Conditional cash transfers and child body weight in Colombia: Causing obesity or preventing undernutrition?

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ABSTRACT

Conditional cash transfer (CCT) programs aim to relieve poverty by offering cash assistance to disadvantaged families in low-and middle-income countries. We examine the impact of *Familias en Accion* (FA), a large CCT program in Colombia, on the body mass index (BMI) and weight trajectories of young children.

1,301 children from treatment municipalities assigned to receive conditional cash transfers in 2002 were compared to 1,584 children from control municipalities. Height and weight were measured in 2002 and during follow-ups in 2003 and 2005/6. Based on a difference-in-differences approach, we find that CCT treatment was associated with a significant increase in BMI z-scores as compared to the control group. CCT treatment was associated with reduced odds of thinness, but no increase in child overweight or obesity. Our study suggests that conditional cash transfers are a potential intervention to reduce malnutrition in children from poor households in low-and middle-income countries.

INTRODUCTION

Conditional cash transfer (CCT) programs aim to reduce poverty by providing monetary transfers to poor families, contingent upon families' compliance with the use of pre-specified health services and school attendance. Common requirements include enrolling children in school, periodic health check-ups, growth monitoring, adherence to vaccination schedules, and use of nutritional supplements [1-3]. Over the last 15 years, CCT programs have become one of the key poverty reduction programs around the world. Virtually every country in Latin America has a CCT program, and large-scale programs have been implemented in India, Bangladesh, Indonesia, Cambodia, Malawi, Morocco, Pakistan, South Africa, and Turkey, among others [3-8]. Recent studies have shown the potential benefits of CCT program for improving child health and reducing child mortality [9,10]. However, concerns have been raised that providing cash benefits to the poor may have unintended negatives consequences on healthy nutrition, increasing the risk of overweight and obesity among children [11].

Income from conditional cash transfers may have two potentially conflicting effects on children's body mass index (BMI). Cash transfers, paired with health information sessions and requirements to attend school, may improve the nutritional status of children from very poor families. For example, recent evidence from Mexico suggests that CCTs increase the quality of diet by increasing household fruit, vegetable, and micronutrient consumption [6]. On the other hand, income from cash transfers may also increase access to unhealthy food choices and contribute to rising BMI among poor children in low- and middle-income countries. For example, evidence from Mexico suggests that CCTs increase total energy consumption and energy from animal source foods [7]. Similarly, observational data from Brazilian CCT Program *Bolsa Familia* suggests that greater purchasing power of poor families increased consumption of unhealthy foods such as sugar and soft drinks [12].

Whether the benefits of CCT programs outweigh potentially harmful effects on diet and nutrition is as yet an unresolved question relevant for the design of future CCT programs worldwide.

In this paper, we evaluate the impact of conditional cash transfers on the BMI of children from poor households in a middle-income country. In 2002, the Government of Colombia introduced the CCT program *Familias en Acción* (FA) targeting poor households with children aged 0 to 17 years [13,14]. Currently, FA serves 2.6 million households, covering a quarter of the Colombian population and over half of the nation's poor [15]. Early evidence from FA suggested that CCTs were associated with increased consumption of protein-rich foods and dietary diversity among children [13,16,17]. CCTs were also associated with increased height among the youngest and poorest children [13,16,17]. A potential concern is that CCTs increase BMI and improve the weight status of low-weight and undernourished children, but at the same time it increases body weight among normal-BMI or overweight children. To shed light on this question, we assess the impact of conditional cash transfers on BMI, underweight, overweight and obesity among children participating in the FA program in Colombia.

METHODS

Ethical Considerations

Ethical approval for the evaluation study was granted by a local institutional ethics committee. Adults provided signed informed consent to participate in the study. Data from the evaluation are made publically available by the Planning Department of the Colombian Government with no identifiable information on survey participants (https://pwh.dnp.gov.co/Programas/Sinergia/EvaluacionesEstrat%C3%A9gicas/Evaluaci%C3%B3ndeImpactoProgramaFamiliasenAcci%C3%B3n.aspx)

Study Population and Design

Data came from the experimental evaluation of the FA program [16] a large-scale intervention that provides cash to mothers of poor households provided that their children younger than 7 years regularly attend vaccination programs, and growth and development check-ups. The program also requires that children aged 7-17 years regularly attend school. FA beneficiaries receive monthly cash transfers that vary in size depending on the pre-specified conditions. For example, families with children under 7 years receive between 61,200 and 71,400 Colombian pesos (US$32 to US$38) for children that attend vaccination, growth and development check-ups; while families with children aged 7-17 receive 25,500 to 56,100 Colombian pesos (US$13 to US$30) for each child that attends at least 80% of school lessons in primary and secondary school.

To be eligible for FA program participation, municipalities were required to have: 1) a population of less than 100,000 inhabitants; 2) the health and education infrastructure to guarantee program implementation; 3) a bank to enable cash transfers; and 4) up-to-date census, welfare and service infrastructure data. In addition to residing in a municipality where

the program was implemented, families were required to: (1) hold a Colombian citizen card; (2) have children younger than 18 years; and (3) being formally classified in the lowest level of the official socio-economic classification as of December 1999. These criteria approximately covered the 20% poorest households in Colombia.

The evaluation of the program was carried out by the Institute of Fiscal Studies, an independent research institute in London (United Kingdom). Details of the evaluation are available elsewhere [16]. Given that selection into FA treatment could not be randomly assigned due to political reasons, to maximize comparability, a matched control design was used. Municipalities were classified into 25 strata according to geographical region, population size, proportion of population living in urban areas and the value of a synthetic index for quality of living conditions, as well as education and health infrastructure. Treatment municipalities were randomly selected within each stratum among participating municipalities. For each treatment municipality, a matched control municipality was chosen from the same stratum among municipalities not participating in the program. In total, 622 (60%) municipalities qualified for the program. Based on the four eligibility criteria, 457 municipalities were assigned to treatment and 165 to the control group. The sample for the FA program evaluation study included 57 treatment municipalities and 65 matched control municipalities. In practice, except for the requirement to have a bank, control municipalities fulfilled all other eligibility criteria, and were thus comparable to treatment municipalities.

