The Impact of a Technical Education Program for Childcare Providers on Children's Well-being[1]

Abstract

The early childhood community-based program *Hogares Comunitarios de Bienestar* serves 800,000 low-income children under the age of 5 in Colombia. Earlier studies have identified care providers (*madres comunitarias*) as having, on average, low education levels and not being appropriately trained for the provision of childcare services. In 2007, a technical education program was introduced which offers a degree in child development and care for childcare providers. In this paper we assess the effects of this program on the quality of care provided in the relevant nurseries and on the nutritional and health status, and cognitive and socio-emotional development of beneficiary children in Bogotá. This evaluation takes advantage of the gradual geographic expansion of the program in order to estimate treatment effects. Results indicate that the quality of care has significantly increased in these family-based nurseries and that the program has thus had a positive and significant effect on the health, cognitive and socio-emotional development of beneficiary children, especially those younger than 3 years of age.

JEL codes: J13, I20, H43
Key words: Economic impact, early childhood, technical education.

[1] Abbreviations used: ICBF for Instituto Colombiano de Bienestar Familiar (Colombian Family Welfare Agency) HCB for *Hogares Comunitarios* (home-based nurseries) and MC for *madres comunitarias* (care providers at *Hogares Comunitarios*).

1. Introduction

Hogares Comunitarios de Bienestar ICBF (HCB) is a home-based childcare program that was established in 1972 in Colombia with the primary aim of providing childcare to vulnerable families and thereby promoting female labor participation. The program currently delivers home-based childcare, supplemental nutrition and psychosocial stimulation to 784,000 low-income children under the age of 6 (32% of eligible children are aged between 0 and 5) in almost 79,000 HCBs throughout most of Colombia's 1,100 municipalities. Historically, the implementation of early childhood and family support policies in Colombia has been led by the National Institute of Family Welfare (ICBF). The ICBF's budget represents 0.3% of GDP and has traditionally been funded through payroll taxes (Bernal & Camacho, 2012).

The central features of the HCB program are the provision of 50-70% of daily nutritional requirements through lunch and two snacks, and the promotion of children's physical growth and health, and their social and cognitive development. Participating parents are required to pay a monthly fee of no more than 25% of the daily minimum wage. Traditional HCB childcare homes are led by a "community mother" (MC), a home-based childcare provider who lives in the same community. During weekdays, each childcare home serves up to 15 children between the ages of 6 months and 5 years via part-time or full-time schedules. The cost of the program is around US$430 per child per year.

Bernal et al. (2009) and Bernal and Fernandez (2013) conclude that long-term exposure to the program, versus short-term program exposure, has a positive effect on children's cognitive and socio-emotional development. However, the authors also report severe flaws in the quality of the care provided, which significantly decreases the potential effects of the program. In particular, they reveal that care providers (MC) have, on average, low education levels and are not appropriately trained for the provision of childcare services. Bernal et al. (2009) report that almost 16% of MCs complete primary school or a lower level of education, 68% are high-school dropouts, 16% are high-school graduates, and only a few have at least one year of college or technical/vocational education. In addition, MCs score approximately 57% on the Knowledge of Infant Development Inventory (KIDI, MacPhee 1981), a 58-item instrument that assesses a caregiver's factual knowledge of childcare/parenting practices, health and safety, developmental processes, and milestones.

The authors also report that ratings of the Family Day Care Rating Scale (FCDRS; Harms and Clifford 1989) are low (M= 3.08; SD = 0.89; scale range 1-7). FDCRS total scores are higher for HBCs led by MCs with a technical or professional degree (M= 3.02; SD = 0.83), compared with those led by MCs with basic primary schooling (M= 2.70 = SD = 0.65). These scores suggest that only the minimum required conditions are met in the daycare setting according to international standards.

These findings have partly motivated the design and implementation of a technical education program for early childhood development and care for MCs, which is offered jointly by ICBF and the National Learning Agency (SENA), the institution in charge of adult training programs in Colombia. The program offers a technical degree over two academic semesters and approximately 2,640 hours of instruction. The program is aimed at: (1) improving knowledge about early childhood development, developmental milestones and appropriate educational and stimulation practices by age range; (2) promoting the development of specific curricular guidelines aimed at improving children's cognitive and socio-emotional development; (3) developing skills aimed at promoting children's health and nutrition from gestation to the age of 6; and (4) providing MCs with appropriate training in cases of sudden illness or accident.

In this paper we evaluate the effects of this technical education program in Early Childhood Development and Care (ECDC), which is offered at no cost to MCs in the city of Bogotá who voluntarily agree to participate. The program has been introduced throughout regions and within city neighborhoods in a somewhat random order and at a sporadic pace. We exploit the program's gradual expansion in Bogotá in order to assess its effects on the quality of care offered through HCB and its effects on the nutritional and health status, cognitive and non-cognitive development of beneficiary children.

This evaluation contributes to early childhood and education literature across various dimensions. First, it shows the direct effects of the program on children being taken care of by these childcare providers. Second, it highlights the importance of technical education beyond its direct effects on the student; we show the effects of technical education on the direct beneficiaries of these students and thus contribute to an understanding of the externalities and social gains of relevant vocational education for adults. Finally, this paper adds to an understanding of the characteristics of childcare providers that have a positive impact on children and the cost-effective ways of enhancing their skills. As evidenced in the education literature, it is difficult to determine the characteristics of "good teachers" in the case of early education. In general, evidence does not support any association between a teacher's educational qualifications and program quality or child learning. Previous studies report no general effects for any level of education beyond a high school diploma (Bernal and Fernández, 2013; Nores and Barnett, 2013; Early et al., 2006 and Early et al., 2007). We provide evidence of a technical education program for childcare providers that can have a significant effect on child development. This is particularly important since many countries in the Latin America region provide early childhood services for children younger than five via very similar home-based programs. [2]

[2] For example, *Programa de Desarrollo Infantil* in Bolivia, *Hogares de Cuidado Diario* in Venezuela, *Estancias* in Mexico, and *Programa Nacional Wawa Wasi* in Peru.

The results indicate that quality of care has increased significantly since the introduction of the program and that pedagogical processes have improved. In particular, the implementation of learning activities, the use of pedagogical resources, and interactions between parents and care providers have increased. Consequently, we have seen positive and significant effects for beneficiary children in treated HCBs regarding health and cognitive and non-cognitive outcomes, particularly in relation to children between the ages of 6 months and 3 years. These results are both interesting and extremely relevant to education policy because they suggest that it is possible to improve the quality of such an inexpensive childcare program.

This paper is organized as follows. In section 2 we describe the ECDC program in detail. In section 3 we present the evaluation strategy. In section 4 we present the results of the evaluation and section 5 concludes.

2. The ECDC Program

Together with SENA, the ICBF designed and implemented the ECDC program in 2007 in order to offer technical education to the care providers of HCB, known as *madres comunitarias* (MC), in topics relating to early childhood development and care. The program's objective is to offer pedagogical tools that (1) respond with quality and relevance to the needs of children between the ages of 0 and 6, (2) promote permanent analysis, training and research concerning these needs, (3) design responses to concrete problems that are latent in different modes of early childhood programs, and (4) promote participation and permanent interactions with parents and the community (SENA, 2007). The program has a total duration of 2,640 hours of training, of which 1,320 comprise guided classes with instructors, 440 involve individual work and 880 are devoted to group and individual projects. Individual and group work is emphasized to promote problem-solving skills. The program is free for MCs but tuition costs per MC for SENA are US$684.

The program is aimed at improving pedagogical practices among childcare providers (MCs). This is achieved through a structured curriculum of five components: (1) Educational processes during early childhood aimed at promoting child cognitive development; (2) promotion of socio-emotional abilities during early childhood; (3) assistance in cases of accident and sudden illness, (4) child nutritional and health status from gestation to 6 years of age; and (5) ethics, transformation and leadership within the community.[3] Accordingly, the program involves a combination of several training areas relating to health, education, community participation and nutrition. This is a direct consequence of the fact that the HCB program constitutes a comprehensive early childhood intervention that serves children across all of these dimensions.

