.3kg/m^2, t=0.19, p=0.85), as shown in Table 1. They were, however, slightly older (34.0 vs 33.3 years, t=2.55, p=0.01), with lower formal educational attainment (χ^2=10.85, p=0.01) and reported greater parity (5.1 vs. 4.4 live births, t=5.8, p<0.001). Within those lost to follow-up, women from treatment areas were older (34.5 vs 33.3 years, t=2.23, p=0.03) and from more wealthy households (12.9 vs 12.8 log pesos, t=2.21, p=0.03) than women from control areas.

3.2 Missing data

181 (5.1%) women were missing one or more co-variates and deleted list-wise from the sample. Missingness was not significantly associated with treatment/control status (χ^2=4.4, p=0.11) or other likely predictors of follow-up BMI including baseline BMI, age, parity, educational level and household wealth (all p>0.1).

3.3 Baseline characteristics of the analytic sample

Mean baseline BMI was 25.4kg/m^2 in control and 25.2kg/m^2 (t=1.91, p=0.06) in treatment areas. Women from treatment areas were older (33.9 vs. 33.1 years, t=3.10, p<0.01), lived in less crowded (2.8 vs. 3.1 persons per room, t=5.3, p<0.01) and wealthier households (12.9 vs. 12.8 log pesos, t=5.70, p<0.01). Several differences were also apparent at area-level, as shown in Table 2, all of which were entered into the regression models. A supplementary table splitting treated women into exposed and pre-exposed groups is available as a web appendix.

3.4 Outcomes of interest

A crude indication of the effect of *Familias* can be obtained from double-difference tables. These data suggest that BMI and rates of overweight and obesity increased in all areas with time, but more rapidly in treatment areas than in control areas (Figures 2-4).

Multivariate analysis demonstrates a statistically significant association between exposure to *Familias* and increasing BMI (β=0.25, 95% CI 0.03, 0.47; p=0.03; Table 3). Age was positively associated with BMI (β=0.09; 95%CI 0.06, 0.13; p<0.001) as was household wealth (β=0.78; 95%CI 0.41, 1.15; p<0.001). After adjustment, parity was negatively associated (β=−0.14; 95%CI −0.24, −0.04; p=0.01) in this population.

Logistic regression on odds of overweight did not demonstrate a statistically significant relationship with exposure to *Familias* (O.R.=1.06; 95%CI 0.90,1.26; p=0.46). Age (O.R.=1.04; 95%CI 1.02, 1.05; p<0.001) and household wealth (O.R.=1.44; 95%CI 1.23, 1.70; p<0.001) were positively associated.

Logistic regression on odds of obesity did, however, demonstrate a statistically significant relationship (O.R.=1.27 95%CI 1.03, 1.57; p=0.03). A positive relationships was also seen with age (O.R.=1.04; 95%CI 1.02, 1.06; p=0.001).

3.5 Subgroup analysis

Analysis excluding women in pre-exposed areas yields a similar although non-significant point estimate for the effect of *Familias* on BMI (β=0.18; 95%CI −0.07, 0.42; p=0.16) and overweight (O.R.=1.10; 95%CI 0.91, 1.32; p=0.32). Programme effect on odds of obesity appears similar and remains statistically significant (O.R.=1.33; 95%CI 1.05, 1.69; p=0.02).

4. Discussion

4.1 Key results

The study finds that participation in *Familias* appears associated with an increase in women's BMI, after controlling for several individual, household and community level co-variates and time-invariant unobserved co-variates. Increasing age and household wealth also appear associated. Although the BMI increase demonstrated is small (around 0.2 kg/m^2), it is associated with significantly increased odds of obesity.

4.2 Strengths and limitations

This prospective study collected data on a wide range of individual, household and area level variables, on a panel of several thousand households. Several quality control mechanisms were implemented, including independently commissioned data collection and analysis. A conservative statistical approach was implemented, using an intention-to-treat protocol and coarsely clustered standard errors.

Follow-up rates were just over 60% and did not vary by exposure. Of those lost to follow-up, women from treatment areas were older and wealthier than those from control areas. Since analysis of determinants of baseline BMI (not shown) demonstrated that these factors are significantly positively associated with increased BMI in our population, this unevenness in attrition likely to have led to a more conservative estimate of programme effect.