Baseline data was collected in 2002. Baseline assessments were scheduled to take place before the program started, but due to political pressure, the program started before baseline assessment in 26 out of the 57 treatment municipalities. Therefore, 31 treatment municipalities in which the FA program started after the baseline data collection were randomly selected and matched with municipalities in the control group [16]. In sensitivity analyses, we also implemented models that included all municipalities regardless of whether

their baseline assessments took place before or after program initiation. At least 100 eligible households were randomly sampled from each municipality, generating an analytic sample of 7,904 households and 6,039 children aged 2 to 7 years. Complete anthropometric information was available for 5,591 children (93% of those eligible). We excluded 746 children with missing covariates at baseline, leaving a baseline sample of 4,845 children (supplementary table S1).

A first follow-up assessment was carried out in 2003 among children under 7 years, and included 4,097 (85%) children who had previously been measured in 2002. A second follow-up assessment was carried out between 2005 and 2006, and included 2,885 (70%) children who had been evaluated both in 2002 and 2003. The final sample for analysis thus comprised 2,885 children with valid data for weight and height in all the observed periods.

Outcome measures

Height and weight of children were measured by trained fieldworkers using a protocol of the Pan-American Health Organization Manual on Anthropometrics [18], with standardized measuring boards (Shorr Productions, Olney, Maryland USA) and electronic scales (Seca 770, Vogel & Halke, Hamburg, Germany). BMI was computed as weight in kilograms divided by the square of height in meters. In accordance with guidelines from the Ministry of Health in Colombia [19,20], we calculated BMI-for-age and sex z-scores (BMI z-scores), based on the World Health Organization (WHO) Child Growth Standards [21] for children under 5 years and the WHO Growth Reference Data for children older than 5 years [22]. Two different outcome measures were defined: the BMI z-score as a continuously distributed variable and a categorical variable with the following categories: thinness (BMI z-score at least two standard deviations (SD) below the average BMI); overweight (BMI z-score at least one SD above average BMI), and obesity (BMI z-score at two SDs above average BMI). In this categorization overweight includes obesity as well.

In sensitivity analyses, we also used an alternative definition of BMI based on Cole's classification [23,24] of BMI categories for children and corresponding definitions of thinness, overweight, and obesity.

Control variables

Covariates at the individual, household and municipality levels were used as control variables. Children's individual characteristics included age, sex and whether the child was participating in *Hogares comunitarios,* a home-based childcare program for children from poor families. We controlled for maternal characteristics including mother's educational attainment, marital status, age and BMI. Mother's highest level of education completed was categorized into: 1) no education, 2) incomplete primary, 3) completed primary, 4) incomplete secondary, 5) completed secondary and 6) higher education. Covariates also included household size and household income, measured by asking respondents their income from all sources in the past month, including wages, salaries, retirement benefits, help from relatives, and rent from property. We calculated household income as the sum of gross income from all members of the household, divided by the square root of household size. In regression models, household income was log transformed to account for non-linearities. At the municipality level, models included number of inhabitants, level of urbanization and characteristics of the geographical region categorized into: 1) Central region, 2) Caribbean region, 3) Pacific region and 4) Eastern region.

Statistical Analysis

We started by comparing characteristics of treatment and control municipalities using t (for continuous variables) or chi-squared tests (for categorical variables). Although the matched sample design tried to minimize differences between treatment and control municipalities, differences between the two groups may have persisted. These differences would bias results if variation in post-program outcomes was due to differences in unmeasured covariates

between treatment and control, rather than to the program. Therefore, we used a difference-in-differences (DID) approach to purge estimates of program impact from pre-existing differences. The DID approach compares changes between baseline and follow-up between treatment and control, instead of comparing post-treatment outcomes only. The DID estimate is thus defined as the difference in outcome in the treatment group before and after treatment minus the difference in outcome in the control group over the same period. The rationale behind this approach is that the change observed in the control group represents the counterfactual change we would have observed in the treatment group had participants not been treated [25]. This approach has been commonly applied in the evaluation of CCT programs [26-28].

A crucial assumption of the DID approach is that the outcome variable would have evolved in the same way between baseline and follow-up in both treatment and control municipalities had the FA program not taken place. This is known as the common trend assumption. Although this assumption cannot be tested (we can only observe outcomes for each municipality in either treatment or control state), a common indirect test is to examine trends in the outcome prior to program implementation. If trends in relevant outcomes were different prior to the program, the common trend assumption would be unlikely to hold during program implementation. We did not have data on BMI across treatment and control municipalities before treatment. However, to assess the potential validity of the common trend assumption, we estimated trends in under-5 mortality rates and urbanization in control and treatment municipalities between 1997 and 2001, before the program started. If trends in these indicators of health and living conditions were similar prior to the program, this would provide an indication that the common trend assumption might hold.

We used linear regression (OLS) models to examine the impact of treatment with CCT on linear BMI z-scores, and we implemented logistic regression models to examine the

impact of the program on thinness, overweight and obesity. The basic linear model was as follows:

$$y_{ijt} = \alpha + \beta_1 Time_t + \beta_2 Treatment_j + \beta_3 (Time_t * Treatment_j) + \beta_4 M_j + \beta_5 X_{ij} + e_{ijt,}$$

where y is the outcome of interest for individual i in municipality j at time t; *Time* as a dummy with value 0 for baseline assessment and 1 for assessments after the program started; *Treatment* is a dummy with value 0 for control assignment and 1 for FA treatment assignment; M is a vector of baseline municipality-level confounding variables; X is a vector of baseline individual-level confounding variables; and e_{ij} is the error term. Coefficients for *Time* represent the change in BMI between baseline and follow-up in the control group. The treatment coefficient reflects differences in BMI between treatment and control at baseline. $Time_t * Treatment_j$ assesses the interaction between treatment assignment and time and corresponds to the DID estimate, as it estimates differences in BMI trends between treatment and control.

All analyses were performed using SAS software 9.3. We incorporated appropriate sample weights and calculated robust standard errors to account for differential selection probabilities and a clustered design.

RESULTS

Table 1 shows that there were no significant differences between treatment and control groups in key baseline characteristics including children's age and sex; mother's age and BMI; household size and income; and municipality population size and geographic location. As compared to children in control municipalities, children in treatment municipalities were more likely to live in rural areas and less likely to participate in *Hogares Comunitarios,* a home-based childcare program. Children in treated municipalities were also more likely to have mothers with lower education and mothers who lived without a partner, although differences were small. Mean age for children was 4.4 years in treatment municipalities and 4.5 years in control municipalities.