[3] Details about the five modules are presented in Appendix A.

MCs who participate in the ECDC program have to be high school graduates and over 17 years of age. Upon completion, they receive a technical degree in Early Childhood Development and Care (ECDC). Regardless of their schooling, all MCs earn a minimum wage plus fringe benefits (close to USD 500 per month).

The program is currently on offer in Colombia's main cities and is gradually being expanded across a range of municipalities and neighborhoods. In Bogotá (Colombia's capital city), groups of around 60-70 MCs begin the program every trimester. During the initial stages of the program's operations in Bogotá, ICBF gradually expanded the program to encompass various neighborhoods. It did so without any systematic order and according to relatively vague criteria. At the beginning of each trimester, the ICBF issues a call for participation in the ECDC program within a specific neighborhood. MCs interested in participating in the program express their interest by signing up to a waiting list at their local ICBF office. MCs included in the list are then invited by SENA to attend a presentation about the program where they learn about the full requirements for participation. MCs are then immediately registered for courses and classes begin two to three weeks later.

3. Evaluation Strategy of the ECDC Program in Bogotá

Our study takes advantage of the gradual and somewhat ad hoc expansion of the program within neighborhoods in Bogotá in order to define a treatment group of MCs who had graduated from the ECDC program by 2009 (first and second cohorts) and a control group of MCs that had expressed interest in the program during the second semester of 2009 and were scheduled to start classes in January 2010. These groups belong to different communities since the program has been offered sequentially throughout neighborhoods according to vague criteria that we claim to be arbitrary. Details are presented below in section 3.1. Following this, data was collected for the socio-demographic characteristics and outcome variables for children in a sample of 140 HCs in these two groups between November and December 2009. Unfortunately, we did not collect longitudinal data to control for preexisting differences between the groups. However, we use other administrative data to study the possibility of differences occurring between the groups prior to the introduction of the intervention.

3.1. Definition of the comparison groups and estimation strategy

In Figure 1 we present both the timeline and design used in this evaluation. The lower panel (dark grey) describes the treatment group, which comprises two different cohorts of MCs who had completed the ECDC program by July 2009 (first and second cohorts). The first cohort began the program in September 2007 and graduated in December 2008, while the second cohort started in April 2008 and graduated in July 2009.

[Figure 1]

From the two neighborhoods of Engativá and Suba, 72 MCs commenced the program in September 2007, out of which 43 successfully graduated in December 2008 (first cohort). Similarly, 78 MCs from four other neighborhoods, namely Barrios Unidos, Ciudad Bolívar, Santa Fé and Usme, started in April 2008, out of which 54 went on to successfully graduate (second cohort). SENA did not keep detailed student files for the MCs that dropped out of the ECDC program before graduation and for this reason we only possess data for treated MCs who successfully finished the program. Out of the total 100 MCs that graduated from the ECDC program in these two cohorts, we randomly selected 80 for the study and successfully interviewed 67 of these.

The upper panel in Figure 1 (light grey) describes the control group. In September 2009, a call for program participation was issued in three neighborhoods in Bogotá: San Cristóbal, Bosa and Ciudad Bolívar. In response to the call, 198 MCs preregistered for the program at their local ICBF offices. From these, 80 were randomly selected to form part of the study sample, out of which 73 were successfully interviewed. This group of MCs was set to initiate the program in January 2010. Finally, between November and December 2009 we collected information about MCs in both the treatment and control groups (140 HCBs were interviewed). We also collected data about the children served by these HCBs and their families. Women in the first graduating cohort had graduated a whole year prior to data collection, while women in the second cohort had graduated only six months before.

However, it must be noted that assignment to treatment was not random. We therefore assume that MCs who expressed interest in the program and preregistered in neighborhoods where calls for participation were issued *later* provide a valid counterfactual for MCs who completed the ECDC program in neighborhoods where calls were issued *earlier*. This assumption is particularly strong given that program dropout rates were close to 40% within the first two cohorts. Thus, the control group (MCs interested in the program) may differ from the MCs who successfully graduated from the program precisely because some of them might drop out of the program later on. The obvious solution would be to estimate the Intent to Treat (ITT) effect of the program by including both the MCs from the first two cohorts who completed and dropped out of the program. Unfortunately, detailed data were not available for MCs who dropped out of the program and so we do not possess any information about them (prior to or following the program).

We adopt two strategies to try and overcome these shortcomings. First, we matched the MCs in our study sample to two different administrative datasets prior to the introduction of the intervention in order to check for preexisting differences between the two groups and to control for average outcome variables at baseline. The results presented in section 4 indicate that the

MCs in both groups were identical in terms of observed socioeconomic characteristics before 2009. Moreover, the average nutritional status of children served by HCs in both groups was also identical prior to the intervention.[4] Second, we use propensity score matching to match MCs in the treatment and the control group in order to estimate more reliable treatment effects and also present estimates of different exposures to treatment by using only treated MCs.

A detailed description of the composition of the treatment and control groups by neighborhood is presented in Table 1. From a total of 160 MCs selected for evaluation, 20 did not form part of the final study sample. Eleven MCs were not included because they dropped out of the HCB program. All of these belonged to the treatment group and left the program sometime after graduating from the ECDC program.[5] The other nine MCs were not interviewed due to incorrect address, incorrect classification of HCB type and refusal to participate, all of which we assume to be randomly distributed across the groups.

Finally, in Table 2 we present the number of MCs and number of children by age range included in the final study sample. We end up with a total 140 HCBs: 67 treated and 73 controls. We have 187 children younger than the age of 3 and 584 children older than the age of 3 who belong to treated HCBs, making a total of 771 children. We have 187 children younger than the age of 3 and 621 children older than the age of 3 in the control HCBs, making a total of 808 beneficiary children in HCBs with untreated MCs. In sum, a total of 1,579 children comprise the study sample. We further define a subsample of children older than 3 years of age, making 40% of the total, for whom we collected some of the more costly instruments described in section 3.2.

[Table 2]

3.2. Measurement of outcome variables

We assess the effect of ECDC on: (1) the quality of care offered by HCB, (2) child nutritional status, (3) child health status, (4) child cognitive and socio-emotional development, and (5) the psychomotor development of children younger than 3. Quality of care offered is measured in various dimensions, including infrastructure and processes within the HCB, quality of pedagogical activities during the day, compliance with administrative guidelines regarding hygiene, food handling, personnel and infrastructure, and the interaction of MCs with parents.

[4] Nutritional data are obtained from ICBF's administrative dataset METRIX for nutritional follow-up and described later in section 4; they are not obtained from baseline survey data.

[5] By matching our dataset to administrative SISBEN data (from 2002 to 2008), i.e., prior to the ECDC program, we observe that treated MCs that drop out from the HCB program are not significantly poorer (socioeconomic stratum, SISBEN score, SISBEN level, monthly income, household characteristics such as floors) than non-dropouts. In addition there do not seem to be any differences in terms of education, marital status, household size or durable goods ownership with the exception of color television and sewerage. There is only a statistically significant difference in age, with MCs who drop out of the HCB program after ECDC graduation being younger than non-dropouts.

Each of these dimensions is directly associated with the expected results of the program, given the objectives and curriculum content. In this section, we summarize the instruments used to measure each of these outcome variables in the five selected areas of interest. These instruments were collected between November and December 2009 through surveys, surveyors' direct observation of HCBs, and direct evaluation of the children, for example, anthropometric measurements.