Weaknesses include non-randomised evaluation and the phenomenon of pre-exposed communities. Several differences in baseline co-variates are apparent by treatment/control status, particularly at area-level. Although all are adjusted for in multi-variate analyses the possibility of residual confounding remains. It is known that most control municipalities were ineligible for *Familias* because of absence of a bank and other civic infrastructure. As a result, control areas are slightly poorer than treatment areas. Several mechanisms can be imagined which would lead to faster weight gain in wealthier treatment areas, unrelated to *Familias.* Faster expansion of fast-food outlets, sedentary leisure such as cinemas or motorized public transport would be examples.

Pre-baseline exposure in some treatment areas was an unfortunate event, which perhaps reflects the difficulties encountered when evaluating public policy. Discarding these women implies a heavy data loss, however the double-difference approach offers a robust method for including these women. It is important to note that crude data and multivariate data with and without pre-exposed areas gave similar point estimates for the effect of *Familias* on women's BMI, with the full dataset yielding smaller standard errors and greater significance as expected.

4.3 Comparison with other studies

Our findings are consistent with an earlier study showing significant increases in household spending on meat, dairy, other fats and oils and cereals in *Familias* households. Spending on fruits and vegetables was unchanged[6].

Fernald et al[5] attempt to isolate the effect of cash in Mexico's *Progresa* CCTS by analysing the effect of the cumulative amount of cash transferred to households over six years. They find that, in adults aged 18-65, a doubling of cumulative cash transferred was associated with higher BMI ($\beta=0.83$, $p<0.001$) and higher odds of being overweight or obese (odds ratios 1.41 to 1.57, $p<0.001$ to 0.03), after adjustment for covariates including household composition.

There are, however, difficulties interpreting this as an effect of programme operation since cumulative cash transferred depends on factors that may not be random[9]. For example, households with more children in school receive more cash. This could reflect a manifestation of endogenous unobservables such as child-rearing skills or social support networks.

Our finding of a positive association between household wealth and BMI contrasts with national survey data discussed earlier, which show an association between disadvantage and obesity in Colombian women. The gradient in 2005, however (around the time of our study), was less pronounced and indeed positive across the first four wealth quintiles in women[1].

4.4 Meaning of study

Obesity is recognised, particularly among women, as a driver of already high health inequities generated by nutritional deficiencies, infectious diseases, and maternal and perinatal conditions[11]. It appears that targeted cash transfers have the potential to exacerbate the problem.

CCTS are important and popular welfare interventions. Rather than an argument to terminate them, the implication is that policy must pay close attention to the complex determinants of obesity and disadvantage and try to ensure that discrete interventions to tackle one problem do not inadvertently worsen the other.

Although the drivers of obesity are relatively well described, prevention and reversal of obesity trends remains poorly understood and a major public health challenge. A recent systematic review of prevention strategies identified 24 studies covering 44 interventions and found that intensive counselling was the most cost-effective strategy with mass media campaigns as the least cost-effective[12]. It is already known that the "transitional" diets of poor communities are typically energy dense but micronutrient poor, particularly when supported by welfare programmes such as food subsidies or cash transfers[13].

Further research must focus on how programmes such as *Familias* can optimise the health benefits and avoid the potential adverse effects of greater material and food security. For example, the educational programme which participating women are encouraged to attend currently focuses on childcare, with little attention given to healthy eating for adults or preventive behaviours such as physical activity[14]. Redesigning the programme to be more family-oriented may be beneficial. Changes in the physical, economic, and socio-cultural environment that make healthier choices concerning diet and physical activity behaviours feasible for all social classes are also likely to be necessary[8].

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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	CONTROL	TREATMENT
Women with anthropometrics observed at baseline	2113	3400
	▼	▼
Excluded*	-730	-1232
	▼	▼
Missing baseline co-variates	-36	-145
	▼	▼
Study Baseline¶	**1347**	**2023**
	▼	▼
Re-observed at follow-up¶	**835**	**1238**
	(62.0%)	(61.2%)

$\chi^2 = 0.21$, p= 0.64

* age <18 or BMI <18.5 at baseline, or pregnant or breastfeeding at baseline or follow-up. ¶ censored at 1-99% centiles for height and weight.

Figure 1.
Participant flow-chart *(this could appear as web supplementary material)*

	Control	Treatment	*Diff. across groups*
Baseline	**25.5**	**25.1**	
	(25.2, 25.7)	(24.8, 25.4)	**-0.4**
Follow-up	**26.2**	**26.1**	
	(25.9, 26.5)	(25.8, 26.4)	**-0.1**
Difference over time	**0.8**	**1.0**	**0.2**

Figure 2. crude BMI (kg/m^2, 95% CI) and double-difference*
*Women from pre-exposed areas not included; differences inexact due to rounding.