Figure 1 shows the distribution of BMI z-scores for each treatment group before and after program enrollment. In the control group, there was a general shift to the left across the entire distribution of BMI between baseline and follow-up. In contrast, in the treatment group, the distribution of BMI narrowed, due to a rightwards shift in the left-side tale of the distribution, paired with a leftwards shift of the right-side tale of the BMI distribution.

Figure 2 summarizes trends in BMI z-scores for treatment and control municipalities from 2002 (before the FA program started) to 2005/6. From baseline to first follow-up, children's BMI z-scores decreased in both treatment and control municipalities, but less among children from FA treatment municipalities than among children in control municipalities. Between 2002 and 2006, the prevalence of thinness increased in the control group, while it declined in

the treatment group overall. The prevalence of overweight declined in both treatment and control, but the decline was smaller in the treatment group. In contrast, the prevalence of obesity declined in the treatment group between 2002 and 2006, while it remained constant in the control group.

Table 2 shows estimates of the main results examining differential trends in BMI z-scores between control and treatment group, controlling for all covariates. The first column shows estimates of the effect of the program on BMI z-scores. At baseline, BMI z-scores did not significantly differ for children in the treatment and control group. In control municipalities, BMI z-scores decline by 0.29 points (95% CI 0.38, 0.20) between baseline and follow-up assessments. The last raw presents the interaction between treatment and time, the DID estimate of interest, which suggests that assignment to treatment with *Familias en Accion* was associated with a larger increase in BMI z-scores between baseline and follow-up relative to the control group (0.14, 95% CI 0.00, 0.27, $p < 0.05$). Columns 2 to 4 presents odds ratios from logistic regression models examining the impact of the FA program on thinness, overweight and obesity. While the odds of thinness doubled between baseline and follow-up in the control group (OR= 2.27, 95% CI 0.98, 5.28), children participating in the FA program were significantly less likely to turn thin after the program (OR= 0.25, 95% CI 0.09, 0.74). By contrast, there was no evidence that the FA program influenced the odds of overweight (OR= 1.24, 95% CI 0.80, 1.91) or obesity (OR= 0.57, 95% CI 0.21, 1.51). Supplementary analyses of the effects of the program separately for each follow-up assessment yielded essentially the same results, although confidence intervals were somewhat wider (Supplementary table S2).

Table 3 summarizes DID estimates from models stratified by sex, age, maternal education and household income. There was no clear evidence that the impact of *Familias en Accion* on BMI z-scores differed by most key demographics. Participation in the FA program reduced the odds of thinness significantly more for children from households above median

than below median income (p value for interaction <0.01). The program appeared to have somewhat stronger effects among older children as well as children from mothers with secondary/higher education, but these differences were not statistically significant.

Sensitivity analyses and common trend assumption

In sensitivity analyses, we used Cole's classification to define cut-off points for thinness, overweight and obesity. Table S3 and Figure S1 in the supplementary material show that using Cole's cut-off points, the program had no effects on the odds of thinness, which contrasts within findings using the WHO cut-off points. This pattern, however, results from the fact that the Cole cut-off point for thinness is higher than the WHO cut-off point. For example, the baseline prevalence of thinness in the treatment group based on the Cole cut-off point was 11.4%, compared to 2.6% based on the WHO guidelines. This suggests that the effect of the FA program on thinness is primarily driven by an effect on the lower end of the BMI z-score distribution. There was no evidence of an effect of the program on overweight or obesity based on the Cole's cut-off points, confirming results using the WHO-cut off points.

A crucial assumption of the DID approach is that there would have been a similar trend between treatment and control had the FA program not taken place. Although this assumption cannot be tested, Figure 3 shows trends in under-5 mortality rates and urbanization in control and treatment municipalities between 1997 and 2001, before the program started. If trends in these indicators of health and living conditions were similar prior to the program, this would provide an indication that the common trend assumption might hold. Despite some fluctuations across years, there was no evidence of differential trends in infant mortality rate and urbanization between treatment and control municipalities. This was confirmed in models that suggested no interaction between municipality treatment status and time ($p > 0.05$). Although not a definitive test, this provides some reassurance that trends did

not differ systematically between treatment and control, and confirm findings from previous analyses suggesting that there were no pre-treatment differences in income trends between treatment and control municipalities [16].

DISCUSSION

Our results suggest that children in households assigned to treatment with *Familias en Accion*, a conditional cash transfer program, were less likely to be thin during follow-up than children in the control group. As a result, CCT treatment was associated with an increase in BMI z-scores, but there was no evidence that the program increased child overweight or obesity. Effects were similar across most demographic sub-groups, but reductions in thinness associated with CCT program participation were somewhat larger for children from households with above median income. These findings suggest that conditional cash transfers are a potential intervention to reduce undernutrition and very low weight in children from poor households in low-and middle-income countries.

Our findings contribute to growing evidence of a positive impact of CCT programs on the nutritional status of children. Previous studies across different countries have reported positive effects of CCT programs on height in the youngest and poorest children [6,29-31]. However, only one study has assessed the effect of CCT programs on children's BMI. Fernald and colleagues showed that children participating in the Mexican *Oportunidades* program were less likely to be overweight, but this study only evaluated changes among participants in the program without a comparison to children in control areas [32]. Our results suggest that conditional cash transfers in Colombia did not have any substantive effect on overweight or obesity.

Our results show that children participating in the FA program experienced a decline in the likelihood to be thin, whereas children in the control group had an increase in thinness. Several potential explanations could account for this effect of the FA program on thinness. First, conditional transfers may have improved the quality of home diet, thus reducing the risk of malnutrition. Early reports of FA impact suggested that families participating in the program spent on average 15% more of their household income on food than families in the

control group. Since the majority of families participating in the FA program were from rural areas and worked in agriculture, they may have relatively easy access to healthy foods such as fruits and vegetables, whole grains and non-hydrogenated fat [14]. Even small cash transfers, such as those provided by the FA program, may thus increase consumption of healthy products rather than increase consumption of unhealthy goods available in more urbanized areas. Second, our results may be linked to better access and use of health care, which might reduce frequency and severity of infectious diseases. This hypothesis is substantiated by early reports of the program suggesting that children beneficiaries of the program reported less symptoms of diarrhea than those in the control group [17]. Project reports have also shown that families participating in the FA program use health care services more frequently than families in the control group and in the general Colombian population [13,16,17]. An increased use of preventive health care services is one of the requirements to receive cash transfers in the FA program. The FA program has been shown to increase compliance with the growth and developmental checks for children under 48 months, and it has increased the rates of DPT vaccination for children under 24 months [13,16,17].