First, we measure the effects of the program on quality of care offered at HCB. To do this, we include four measures:

i. The Family Day Care Rating Scale (FDCRS; Harms and Clifford, 1989) provides a global measure of family day-care quality via 40 items (and seven subscales) that cover a broad range of quality considerations, from safety to care provider and child interaction to parent involvement. This measure has been used extensively and has well-established validity and reliability across a number of countries and within different cultures and economic contexts. The FDCRS scale evaluates 7 dimensions of the childcare environment: (1) space and furnishings, (2) personal care routines, (3) listening and talking, (4) activities, (5) interaction, (6) program structure, and (7) parents and provider. Each dimension is scored from 1 to 7, where 1 reflects the worst conditions and 7 the best. This instrument is completed by appropriately trained personnel after the careful observation of daily activities. We construct a total FDCRS score and two subscales: the *infrastructure* subscale (which corresponds to item 1 above) and the *processes* subscale (which corresponds to the average of items 2 to 7).

ii. We use the rate of compliance with administrative ICBF guidelines in three domains, including kitchen personnel, food consumption areas and protective practices. These are registered after observation by the assessor. We group items into similar categories by computing the principal component. For example, "guidelines related to kitchen personnel" corresponds to the principal component of compliance for things such as wearing appropriate clothing, covering the hair, appropriate handling of food, and so on. A higher principal component indicates greater compliance with the guidelines. Guidelines related to the food consumption area include items such as the availability of appropriate tables and chairs for children in the dining area, cleanliness of the area, absence of garbage, hand-washing habits, and so on. Finally, protective practices refers to the availability of menu guidelines, substitution lists for items unavailable in the menu, standardized recipes, use of dietary supplements and use of filtered water .

iii. The implementation of conducive learning environments is measured by recourse to three instruments. The first is the frequency of pedagogical activities taking place at the HCB. This comprises 19 items rated on a five-point Likert scale. MCs indicated how often they implemented a variety of pedagogical routines (once a day, sometimes in a week, sometimes in a month, rarely or never), including teaching colors, letters, numbers and shapes, solving

problems, writing, learning body parts, gross and fine motor development, language, reading books, and so on. The second measure is the frequency with which the MC uses recyclable material for pedagogical purposes. For example, cartons, newspapers, bottles, old books, other organic materials, and so on. The number reported is the principal component of 10 items rated on a three-point Likert scale (many times, sometimes and never). Finally, we include the frequency of pedagogical activities outside the HCB on a three-point Likert scale, including visits to libraries, museums, parks and pools.

iv. The interaction of MCs with beneficiary parents, which we measure by asking parents about the frequency and type of information that the MC shares with them about their children. Responses for each category are coded on a three-point Likert scale (never, sometimes, very frequently).

Second, we measure the effect of the program on the children's outcome variables, such as health and nutritional status, cognitive, psychomotor and socio-emotional development. First, we measure child health by asking about incidences of diarrhea, coughing, colds or the flu and other illnesses during the two weeks prior to the parental report. Second, for nutritional status we use Z-scores for height for age, weight for age and weight for height.

Third, socio-emotional development is assessed by the Penn Interactive Peer Play Scale for children older than 3 years, while the Ages and Stages Questionnaire is used for all children in the sample. The Penn Interactive Peer Play Scale (PIPPS; Castro et al., 2002; Fantuzzo & McWayne, 2002) is a behavioral rating instrument that is used to assess peer play behaviors across various settings during early childhood; it has been validated with Spanish-speaking Hispanic low-income preschoolers in the US. It consists of 32 items rated on a four-point Likert scale. Childcare providers indicated how often they observed a range of behaviors during free play in the previous two months (for example, "shares toys with other children," "destroys other children's property," "is physically aggressive"). The items assess three dimensions of a child's behavior: (i) play strengths such as comforting and helping other children (Play Interaction); (ii) aggressive or disruptive behaviors that interfere with peer play (Play Aggression); and (iii) withdrawn behavior and nonparticipation in peer play (Play Isolation).

The Ages and Stages Questionnaire for the Socio-Emotional domain (ASQ: SE) (Squires, Bricker and Twombly, 2009) is a parent-completed assessment system for children aged 6 to 60 months. The ASQ comprises a series of culturally sensitive, parent-completed questionnaires that focus on socio-emotional development and the identification of children at risk of social-emotional difficulties. It includes self-regulation, compliance, communication, adaptive functioning, autonomy, affect and interactions with others. It is designed to be administered at 6-month intervals. The ASQ shows high levels of consistency, reliability, validity and specificity (Squires, Bricker and Twombly, 2007; Squires, Bricker, Heo and Twombly, 2001) and has been

used for early development assessments in numerous low-income and middle-to-low-income countries (Handal et al. 2007; Heo et al. 2007; Tsai et al. 2006).

Finally, we measure cognitive and psychomotor development by using two approaches. First, we use the Ages and Stages Questionnaire (ASQ3) for children between 0 and 3 years of age, which contains two sections that measure cognitive development, communication and problem solving, and two sections that measure fine and gross motor development. Second, we use the Woodcock-Muñoz Battery III (Muñoz-Sandoval et al., 2005), which is the Spanish adaptation of the Woodcock-Johnson Battery and consists of two distinct, co-normed cognitive and achievement tests in order to measure general intellectual ability, specific cognitive abilities, scholastic aptitude and academic achievement in children older than 3 years of age. Maintaining consistency with the aims of the HCB program, we use subscales that yield indicators of brief intellectual ability, verbal ability, mathematical reasoning and general knowledge for children older than 3 years of age.[6]

4. Evaluation Results and Discussion

We surveyed 67 treatment HCBs and 73 control HCBs, making a total of 140 HCBs. 1,579 children were registered and the parents interviewed at home, while another 1,365 were present and assessed during the day of our visit to the HCB.

4.1. Description of the treatment and control groups

To assess for preexisting differences between the treatment and control groups we use two other different sources of administrative data. First, we use SISBEN survey data from 2002 to 2008. SISBEN[7] is the System for Identification and Selection of Beneficiaries, an instrument developed to identify potential beneficiaries for social programs in Colombia. Today, the SISBEN survey represents a census of socioeconomically vulnerable households in Colombia (the target population of the HCB program). It inquires into the socio-demographic characteristics of household members and the characteristics of their dwelling before using this information to construct a SISBEN score. Eligibility for social programs is defined based on SISBEN score cutoffs. Second, we use ICBF's Nutritional Follow-up Database Metrix. Metrix is a monitoring system by which MCs report anthropometric measurements for the children served in their HCBs on a monthly basis.

Of the original 160 MCs in our study sample[8] we matched 123 with SISBEN data. From the unmatched 37 MCs, 14 reported in our study survey that they were not SISBEN beneficiaries.

[6] We collected this instrument from a subsample of 540 children between the ages of 3 and 6.
[7] *Sistema de Información de Selección de Beneficiarios*.
[8] A total of 160 were sampled for the study, even though only 140 were effectively interviewed. We matched the original sample to study bias due to dropout rates and non-interviews.

The remaining 23 could not be matched by name (due to different combinations of names) or identification number. In Appendix B we show how merged MCs differ from non-merged MCs (first column) in our study survey. In particular, we run a regression of an indicator that equals 1 if the MC was merged with SISBEN data and 0 otherwise for socio-demographic characteristics that presumably remain unaffected by the intervention and a treatment indicator. Results show that the two groups differ only by age and, most importantly, that the treatment indicator is insignificant. We attain a fraction of 50% treated MCs for the matched sample, compared with 48% for the original sample. We compare both groups using SISBEN data in Table 3.

[Table 3]

We present results for socioeconomic stratum (the lower the poorer), characteristics of the dwelling (such as number of rooms, floor materials and number of toilets) and socio-demographic characteristics (such as educational attainment, monthly income, size of the household, durable goods ownership, SISBEN score and SISBEN level, as defined by poverty cutoffs). The results indicate that both groups were very similar prior to the intervention, with the exception of socioeconomic stratum and SISBEN score in favor of treated MCs. However, both differences are only significant at a 10% confidence level.