	Control	Treatment	Diff. across groups
Baseline	**50.2**	**47.6**	
	(46.8, 53.6)	(43.6, 51.6)	**-2.6**
Follow-up	**57.1**	**56.8**	
	(53.8, 60.5)	(52.8, 60.7)	**-0.3**
Difference over time	**7.0**	**9.2**	**2.2**

Figure 3. crude prevalence (%, 95% CI) of overweight and double-difference *
*Women from pre-exposed areas not included; differences inexact due to rounding.

	Control	Treatment	*Diff. across groups*
Baseline	**14.5** (12.1, 16.9)	**10.9** (8.4, 13.3)	**-3.6**
Follow-up	**17.7** (15.1, 20.3)	**17.0** (14.0, 20.0)	**-0.7**
Difference over time	**3.2**	**6.2**	**2.9**

Figure 4. crude prevalence (%, 95% CI) of obesity and double-difference

Table 1

Characteristics of women at baseline by attrition (figures are percentages unless otherwise indicated)

	ANALYTIC SAMPLE			LOST TO FOLLOW-UP			t/χ^2	p
	Mean	95%CI		Mean	95%CI			
Individual level co-variates								
BMI (kg/m²)	**25.26**	25.09	25.43	**25.29**	25.07	25.51	0.19	0.84
age (years)	**33.30**	33.00	33.60	**34.00**	33.51	34.50	2.55	0.01
community participation	**23.9**	22.0	25.7	**25.8**	23.4	28.2	1.28	0.20
parity (number of reported live births)	**4.35**	4.25	4.45	**5.07**	4.82	5.32	5.80	<0.001
primary education incomplete	**58.2**	56.1	60.3	**67.9**	63.6	72.2		
primary education complete	**34.7**	32.7	36.8	**28.1**	24.0	32.2	10.85	0.01
secondary education complete	**5.7**	4.7	6.7	**3.3**	1.7	5.0		
further education	**1.4**	0.9	1.9	**0.7**	0.00	1.4		
Household level co-variates								
household size (persons)	**6.15**	6.05	6.25	**6.10**	5.97	6.24	-0.56	0.58
persons per room	**2.92**	2.85	2.99	**2.87**	2.79	2.96	-0.82	0.41
log household wealth (pesos)	**12.84**	12.82	12.86	**12.82**	12.79	12.85	-1.02	0.30
piped water to household	**63.0**	60.9	65.0	**57.4**	54.7	60.1	-3.24	<0.01
semi-urban location	**47.9**	45.8	50.1	**48.3**	45.5	51.0	0.18	0.86
Area level co-variates								
log population	**9.97**	9.93	10.00	**9.94**	9.89	9.98	-0.87	0.38
log eligible families	**6.71**	6.66	6.75	**6.70**	6.64	6.76	-0.17	0.85
quality of life index	**54.25**	53.83	54.67	**54.76**	54.21	55.31	1.45	0.15
ratio of doctors to population	**−1.31**	−1.33	−1.28	**−1.27**	−1.30	−1.25	1.95	0.05
average household wealth	**12.94**	12.93	12.94	**12.93**	12.92	12.94	-1.15	0.25
average travel time to medical centre	**36.64**	35.82	37.47	**38.10**	37.03	39.19	2.12	0.03
proportion of households with piped water	**62.7**	61.8	63.6	**60.1**	58.9	61.3	-3.52	<0.01
presence of a bank	**74.9**	73.0	76.8	**75.4**	73.1	77.8	0.32	0.75

Table 2

Characteristics of women at baseline by exposure (figures are percentages unless otherwise indicated)