Although we observed no significant differences across several demographic groups, the program appeared to have a larger effect on thinness among girls. Previous evidence suggests that boys may be heavier than girls during childhood in both developed and developing countries [33,34], although this is not always the case [35-37]. Further research is required to examine to what extent boys and girls may respond differently to conditional cash transfers. The FA program also appeared to have a more consistent effect on thinness among children from poorly educated mothers. In contrast, the program had significantly larger effects on thinness for children from households with above median income. Overall, however, there was only weak evidence that the program had differential effects across demographic groups.

Our results show that the FA program led to a significant 4-fold reduction in the odds of thinness (Table 2). However, an important consideration in interpreting these findings is the fact that baseline prevalence of thinness -as defined by the WHO guidelines- was relatively low in our sample. At baseline, the prevalence of thinness was 2.6 in the treatment group and 0.6 in the control group, while by the last follow-up, thinness prevalence was 1.8 in the treatment group and 1.6 in the control group (Figure 2). This implies that our estimates capture an effect of the program on a small fraction of the sample, while the program had little effect on the weight growth of other children. This raises the question of whether conditional cash transfers are a cost-effective strategy to reduce very low weight as compared to in-kind benefit programs such as nutritional supplements, early childhood-programs or health promotion interventions. Although CCT programs likely have several benefits beyond those on nutrition and weight that need to be considered, it is important to assess whether the opportunity costs of conditional cash transfer programs relative to more direct early childhood interventions justify their choice as primary intervention to improve children's outcomes.

Limitations

Our study has several strengths, including the longitudinal design with a long follow-up; a robust difference-in-differences approach; and the use of both direct and standardized weight and height measurements for children. However, some limitations should be considered. First, study participation rates were around 80% and there was a 30% loss-to-follow-up due to the high mobility of participants. The impossibility to contact some participants partly reflects the unstable living conditions of a migrating workforce. Nevertheless, children contacted at follow-up did not differ from those who were not contacted at follow-up with respect to several key baseline individual, household and municipality characteristics.

A second limitation refers to the fact that due to political reasons, some treatment municipalities started to receive program benefits before the baseline assessment. For these municipalities, therefore, we did not have pre-treatment assessments, and we therefore excluded them from the main analysis. In sensitivity analyses, we examined the impact of the program incorporating these municipalities as part of the treatment group (Supplementary Table S4). Although confidence intervals were wide, we found similar effects of the program on thinness which were borderline significant (OR=0.35, 95% CI 0.12, 1.02), with no adverse effects on overweight and obesity. Our estimates, therefore, are unlikely to be driven by the exclusion of these municipalities from the treatment group.

We based our interpretation on results using the WHO cut-off points because they come from WHO growth reference standard curves that rely on age- and-sex-specific BMI standard deviation scores to define cut-offs, while Cole cut-off points are defined by values of BMI at age 18. This is also in accordance with recommendations by the Colombian government to use WHO cut-offs, as they are based on estimates of how children grow when properly fed and cared for, rather than describing how they grow at a particular time and place [20].

Conclusion

Our results suggest that *Familias en accion*, a conditional cash transfer program in Colombia, was associated with decreased thinness among young children, while there was no evidence of adverse effects of the program on overweight or obesity. These results suggest that conditional cash transfers are a potential intervention to reduce malnutrition in children from poor households in low-and middle-income countries. Nevertheless, given the relatively low prevalence of thinness among children in our sample, future studies are required to assess the cost-effectiveness of conditional cash transfers relative to other early childhood interventions to improve nutritional status. Our findings suggest that conditional cash transfers do not

increase overweight or obesity, minimizing concerns of potentially negative consequences on child obesity.

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Table N. 1 Baseline characteristics of children in control and treatment municipalities in *Familias en Accion (FA)*, children 2-7 years, Colombia

Characteristic	Control	Treatment	*p-value*
Participants (n %)	1,584	1,301	
Female (n [%])	793 (50.0)	641 (49.3)	0.89
Age, years (mean [SD])	4.5 (1.3)	4.4 (1.3)	0.42
Childcare "Hogares" participation (n [%])	902 (57.0)	526 (40.4)	0.01[a]
Mother's characteristics			
Mother's age (mean [SD])	32.2 (7.11)	32.5 (7.49)	0.35
Mother lives with partner	1,398 (88.3)	1,124 (86.4)	0.06
Mother's Education			
No education	217 (13.7)	218 (16.8)	0.005[a]
Incomplete Primary	729 (46.0)	604 (46.4)	
Complete Primary	307 (19.4)	266 (20.5)	
Incomplete Secondary	227 (14.3)	140 (10.8)	
Complete Secondary	88 (5.6)	66 (5.1)	
Higher	16 (1.0)	7 (0.5)	
Mother's BMI (mean [SD])	25.1 (4.7)	24.7 (4.7)	0.87
Household characteristics			
Family size (mean [SD])	6.7 (2.5)	6.7 (2.4)	0.57
Household income			
Below median (n [%])	768 (48.5)	679 (52.2)	0.53
Municipality characteristics			
Level of urbanization			
Rural (n [%])	690 (43.6)	750 (57.7)	0.002[a]
Population			
< 5,000 inhabitants (n [%])	454 (28.7)	453 (34.8)	0.79
5,000- 14,000 inhabitants (n [%])	681 (43.0)	422 (32.4)	
> 14,000 inhabitants (n [%])	449 (28.3)	426 (32.7)	
Region			
Atlantic (n [%])	705 (44.5)	462 (35.5)	0.56
Oriental (n [%])	314 (19.8)	210 (16.1)	
Central (n [%])	359 (22.7)	444 (34.1)	
Pacific (n [%])	206 (13.0)	185 (14.2)	

[a] Groups differ, $P < 0.05$

p-values for continuous variables correspond to t- test and for categorical variables to chi-square test.