To complement the analysis of preexisting differences, we also matched MCs in our study sample with data from ICBF's Metrix nutritional monitoring system. We matched 82 MCs (out of 160) in our sample with 2006-2008 Metrix data to assess whether average children's nutritional status in HCBs differed across groups prior to the intervention. The matching of MCs was done via the name of the HCB since the MCs' names and identification numbers are not available in Metrix.[9] From the 82 matched MCs, 35 belong to the control group and report a total of 5,047 child-month observations, while 47 belong to the treatment group and report a total 3,209 child-month observations. Unmatched MCs occur mostly due to typos or other errors in the names of HCBs and missing data within Metrix. In Appendix B we show how merged MCs differ from non-merged MCs (second column) using our study survey. In particular, we run a regression of an indicator that equals 1 if the MC merged with Metrix data and 0 otherwise for socio-demographic characteristics within our survey that presumably remain unaffected by the intervention and a treatment dummy. Results indicate that the two groups differ only in age and marital status but, most importantly, the treatment indicator is insignificant.

Using Metrix data, we estimate the following equation:

[9] We also tried matching children in our study sample with Metrix. However, this matching needed to be done with the child's name since identification numbers are not available in either dataset. Given the difficulty of matching by name we could only match about 400 children out of 1,800.

$$z_{ijmy} = \beta_o + \beta_1 D_j \ldots + \gamma_{month} + \gamma_{year} + \delta_1 age_{ijmy} + \delta_2 exposure_{ijmy} + \varepsilon_{ijmy} \quad (1)$$

where z_{ijmy} is a nutritional status indicator, specifically, a nutritional Z-score for each child *i* in HCB *j* in month *m* and year *y*. As explanatory variables we include an indicator for treatment (i.e., D_j =1 if MC *j* participated in the intervention and 0 otherwise), month and year fixed effects, child's age in months and the duration of the child's participation in the HCB program ($exposure_{ijmy}$). Finally, errors are clustered at the HCB level. The estimated β_1 is reported in Table 4 for each of the three nutritional status indicators: height for age, weight for age and weight for height. As can be observed, there are no significant differences in nutritional status by group prior to the intervention.

[Table 4]

Finally, we also check for balance between groups in Table 5, where we present a comparison of MCs by group using our study survey (post-intervention). In particular, we show differences in socio-demographic variables, such as household average income and expenditures, whether the MC's household was surveyed by the SISBEN instrument, if the household has a SISBEN level less than or equal to 2[10], household composition (household size, number of children, marital status of the MC and relationship with the head of the household), MC's average income associated with her work in the HCB, MC's household wealth quintile[11], time as an MC and number of children in her HCB. Most importantly, we pay close attention to variables that cannot be changed by the intervention, such as age, other household demographic characteristics, marital status and pre-intervention education level[12].

The results presented indicate that MCs from the treatment group do not significantly differ from MCs in the control group, particularly in relation to variables that should not have been affected by the intervention. The only variable for which groups significantly differ is total time serving as an MC.[13] The last row in the table presents a summary index of all socio-demographic characteristics of the MCs as defined by Kling, Liebman and Katz (2007)[14]. The mean comparison indicates that the two groups are not statistically different.

[10] This threshold identifies the poorest segment of the Colombian population.

[11] The household wealth index is constructed as the principal component of several items, including ownership of durable goods and characteristics of the household, such as quality of floors and walls and availability of public utilities.

[12] In the case of educational attainment, we present pre-intervention levels for MCs in the treatment group.

[13] We also ran a LPM that includes all the observed characteristics presented in Table 5. Individually, MC's age and time as MC are statistically significant. However, the model is not jointly significant, with an F test of 1.48 with p-value equal to 0.1138.

[14] In particular, we define the summary index to be the equally weighted average of all Z-score components of the index, with the sign of each component adjusted so that positive (beneficial) outcomes have a positive sign and vice versa. The individual Z-scores of components of the summary index are computed by subtracting the control mean from the variable and dividing by the control group standard deviation.

[Table 5]

In Table 6 we present a description of households of beneficiary children by group using data from our survey, i.e., post-intervention. As before, we focus on variables that are unlikely to be affected by the intervention, thus creating a balancing test.[15] These results suggest that both groups are very similar in terms of wealth, maternal age, education and employment status, household structure (marital status, presence of the father, female head of household, household size, number of children, and so on), type of health insurance, maternal labor income, and more. Individually, a few variables are statistically different between the two groups, including whether the household has a SISBEN survey, the fraction of households with a SISBEN level less than or equal to 2 and average monthly expenditures. In particular, control households have a higher likelihood of having a SISBEN survey, having a lower SISBEN level and lower average expenditures.[16] The Kling et al. (2007) summary index at the end of the table indicates that the there is a small difference of 0.02 SD between the two groups, which is significant at a 10% confidence level.

[Table 6]

Overall, we take this as evidence to suggest that the treatment and control groups were very similar prior to the intervention and that post-intervention they have remained similar, especially in terms of those variables that were unlikely to be affected by the intervention, such as maternal education, age, household size and composition, marital status and employment status. This provides evidence in favor of our hypothesis that MCs interested in the program are similar to MCs that successfully complete the program.

4.2. Estimation results

In spite of the results presented in Section 4.1, we do observe some significant differences between treated and control MCs, particularly for years of experience as a MC. This might be problematic if experience is associated with MC skills and performance. For this reason, we estimate program effects using propensity score matching in an attempt to attenuate the possible bias that these differences might induce. We thus assume that selection into groups is due to observed characteristics of MCs, and possibly observed differences of the children served and their families. To estimate the effect of the program on the quality of care offered at HCBs, we first estimate the propensity score using a probit regression model for the probability of belonging to the treatment group on all observed characteristics of the MCs in Table 5[17]. The

[15] We could not match children's parents to the SISBEN Survey since we did not collect identification numbers from parents. We tried matching by name but achieved a very small sample of less than 25%.
[16] We estimate a LPM for the probability that the household belongs to the treatment group. The F test for joint significant for all these observable socio-demographic characteristics is 1.33 with a p-value of 0.168.
[17] Except for SISBEN level, monthly household income and expenses, ICBF monthly grant and parental co-payments due to excessive loss of observations.

propensity score quantifies the extent to which MCs are similar in terms of observed characteristics. Then we match the treatment and control MCs based on their predicted probability of treatment and compare their outcome variables in order to estimate program effects. The estimation has been conducted using the nonparametric kernel method and has been adjusted for common support; standard errors have been calculated by bootstrapping (Heckman & Todd, 2009). The common support consists of 65 out of the 67 treated MCs and 66 out of the 73 control MCs.

We also present treatment effects on the outcomes for children by matching the observed characteristics of children and their families, and MCs. In particular, the propensity score is estimated using child's age and gender, household average monthly expenses, mother's education and marital status, household size and number of children under 18, an indicator of the lowest household income quintile and all of the MC characteristics that are included in models at the HCB level. We also estimate this model using the nonparametric kernel method and adjust for common support. In this case, standard errors are calculated by bootstrapping with 50 repetitions and are robust to HCB clusters. The common support consists of 614 children out of 651 in the control group and 637 children out of 658 in the treatment group.

4.2.1. Effects of the program on the quality of care provided by HCB

In Table 7 we present estimated treatment effects on the quality of care provided by HCB. The first columns show the mean and the standard deviation for the outcome variables of the control group. The first panel presents program effects on the quality of care provided by HCB, as measured by the FDCRS scale. The mean FDRCS score in the complete sample is 3.8/7.0. The mean processes subscale is 3.98/7.0 and the average infrastructure subscale is 3.1/7.0. Scores between 2 and 4 imply minimal compliance with quality criteria, which means that the scores attained by both groups are considerably low.