	CONTROL		TREATMENT				
	Mean	95% CI	Mean	95% CI		t/χ^2	p
Individual level co-variates							
BMI (kg/m²)	**25.43**	25.21 25.65	**25.17**	25.00 25.34		1.91	0.06
age (years)	**33.05**	32.67 33.44	**33.91**	33.55 34.27		−3.10	<0.01
community participation	**17.5**	15.4 19.5	**29.4**	27.4 31.4		−7.97	<0.001
parity (number of reported live births)	**4.44**	4.29 4.59	**4.50**	4.38 4.62		−0.62	0.54
primary education incomplete	**58.4**	55.8 61.1	**61.5**	59.3 63.6			
primary education complete	**34.9**	32.3 37.4	**32.2**	30.1 34.2		3.78	0.29
secondary education complete	**5.3**	4.1 6.4	**5.3**	4.3 6.2			
further education	**1.4**	0.8 2.0	**1.1**	0.6 1.4			
Household level co-variates							
household size (persons)	**6.20**	6.08 6.33	**6.08**	5.99 6.18		1.48	0.13
persons per room	**3.08**	2.99 3.18	**2.79**	2.72 2.85		5.25	<0.001
log household wealth (pesos)	**12.76**	12.73 12.79	**12.88**	12.85 12.90		−5.70	<0.001
piped water to household	**64.1**	61.5 67.6	**58.6**	56.5 60.8		3.17	<0.01
semi-urban location	**55.5**	52.9 58.2	**43.1**	41.0 45.3		7.12	<0.001
Area level co-variates							
log population	**9.80**	9.76 9.85	**10.06**	10.02 10.09		−9.13	<0.001
log eligible families	**6.25**	6.19 6.31	**7.01**	6.97 7.05		−21.37	<0.001
quality of life index	**55.65**	55.08 56.22	**53.65**	53.24 54.06		5.74	<0.001
ratio of doctors to population	**− 1.18**	−1.20 −1.16	**− 1.37**	−1.39 −1.35		11.87	<0.001
average household wealth	**12.90**	12.89 12.92	**12.95**	12.94 12.96		−6.15	<0.001
average travel time to medical centre	**36.46**	35.19 37.72	**37.71**	37.01 38.41		−1.83	0.07
proportion of households with piped water	**65.6**	64.3 66.8	**59.2**	58.3 60.0		8.60	<0.001
presence of a bank	**38.2**	36.2 41.8	**100.0**	99.6 100.2		−56.00	<0.001

Table 3

Determinants of nutritional outcomes

	BMI			OVERWEIGHT			OBESE		
	Coefficient	robust S.E.	p-value	O.R.	robust S.E.	p-value	O.R.	robust S.E.	p-value
Programme effect	0.25 *	0.11	0.03	1.06	0.09	0.46	1.27 *	0.14	0.03
Individual level co-variates									
age	0.09 ***	0.02	<0.001	1.04 ***	0.01	<0.001	1.04 *	0.01	<0.001
community participation	0.00	0.00	0.78	1.00	0.00	0.60	1.00	0.00	0.67
parity	-0.14 **	0.05	0.01	0.96	0.02	0.11	0.94	0.04	0.12
primary education complete	-0.27	0.19	0.15	0.90	0.09	0.27	0.84	0.11	0.20
secondary education complete	-0.79 *	0.33	0.02	0.66 *	0.11	0.01	0.49 *	0.15	0.02
further education	-0.15	0.69	0.82	1.37	0.52	0.40	0.39	0.23	0.11
Household level co-variates									
household size (persons)	-0.09	0.05	0.05	0.94 **	0.02	0.01	0.95	0.03	0.22
persons per room	0.02	0.06	0.70	1.01	0.03	0.81	1.01	0.04	0.80
log household wealth (pesos)	0.78 ***	0.19	<0.001	1.44 ***	0.12	<0.001	1.32	0.18	0.05
piped water to household	0.00	0.00	0.63	1.00	0.00	0.47	1.00	0.00	0.70
semi-urban location	0.00	0.00	0.71	1.00	0.00	0.63	1.00 **	0.00	0.01
Area level co-variates									
log population	-0.38 *	0.18	0.04	0.81 **	0.06	0.01	0.91	0.09	0.36
log eligible families	0.15	0.14	0.29	1.07	0.07	0.32	1.08	0.08	0.31
quality of life index	0.00	0.01	0.78	1.00	0.01	0.97	1.07	0.08	0.36
ratio of doctors to population	-0.23	0.21	0.27	0.94	0.10	0.52	1.00	0.01	0.82
average household wealth	-0.55	0.57	0.33	0.83	0.24	0.52	0.82	0.31	0.59
average travel time to medical centre	0.00	0.01	0.75	1.00	0.00	0.91	0.97	0.00	0.49
proportion of households with piped water	0.00	0.00	0.35	1.00	0.00	0.64	0.99 *	0.00	0.03
presence of a bank	0.14	0.36	0.71	1.00	0.16	0.95	1.23	0.28	0.36

*
p<0.05

**
p<0.01

***
p<0.001

*‖*compared to primary education incomplete