Table N. 2 Difference- in- differences (DID) estimate of the effect of *Familias en Accion* (FA) conditional cash transfer program on BMI z-scores, thinness, overweight and obesity, children 2-7 years, Colombia

	BMI z-scores[a]	Thinness[b]	Overweight[b]	Obesity[b]
	β-Coefficient (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Treatment vs control at baseline	-0.11 (-0.27, 0.05)	**5.56 (1.76, 17.5)**	0.83 (0.52, 2.03)	**2.02 (1.04, 3.95)**
Time trend in control group	**-0.29 (-0.38, -0.20)**	2.27 (0.98, 5.28)	**0.51 (0.37, 0.69)**	0.82 (0.40, 1.70)
DID Estimate of FA program	**0.14 (0.00, 0.27)**	**0.25 (0.09, 0.74)**	1.30 (0.83, 2.03)	0.56 (0.20, 1.53)

[a] Values are regression coefficients, reflecting the change in BMI z-score per 1 standard deviation.
[b] Values are odds ratios, reflecting the ratio of the likelihood of the outcome
Variables included in the model: age, sex, participation in *Hogares Comunitarios* (home-based health care) mother's marital status, mother's age, mother's education, mother's BMI, household income, level of urbanization, inhabitants and region.

Table N. 3 Sub-group analysis: Difference- in- differences (DID) estimates of the effect *Familias en Accion* (FA) conditional cash transfer program on BMI, thinness, overweight and obesity, children 2- 7 years, Colombia

	BMI z-scores[a]		Thinness[b]		Overweight[b]		Obesity[b]	
	β-Coefficient (95% CI)	*p-value for interaction*	Odds ratio (95% CI)	*p-value for interaction*	Odds ratio (95% CI)	*p-value for interaction*	Odds ratio (95% CI)	*p-value for interaction*
Child's sex								
Female	0.14 (-0.01, 0.30)	0.25	0.19 (0.04, 0.81)	0.28	1.17 (0.79, 1.76)	0.38	0.87 (0.36, 2.12)	0.20
Male	0.12 (-0.09, 0.33)		0.48 (0.13, 1.80)		1.29 (0.73, 2.29)		0.42 (0.11, 1.56)	
Child's age (months)								
2- 5 years	0.12 (-0.05, 0.29)	0.08	0.21 (0.05, 0.82)	0.23	1.39 (0.86, 2.25)	0.98	0.31 (0.09, 1.06)	0.33
≥ 5 years	0.17 (-0.02, 0.37)		0.32 (0.05, 2.02)		0.99 (0.60, 1.64)		1.83 (0.54, 6.16)	
Mother's education								
Lower educated	0.08 (-0.07, 0.22)	0.12	0.22 (0.07, 0.71)	0.38	1.12 (0.75, 1.67)	0.38	0.59 (0.22, 1.60)	0.32
Higher educated	0.32 (-0.09, 0.72)		0.27 (0.01, 4.96)		1.53 (0.60, 3.96)		0.48 (0.11, 2.06)	
Household income								
Below median	0.10 (-0.05, 0.24)	0.09	0.68 (0.17, 2.65)	<0.01	1.25 (0.74, 2.10)	0.50	0.49 (0.14, 1.63)	0.60
Above median	0.17 (-0.03, 0.37)		0.09 (0.02, 0.39)		1.22 (0.68, 2.21)		0.76 (0.27, 2.13)	

[a] Values are regression coefficients, reflecting the change in BMI z-score per 1 standard deviation.
[b] Values are odds ratios, reflecting the ratio of the likelihood of the outcome
Variables included in all models: age, sex, participation in *Hogares Comunitarios* (home-based health care) mother's marital status, mother's age, mother's education, mother's BMI, household income, level of urbanization, inhabitants and region.
p- values are for a three way interaction between treatment, time and the demographic variable of interest.

Figure 1 Body mass index z-score distribution by treatment assignment before and after enrollment in Conditional Cash Transfer *Familias en Accion Program*, children 2-7 years, Colombia