According to the results presented in Table 7, the program has had a positive and significant effect on the quality of care as measured by FDCRS. In particular, the effect is positive and statistically significant at a 1% confidence level in the case of processes, and statistically significant at a 5% confidence level in the case of infrastructure and total score. The size of the effect ranges from 0.2 to 0.4 points on a 1 to 7 scale, which is equivalent to 0.3 standard deviations (SD) in the case of infrastructure scores and 0.5 SD in the case of process scores. Bernal et al. (2009) report a 0.3 SD difference in total FDCRS scores in 2007 between MCs with completed vocational/technical education and MCs with only primary education. Similarly, comparing results from Bernal et al. (2014) and Maldonado and Votruba-Drzal (2013) we know that average differences between public and private center-based services for socioeconomically vulnerable children older than 2 years of age in urban Colombia reach 0.3 of SD in infrastructure

and 0.1 SD in processes using the ECERS[18] scale, both in favor of private settings. Finally, Bernal et al. (2014) report that average ECERS-infrastructure scores are about 0.15 SD higher in center-based facilities for children older than 2 years of age than for HCBs in urban Colombia. To our knowledge, there are no evaluations that assess the impact of interventions on FDCRS scores in the Latin America region with which we might compare these results.

[Table 7]

The second panel in Table 7 shows measures of compliance with administrative ICBF guidelines. We report a positive and statistically significant effect of the program on compliance with guidelines relating to kitchen personnel and protective practices. In particular, both effects are around 0.3 index points, which corresponds to 0.3 SD and 0.6 SD respectively. Both effects are statistically significant at a 5% confidence level. In the third panel of Table 7, we report outcome variables in relation to the design and implementation of conducive learning environments. We find a positive and significant effect in all cases. In particular, there is a positive effect that ranges from 0.3 to 0.4 SD.

In the final panel of Table 7 we report the frequency with which MCs shared information with parents about their children. We find a positive and significant effect in the case of information about nutrition and breastfeeding of approximately 0.3 SD. Finally, we report a summary index in the last row of the table in the spirit of Kling et al. (2007), which weights the Z-scores of all the quality measures included in the table. The results indicate that, on average, the program has had a positive effect on the quality of care offered by HCB of approximately 0.3 SD and is statistically significant at a 1% confidence level.

In Table 8 we present similar results for HCB/MC outcomes but we control for the baseline observed characteristics of MCs by using the SISBEN survey (2002-2008). In addition, we include average baseline weight-for-height Z-scores for the children served by these HCBs from Metrix (2006-2008). Note that since we match the MCs with two different datasets, the sample size in this exercise falls from 135 to 61 HCB. In spite of this reduction in sample size, some of the effects presented in Table 7 remain. There is still a positive and significant effect on our quality summary index of 0.3 SD, which is statistically significant at a 1% confidence level.

[Table 8]

4.2.2. Effects of the program on children's well-being

In Table 9 we present the estimated effects of treatment on the children's nutritional and health status, cognitive and socio-emotional development, and the psychomotor development of

[18] Environment Rating Scales.

children younger than 3 years of age. In each case, we present two sets of results: (1) a comparison of all treated MCs with all MCs in the control group, and (2) a comparison of the subset of treated MCs who completed the ECDC program in 2008 (a whole year earlier) with all the MCs in the control group.[19] This is so because some developmental outcomes take time to change in response to interventions. For this reason, we restrict the second estimation to HCBs in which the children have been exposed to an ECDC MC for at least one year.

[Table 9]

As can be observed, few significant treatment effects are observed when comparing all treated MCs with all control MCs. However, once we restrict the treatment group to those MCs who graduated an entire year earlier, we observe positive and significant effects in most dimensions of child development. In the first panel of the table we report a statistically significant reduction of approximately 5 percentage points in the incidence of cough, cold or flu within the previous two weeks (0.15 SD). We do not report significant treatment effects on the children's nutritional status (second panel). In terms of socio-emotional behavior (third panel), we report positive and statistically significant program effects for ASQ socio-emotional scores and imputed risk for all children between 0 and 5 years of age. Imputed risk decreases by approximately 8 percentage points or 0.2 SD.

In terms of cognitive development (fourth panel in Table 9), we report positive and significant effects for the ASQ problem-solving scores and imputed risk, and ASQ total cognitive scores for children younger than 3 years of age. In particular, the reported effects constitute approximately 4.8 score points (0.4 SD), a risk of lag in problem solving that is 7 percentage points lower (0.26 SD), and 4.8 points in cognitive ASQ scores, or 0.26 SD, for children younger than 3 years of age. In addition, we report a positive and significant effect (at a 10% confidence level) on WM general knowledge results for children older than 3 years of age, which stands at approximately 3.2 score points or 0.24 SD. We do not report any significant effects on psychomotor development for children younger than 3 years of age. Finally, in the last row of the table we report on treatment effects using a summary index that weights all Z-scores equally for children's outcomes in the spirit of Kling et al. (2007). The results indicate a positive effect of approximately 0.14 SD on children's development that is statistically significant at a 1% confidence level.

In sum, evident transformations in the quality of care offered by HCBs have had a positive effect on children's health and cognitive and socio-emotional development as a result of the program. In comparison, Nores and Barnett (2010) report average effects for continuous outcomes in

[19] In this case, the common support corresponds to 46 out of 73 MCs in the control group and 21 out of 26 MCs who graduated from the program in 2008.

verbal ability and/or cognition of 0.25 SD for center-based early childhood programs in the Latin America region. The effects are stronger when we compare the control group with MCs that successfully completed the ECDC at least one year prior to assessments, as well as also being more consistent for children younger than 3 years of age. This evidence is consistent with previous findings that indicate that early childhood program effects will be greater for children who enter the program earlier and stay longer and for the most vulnerable (Bernal and Fernández, 2012; Behrman, Cheng & Todd, 2004; McKay et al., 1978; Nores & Barnett, 2010; Perez-Escamilla & Pollitt 1995).

4.2.3. Effects of exposure to treatment

In an attempt to further reduce the bias that is potentially induced by differences in the unobserved characteristics of the MCs who successfully graduated from the ECDC program, and MCs who have expressed an interest in it, in this section we present exposure to treatment effects. In particular, in Table 10 we compare the children of MCs in the first treated cohort (one year of exposure) with children of MCs in the second treated cohort (six months of exposure). This comparison is made through propensity score matching using the nonparametric kernel algorithm. We estimate the probability of graduating earlier on all the observed characteristics of MCs, as in Table 7, using a probit model. In doing this we avoid the issue of self-selection into treatment but need to assume that selection into different treatment timings is completely explained by observed characteristics of MCs. This assumption is partially supported by the observation that the order in which the communities were selected for the program was somewhat random.

The results indicate positive and significant effects of prolonged exposure to the program on socio-emotional behavior, as measured by ASQ socio-emotional scores and imputed risk (for all children between 0 and 5 years) and PIPPS isolation, as well as adequate interaction scores for children older than 3 years. For example, adequate interactions for children older than 3 years increases by approximately 0.5 SD and imputed risk of socio-emotional lag for all children younger than 5 is reduced by 0.16 SD after six additional months of exposure to the program. Similarly, ASQ cognitive scores (for children younger than 3 years) improve by approximately 0.4 SD after six more months of program exposure, while WM general knowledge scores for children older than 3 years improve by 0.3 SD. Overall, we report a positive and significant effect on our development summary index of about 0.22 SD which is statistically significant at a 5% confidence level.