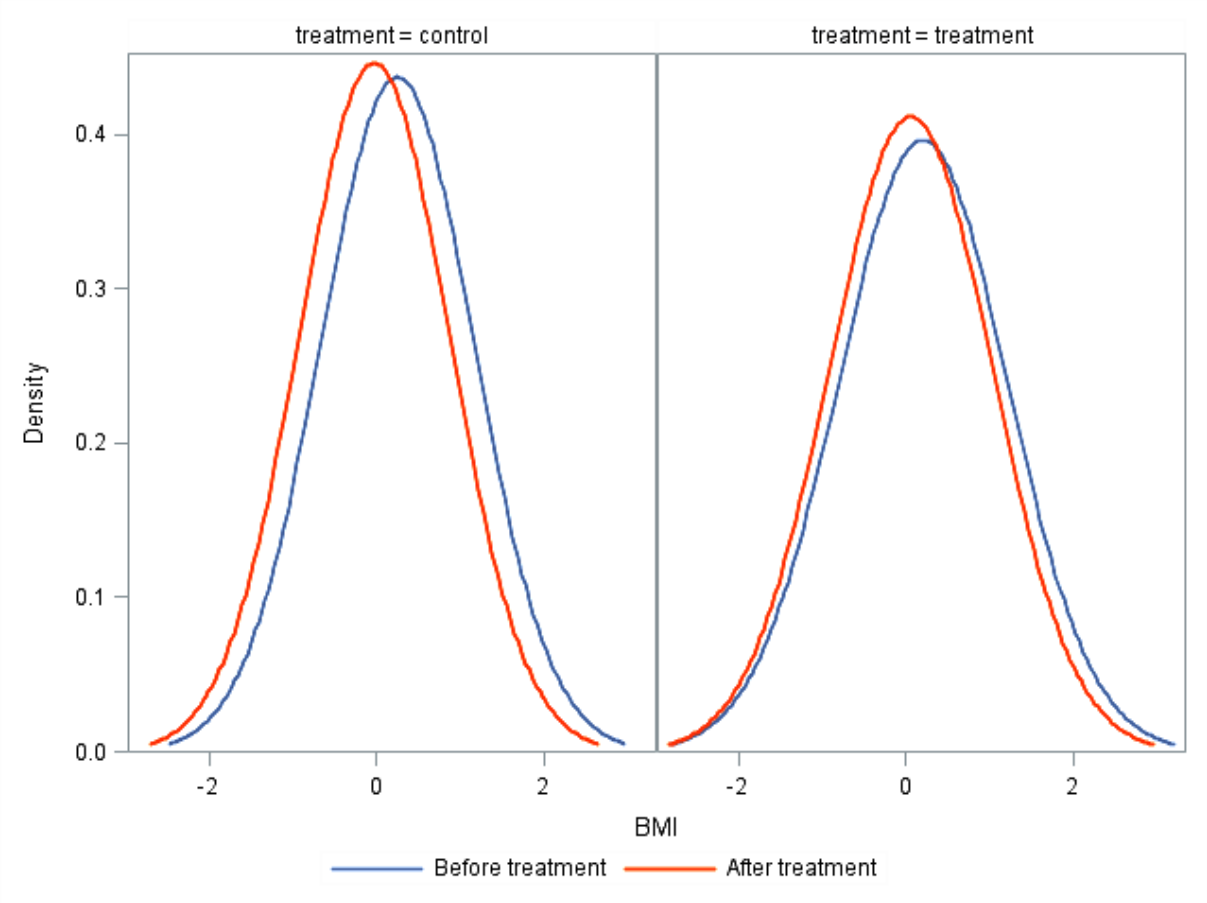
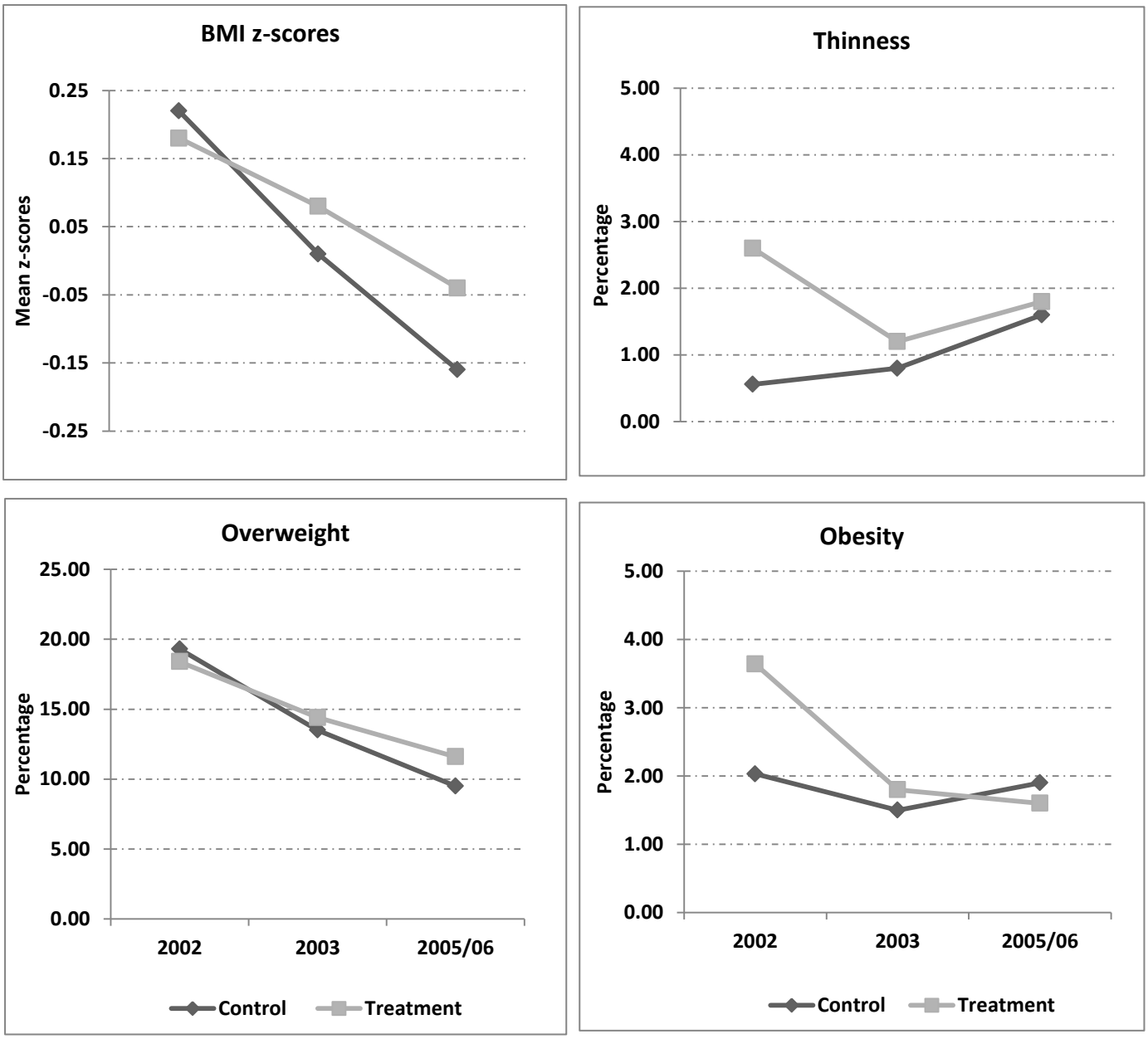
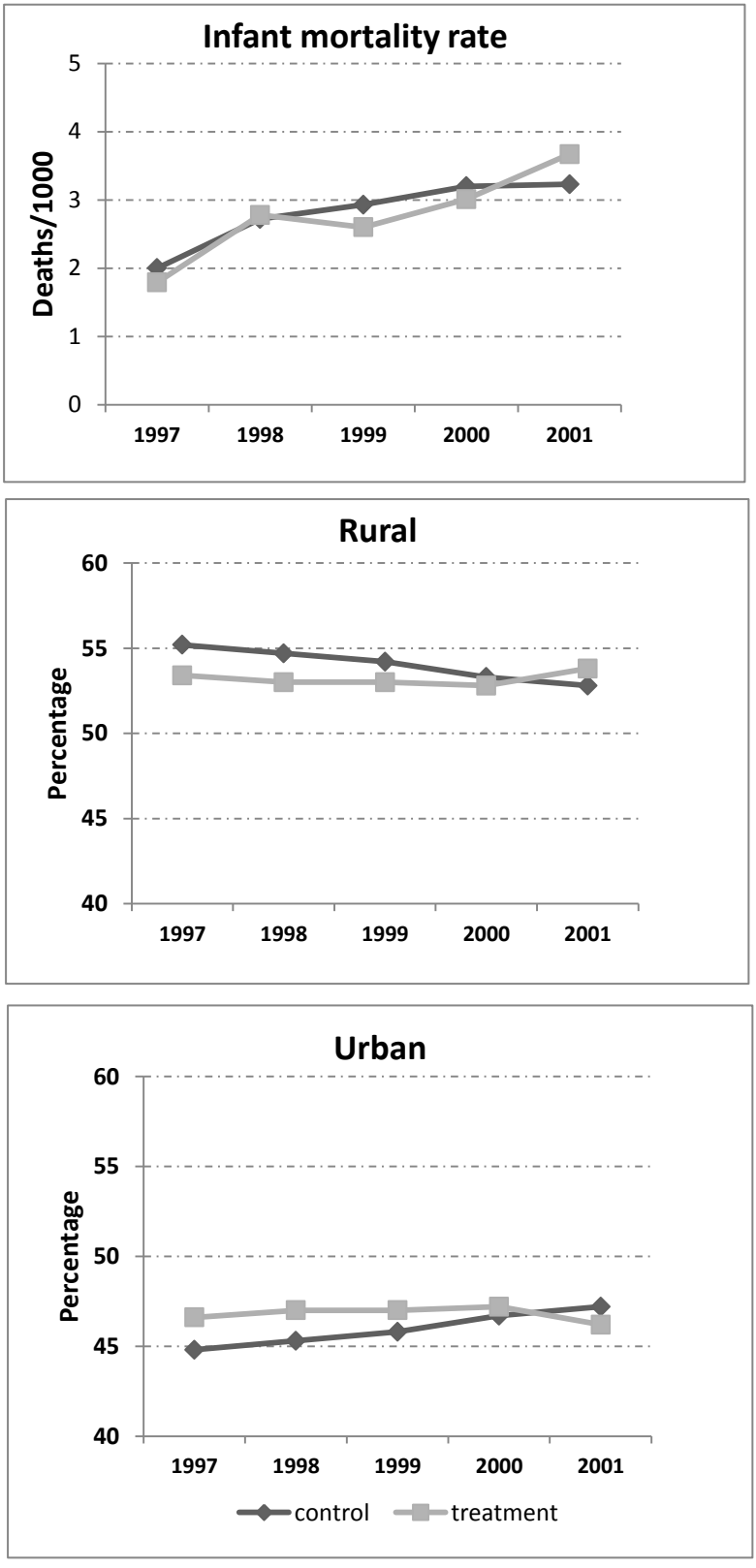