[Table 10]

4.2.4. Heterogeneous effects

In Table 11 we present heterogeneous treatment effects by child gender. The results indicate that most of the positive program effects are driven by girls. In particular, we report a significant

reduction of 6.7 percentage points in the incidence of cough, cold and flu for girls, but not for boys, and a reduction of 2.8 percentage points in the incidence of diarrhea for boys. All positive effects on socio-emotional behavior are observed for girls only. In this case, we report an improvement in adequate behavior (PIPPS) for girls older than 3 years of age of 0.3 SD and an improvement in AS:SE scores and imputed risk for all girls between 0 and 5 years of age of approximately 0.2 SD. The summary index for psychosocial behavior improves by 0.25 SD for girls but not for boys.

[Table 11]

In terms of cognitive development we report statistically significant improvements in ASQ problem solving for both boys and girls younger than 3 years. However, the size of the effect is one and a half times greater for girls than for boys (0.3 SD versus 0.2 SD). On the other hand, while we observe a positive and significant effect on younger girls' communication scores, we report a negative and significant effect for boys at 10% confidence level.

Finally, the results in Table 11 reveal that we do not observe average program effects for psychomotor development due to offsetting heterogeneous effects by child gender. In particular, we report positive and statistically significant effects for girls younger than 3 years of age for fine motor skills (no effects on gross motor skills), but negative effects for boys on both fine and gross motor skills, even though these effects are insignificant. In sum, using our Kling et al. (2007) summary index reported in the last row of the table, we report an overall program effect of 0.18 SD for girls, which is statistically significant at 1%, but we report no statistically significant effect for boys.

Finally, we estimate quantile regressions[20] for program effects that indicate that the effects are greater for children at the bottom of the developmental distribution. In particular, the estimated program effect for children in the 25th percentile is 0.16 SD in our overall development summary index and it is statistically significant at 5%; for children in the 50th percentile the effect is 0.11 SD and statistically significant at 10%; and the effect for children in the 75th percentile is 0.04 SD but not statistically significant.

4.3. Benefit-cost Ratio

Using estimates reported by Lee (2012) for health, by Alderman et al. (1996) for cognitive ability (in Brazil), and by Heckman et al. (2006) and Flossman et al. (2007) for socio-emotional skills (in the United States and Germany respectively), we translate these program impacts into wage increases. In particular, we estimate an increase of 1.6% in wages due to health improvements, an increase of between 1.4% and 2.3% in wages due to improvements in

[20] These results are not shown but are available upon request.

cognitive ability, and an increase of between 2.2% and 8% in wages due to improved socio-emotional skills (depending on the estimate used). We present our benefit-cost ratio based on the most conservative estimates, which implies a total program effect on adult wages of 5.2%.

We calculate the total cost of program participation per MC at USD 1,208. This includes the cost of tuition for one year, USD 684, the cost of monthly transportation, USD 316, the cost of uniforms, USD 117, and the cost of other materials required for coursework, USD 92. This implies a total cost *per child* served of USD 101, estimated by way of a conservative average of 12 children per MC (Bernal & Fernández, 2013). For the group of vulnerable populations eligible for the HCB program, these program impacts imply an annual change in wages from USD 2,574 to USD 2,731. Based on this information, the benefit-cost ratio ranges from 4 to 14, depending on the discount rate used for the calculation of net present values (at 10% and 5% respectively). This ratio might be higher if one considers that the same qualified MC could serve more than one cohort of children.

5. Conclusions and Discussion

In 2007, a program consisting of technical education for childcare providers in family-based nurseries (HCB) was implemented in Colombia. This step was taken in response to evaluation results that suggested that program effects were small or null due to a lack of appropriate training for care providers, known as *madres comunitarias* (MC). In this paper we present the results of the impact evaluation of this program for the city of Bogotá. To this end, we compare MCs who graduated from the program in 2008 and 2009 with MCs who preregistered for the program by the end of 2009 and were set to initiate classes in January 2010. Given that assignment to treatment was not random, we compare MCs in both groups prior to the intervention by merging our dataset with two administrative datasets that contain the socio-demographic characteristics of MCs and the nutritional status of the children served by these MCs prior to 2008. In addition, we use propensity score matching to attenuate biases that may possibly be attributed to the remaining preexisting differences between MCs in both groups. Finally, we also use duration to exposure analysis to sidestep selection into treatment.

The main results indicate that the program has had a positive and significant effect on the quality of care in HCBs, as measured by FDCRS. In particular, we estimate an increase that ranges from between 0.3 SD in infrastructure to 0.5 SD in processes. We also report positive average program effects for compliance with administrative guidelines, design of conducive learning environments in HCBs and the interaction of MCs with children's parents. In sum, we report a significant program effect of about 0.3 SD for a quality of care summary index constructed in the spirit of Kling et al. (2007).

We also report positive program effects on children's health, in particular for incidence of cough, flu and cold at approximately 5 percentage points, positive effects on the socio-emotional development of children between 0 and 5 years of age at approximately 0.2 SD, positive program effects on cognitive development at approximately 0.26 SD for children younger than 3 years and 0.24 SD for children older than 3 years. We do not find statistically significant program effects for either nutritional status or psychomotor development. In sum, we report an average treatment effect for our development summary index of approximately 0.14 SD, which is statistically significant at 1%. Interestingly, although the training program focuses on cognitive and non-cognitive skills it does not seem to induce a crowding-out effect on the provision of other skills. In fact, while we observe positive and significant effects for some of the outcomes, we do not report that the program reduces any of them.

We also report effects for duration of program exposure by comparing children served by MCs from the first graduated cohort with children served by MCs in the second graduated cohort. These results lend further evidence in support of our results, indicating positive effects for socio-emotional development and cognitive development for all children between 0 and 5 years of age.

Heterogeneous effects by gender indicate that most positive program effects are driven by girls. In particular, effects on socio-emotional development are only statistically significant for girls but not for boys, positive cognitive effects are robust and higher for girls than for boys, and effects on psychomotor development are only positive and statistically significant for girls. Finally, program impacts are higher for children at the 25th percentile of the developmental distribution than for children in the 50th and 75th percentiles.

The results reported in this study are very relevant to early childhood development policy. Most of the current debate regarding early childhood policy in Colombia, and in a large number of developing countries, aims at transforming existing and traditional ways of serving poor children into high-quality early childhood centers with the appropriate infrastructure, qualified personnel, well-developed curriculum and daily activities, a comprehensive nutritional component and parental involvement. This sounds ideal of course, but it also implies a significant increase in investment. For example, the cost of serving a child through HCB is around USD 430 per year, while the cost of serving that same child in a well-equipped large-scale childcare center is close to USD 1,400 per year. The cost per child of the qualification of childcare providers in traditional services is about USD 101. This would imply that the effects of modern childcare centers would have to significantly exceed 0.2 of a standard deviation for the transformation to be cost-effective.