Figure 2 Trends in BMI z-scores, thinness, overweight and obesity by treatment assignment, *Familias en Accion* conditional cash transfer program, children 2-7 years, Colombia



Body mass index z-scores.
According to the WHO growth curves, thinness as BAZ <-2SD.
According to the WHO growth curves, overweight as BAZ >+1SD.
According to the WHO growth curves, overweight as BAZ >+2SD.
All plotted points took into account the clustered design of the study and sample weights.

Figure 3 Test of the common trend assumption in infant mortality rate and level of urbanization (rural/urban) before treatment enrollment (1997-2001, Colombia)



Supplementary tables

Table N. S1 Characteristics of children aged 2- 7 years in the total and the analytic sample, *Familias en Accion* conditional cash transfer program, Colombia

Characteristic	Total sample	Analytical sample
Participants (n %)	**4,845**	**2,885**
Female (n [%])	2457 (50.7)	1434 (49.7)
Age, years (mean [SD])	4.7 (1.4)	4.4 (1.3)
Childcare "Hogares" participation (n [%])	2355 (48.6)	1428 (49.5)
Mother's characteristics		
Mother's age, years (mean [SD])	32.4 (7.4)	32.3 (7.3)
Mother lives with partner	4,186 (86.4)	2,522 (87.4)
Mother's Education		
No education	763 (15.8)	435 (15.1)
Incomplete Primary	2248 (46.4)	1333 (46.2)
Complete Primary	913 (18.8)	573 (19.9)
Incomplete Secondary	639 (13.2)	367 (12.7)
Complete Secondary	246 (5.1)	154 (5.3)
Higher	36 (0.7)	23 (0.8)
Mother's BMI (mean [SD])	24.9 (4.5)	24.9 (4.5)
Household Characteristics		
Family size (mean [SD])	6.6 (2.5)	6.7 (2.5)
Household income		
Below median	2416 (49.9)	1447 (50.2)
Level of urbanization		
Rural (n [%])	2481 (51.2)	1440 (49.9)
Population		
< 5,000 inhabitants (n [%])	1520 (31.4)	453 (34.8)
5,000- 14,000 inhabitants (n [%])	1777 (36.7)	422 (32.4)
> 14,000 inhabitants (n [%])	1548 (32.0)	426 (32.7)
Region		
Atlantic (n [%])	1848 (38.1)	1167 (40.5)
Oriental (n [%])	1012 (20.9)	524 (18.2)
Central (n [%])	1337 (27.6)	803 (27.8)
Pacific (n [%])	648 (13.4)	391 (13.6)

Table N. S2 Difference- in- difference (DID) estimate of the effect of *Familias en Accion* (FA) conditional cash transfer program on BMI for each separate follow-up period, children 2-7 years, Colombia

	BMI z-scores[a]	Thinness[b]	Overweight[b]	Obesity[b]
	β-Coefficient (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Treatment group	-0.10 (-0.26, 0.07)	5.00 (1.71, 14.6)	0.83 (0.54, 1.29)	1.89 (1.00, 3.59)
Time dummy at 1st follow-up	-0.21 (-0.29, -0.13)	1.47.95 (0.91, 2.39)	0.63 (0.51, 0.80)	0.73 (0.37, 1.43)
Time dummy at 2nd follow-up	-0.38 (-0.51, -0.25)	2.88 (0.99, 8.40)	0.42 (0.27, 0.65)	0.93 (0.41, 2.09)
DID Estimate (Treatment* time dummy at 1st follow-up)	0.11 (-0.04, 0.26)	0.31 (0.10, 0.95)	1.16 (0.79, 1.72)	0.68 (0.21, 2.18)
DID Estimate (Treatment* time dummy at 2nd follow-up)	0.16 (0.01, 0.32)	0.24 (0.07, 0.84)	1.34 (0.77, 2.34)	0.48 (0.18, 1.31)

[a] Values are regression coefficients.
[b] Values are odds ratios
Variables included in the model: age, sex, participation in *Hogares Comunitarios* (home-based health care) mother's marital status, mother's age, mother's education, mother's BMI, household income, level of urbanization, inhabitants and region.