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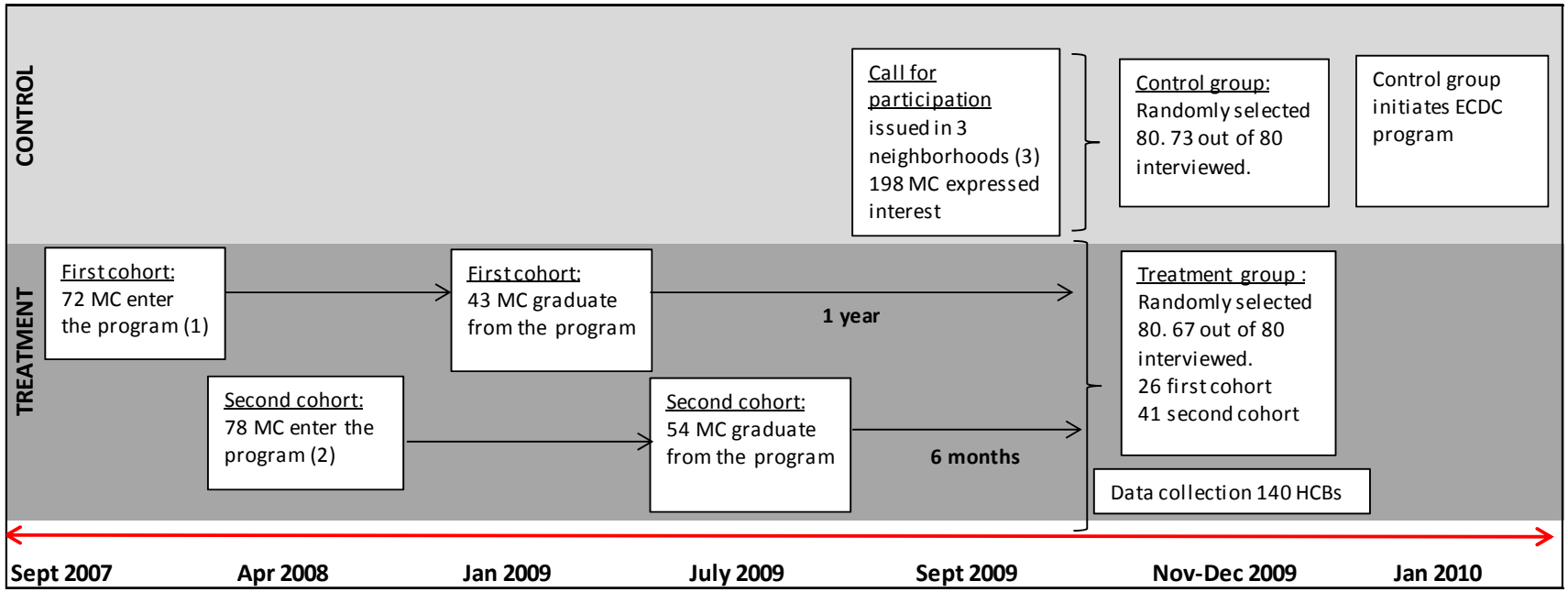
Figure 1. Intervention and Evaluation Timeline and Design



(1) Neighborhoods: Engativá and Suba

(2) Neighborhoods: Barrios Unidos, Ciudad Bolívar, Santa Fé, and Usme

(3) Neighborhoods: San Cristóbal, Bosa and Ciudad Bolívar

Table 1.
Number of HCBs per community and group in the initial sample

	Initial sample			Effective sample		
Community	**Treatment**	**Control**	**Total**	**Treatment**	**Control**	**Total**
Bosa	5	26	31	5	25	30
Engativá	19	0	19	17	0	17
C/Bolívar	18	25	43	15	21	36
Usme	10	0	10	9	0	9
Santa Fe	4	0	4	4	0	4
San Cristobal	0	30	30	0	27	27
Suba	19	0	19	13	0	13
B/Unidos	4	0	4	4	0	4
Total	79	81	160	67	73	140

Table 2.
Sample size by group

	TREATMENT GROUP	**CONTROL GROUP**	**TOTAL**
HCBs	67	73	140
Children 0-3 years	187	187	374
Children 3+ years	584	621	1205
Subsample 3+ years	229	269	498
Total	771	808	1579

Table 3.
Differences between treatment and control MCs using SISBEN survey prior to the intervention

Characteristics	Control	Treatment	P-value for difference
Socioeconomic stratum	1.49	1.77	0.05 *
Families in same dwelling	1.02	1.08	0.25
Rooms in dwelling	2.95	2.82	0.54
Rooms used to sleep	2.15	2.06	0.59
Number of toilets	1.23	1.15	0.30
Household size	4.85	4.63	0.44
Educational attainment	10.0	10.3	0.35
Monthly income (COL$)	130000	130000	0.74
Weeks looking for a job	0.72	1.03	0.72
Age	34.3	32	0.11
Telephone	80.3	79.0	0.86
Gas	75.4	80.6	0.48
Sewerage	85.2	90.3	0.39
Color television	91.8	90.3	0.77
Refrigerator	73.8	71	0.73
Oven	21.3	17.7	0.62
SISBEN score	16.01	18.5	0.07 *
SISBEN level:			
1	29.5	17.7	0.19
2	45.9	45.2	
3	24.6	37.1	
Floor material:			
Sand or dirt	1.6	0	0.47
Unpolished wood	3.3	0	
Cement	39.3	40.3	
Tile, brick	52.5	58.1	
Carpet, marble, parqué	3.3	1.6	
Marital status:			
Cohabiting	31.1	17.7	0.18
Married	36.1	50	
Widowed	0	1.6	
Separated / divorced	13.1	6.5	
Single	19.7	24.2	
Number of observations	61	62	

*** Significance at 1%; ** Significance at 5%; * Significance at 10%

Source: SISBEN Survey II (2003-2010).

For discrete outcomes, we present the p-value for the Pearson chi-squared test.

Table 4.

Difference in children's nutritional status between treatment and control HCB prior to the intervention

Nutritional status	Difference treatment-Control	Standard error	P-value for difference
Height-for-age (Z-score)	0.0259	0.074	0.726
Weight-for-age (Z-score)	0.0019	0.075	0.980
Weight-for-height (Z-score)	0.0098	0.087	0.910

Source: HCB nutritional status tracking system METRIX for years 2006, 2007 and 2008.
No. of observations in control group = 5,047 child-month and 35 HCBs.
No. of observations in treatment group = 3,209 child-month and 47 HCBs.
Difference is the coefficient on the treatment indicator in a regression of nutritional status on month and year dummies, child's age and duration of program participation, and HCB clustered standard errors.

Table 5.
MC & HCB Comparison by Group

OBSERVABLE CHARACTERISTICS	TREATMENT		CONTROL		DIFFERENCE		
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. Err.	
SISBEN survey (%)	68,7	(5,71)	72,6	(5,25)	-3,94	(3,74)	
SISBEN level 2 or less (%)	84,7	(5,85)	91,1	(4,29)	-6,50	(7,13)	
Household's average monthly income (COL$000)	1.223,2	(639,9)	1.388,2	(950,9)	-165,2	(138,3)	
Household's average monthly expenditures (COL$000)	882,8	(490,7)	874,3	(496,1)	8,50	(83,7)	
MC's age	40,9	(8,68)	40,9	(8,22)	-0,03	(1,43)	
MC's average schooling attainment [a]	11,4	(1,50)	11,6	(1,94)	-0,27	(0,30)	
MC is head of household (%)	26,86	(44,6)	30,13	(46,2)	3,27	(7,69)	
MC is head of household's spouse (%)	65,66	(47,8)	61,64	(48,9)	4,02	(8,19)	
MC is head of household's daughter (%)	7,46	(26,5)	5,48	(22,9)	1,98	(4,17)	
MC is married or cohabiting (%)	68,66	(46,7)	71,23	(45,6)	-2,57	(7,80)	
MC is separated, widowed or single (%)	31,3	(46,7)	27,4	(44,9)	3,94	(7,74)	
Household size	4,09	(1,47)	4,16	(1,32)	-0,07	(0,24)	
Number of children under 18 in household	1,45	(1,04)	1,56	(0,97)	-0,11	(0,17)	
ICBF monthly grant to HCB (COL$000)	323	(26,0)	328	(17,4)	-5,40	(3,75)	
Monthly co-payment fees to HCB (COL$000)	281	(126,1)	306	(136,7)	-24,8	(22,8)	
% of HCB in lowest wealth quintile [b]	16,4	(4,55)	21,9	(4,87)	-5,49	(6,71)	
% of HCB in highest wealth quintile [b]	22,4	(5,13)	19,2	(4,63)	3,20	(6,90)	
Wealth index [b]	-0,070	(1,35)	0,064	(0,49)	-0,134	(0,17)	
% contributive health insurance	94,0	(2,91)	94,5	(2,68)	-0,49	(3,95)	
% subsidized health insurance	2,97	(2,09)	1,37	(1,37)	1,60	(2,46)	
Continuous time as MC (years)	10,50	(6,68)	7,60	(5,85)	2,90	(1,06)	***
Number of children in HCB	13,17	(4,26)	12,43	(1,30)	0,74	(0,52)	
Summary index [c]	0,036	(0,43)	0,00	(0,44)	0,031	(0,05)	
Number of observations	67		73				

*** Statistically significant difference at 1%, ** at 5%, * at 10%

[a] MC education net of program participation in the case of treatment group.