Table N. S3 Difference- in- difference (DID) estimate of the effect of *Familias en Accion* (FA) conditional cash transfer program on BMI categories using Cole cut-offs, children 2-7 years, Colombia

	Thinness[b]	Overweight[b]	Obesity[b]
	Odds ratio (95% CI)	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**
Treatment group	1.66 (0.90, 3.03)	0.89 (0.54, 1.47)	1.96 (0.83, 4.63)
Time dummy	1.42 (0.99, 2.03)	0.79 (0.56, 1.13)	0.40 (0.14, 1.13)
DID Estimate (Treatment* time dummy)	0.74 (0.46, 1.19)	1.20 (0.69, 2.08)	1.49 (0.42, 5.30)

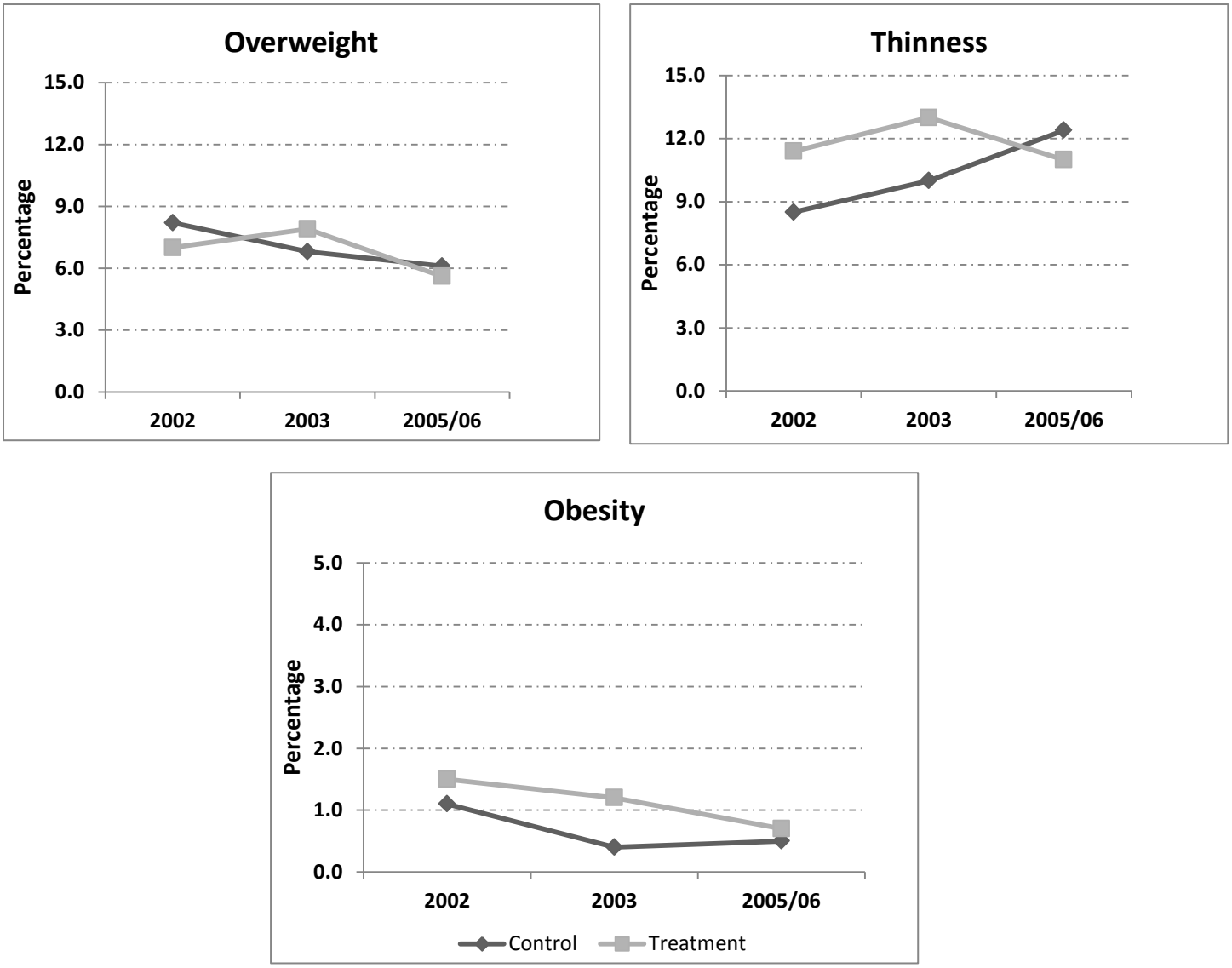
Variables included in the model: age, sex, participation in *Hogares Comunitarios* (home-based health care) mother's marital status, mother's age, mother's education, mother's BMI, household income, level of urbanization, inhabitants and region.

Table N. S4 Difference- in- difference (DID) estimate of the effect of *Familias en Accion* (FA) conditional cash transfer program on BMI, thinness, overweight and obesity for total treatment group (including municipalities that received cash transfers before baseline assessment), children 2-7, Colombia

	BAZ[a]	Thinness[b]	Overweight[b]	Obesity[b]
	β-Coefficient (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Treatment group	0.01 (0.08, -0.15)	3.52 (1.16, 10.65)	0.99 (0.66, 1.49)	2.37 (1.20, 4.67)
Time dummy	-0.29 (-0.39, 0.20)	2.2 7 (0.98, 5.28)	0.51 (0.38, 0.70)	0.82 (0.40, 1.70)
DID Estimate (Treatment* time dummy)	0.03 (-0.09, 0.15)	0.35 (0.12, 1.02)	1.02 (0.70, 1.50)	0.47 (0.19, 1.13)

[a] Values are regression coefficients.
[b] Values are odds ratios
Variables included in the model: age, sex, participation in *Hogares Comunitarios* (home-based health care) mother's marital status, mother's age, mother's education, mother's BMI, household income, level of urbanization, inhabitants and region.

Figure S1 Trends in thinness, overweight and obesity by treatment status using Cole cut-offs, *Familias en Accion* (FA) conditional cash transfer program, children 2-7 years, Colombia



According to Cole cut-off, thinness corresponding to a BMI at age 18 years of <18.5 kg/m^2.
According to Cole cut-off, overweight corresponding to a BMI at age 18 years ≥ 25 kg/m^2.
According to Cole cut-off, obesity corresponding to a BMI at age 18 years ≥30 kg/m^2.
All plotted points took into account the clustered design of the study and sample weights.