[b] Household wealth index: Principal component of factor analysis of questions related to durable goods ownership, and characteristics of the household, such as quality of floors and walls and availability of public utilities. Index between -8.5 and 0.62 with mean zero.

[c] See Kling, Liebman and Katz (2007): weighted sum of Z-scores of all variables computed using mean and SD in the control group.

Table 6.
Children and family characteristics by group

OBSERVABLE CHARACTERISTICS	TREATMENT			CONTROL			DIFFERENCE		
	Mean	s.d.	Obs.	Mean	s.d.	Obs.	Mean	s.d.	
SISBEN survey (%)	63,1	(1,73)	771	74,0	(1,54)	808	-10,9	(2,31)	***
SISBEN level 2 or less (%)	93,9	(11,40)	556	97,52	(6,53)	442	-3,60	(1,25)	***
Household's monthly income (COL$000)	946,4	(552,5)	767	908,2	(592,1)	800	38,18	(29,0)	
Household's monthly expenditures (COL$000)	681,9	(397,7)	766	635,8	(339,4)	801	46,18	(18,6)	**
Mother's age	28,6	(6,55)	755	28,6	(6,61)	782	0,03	(0,34)	
Mother's schooling attainment	10,4	(6,13)	736	10,0	(2,94)	769	0,40	(0,25)	
Female head of household (%)	14,31	(1,2)	771	14,08	(1,14)	808	0,23	(1,64)	
Father present (%)	70,83	(1,73)	654	70,64	(1,78)	689	0,19	(2,48)	
Mother married or cohabiting (%)	72,18	(1,68)	712	70,23	(1,73)	692	1,95	(2,41)	
Mother separated, widowed or single (%)	27,1	(1,66)	712	29,6	(1,73)	692	-2,51	(2,40)	
Household size	4,32	(1,43)	770	4,36	(1,50)	806	-0,04	(0,07)	
Number of children under 18 in household	2,06	(0,98)	771	2,13	(1,02)	803	-0,07	(0,05)	
% in lowest wealth quintile [a]	19,55	(1,33)	771	20,32	(1,32)	808	-0,78	(1,88)	
% in highest wealth quintile [a]	19,16	(1,32)	771	20,96	(1,33)	808	-1,80	(1,88)	
Wealth index [a]	3,558	(0,97)	771	3,509	(1,03)	808	0,05	(0,05)	
% contributive health insurance	61,94	(1,83)	699	57,54	(1,89)	683	4,40	(2,63)	*
% subsidized health insurance	33,62	(1,78)	699	37,62	(1,85)	683	-4,00	(2,57)	
Mother's labor earnings (COL$000)	498	(508,0)	580	479	(493,0)	638	19,70	(31,7)	
Mother's weekly hours devoted to child care	43,97	(40,08)	755	41,44	(22,14)	779	2,53	(1,65)	
Employment status of the head of the household	91,12	(1,13)	631	90,16	(1,21)	610	0,96	(1,65)	
Summary index [b]	0,05	(0,25)	880	0,02	(0,26)	930	0,02	(0,01)	*
Number of observations	771			808					

*** Statistically significant difference at 1%, ** at 5%, * at 10%

[a] Household's wealth index: Principal component of factor analysis of questions related to durable goods ownership, and characteristics of the household, such as quality of floors and walls and availability of public utilities. Number between 0 & 5.2 with mean 3.53.

[b] See Kling, Liebman and Katz (2007): weighted sum of Z-scores of all variables computed using mean and SD in the control group.

Table 7.
Program effects on quality of care offered at HCB estimated by PSM[1]

Outcome Variable	Control group		Treatment	Standard		No. of
	mean	Std. dev.	effect	error		obs.
QUALITY OF CARE OFFERED[2]						
▫Total FDCRS scale (1 to 7)	3,72	(0,643)	0,256	(0,121)	**	135
▫FDCRS Processes Subscale (1 to 7)	3,86	(0,679)	0,399	(0,145)	***	135
▫FDCRS Infrastructure Subscale (1 to 7)	2,91	(0,731)	0,251	(0,099)	**	135
COMPLIANCE WITH ADMINISTRATIVE GUIDELINES[3]						
▫Guidelines related to kitchen personnel	-0,17	(1,094)	0,370	(0,175)	**	129
▫Guidelines related to food consumption area	-0,04	(0,787)	0,091	(0,176)		128
▫Guidelines related to protective practices	-0,18	(0,602)	0,374	(0,163)	**	118
DESIGN OF CONDUCIVE LEARNING ENVIRONMENTS						
▫Index of frequency of pedagogical routines[4]	-0,21	(1,035)	0,446	(0,156)	***	135
▫Index of use of pedagogical material in the HCB[4]	-0,19	(1,036)	0,386	(0,174)	**	133
▫Index of routines and pedagogic materials combined[4]	-0,23	(1,017)	0,487	(0,163)	***	133
▫Frequency of pedagogical activities outside the HCB[5]	-0,18	(0,879)	0,384	(0,173)	**	135
INTERACTION WITH PARENTS[6]						
▫Provided information to parents in last 7 days about:						
Nutrition	2,81	(0,430)	0,147	(0,060)	**	135
Health	2,96	(0,260)	-0,019	(0,044)		135
Breastfeeding	1,75	(0,778)	0,262	(0,134)	*	135
Discipline practices	2,90	(0,379)	0,006	(0,052)		135
Quality summary index[7]	0,013	(0,439)	0,308	(0,060)	***	135

*** Statistically significant difference at 1%, ** at 5%, * at 10%

[1] The Propensity Score includes all variables in Table 5 except SISBEN level, household's average monthly income and expenditures, ICBF monthly grant and parental copayments.
PSM is estimated by the nonparametric kernel algorithm and standard errors are calculated by bootstrapping with 50 repetitions.

[2] Family Day Care Rating Scale (from 1 min to 7 max).

[3] Items correspond to principal component of questions related to compliance with ICBF administrative guidelines

[4] Principal component of frequency of pedagogical routines in HCB and the use of pedagogical materials.

[5] Principal components of the frequency of visits to libraries, museums, parks, recreational facilities and others.

[6] Scale from 1 (never) to 3 (very frequently).

[7] See Kling, Liebman and Katz (2007): weighted sum of Z-scores of all variables computed using mean and SD in the control group.

Table 8.
Program effects on quality of care in HCB controlling for baseline characteristics and baseline outcomes [1]

Outcome Variable	Treatment effect	Standard error		No. of obs.
QUALITY OF CARE OFFERED [a]				
▫Total FDCRS scale (1 to 7)	0,170	(0,151)		61
▫FDCRS Processes Subscale (1 to 7)	0,172	(0,180)		61
▫FDCRS Infrastructure Subscale (1 to 7)	0,260	(0,142)	*	61
COMPLIANCE OF ADMINISTRATIVE GUIDELINES [b]				
▫Guidelines related to kitchen personnel	0,189	(0,203)		61
▫Guidelines related to food consumption area	0,398	(0,289)		52
▫Guidelines related to protective practices	0,356	(0,265)		52
DESIGN OF CONDUCIVE LEARNING ENVIRONMENTS				
▫Index of frequency of pedagogical routines [c]	0,299	(0,231)		61
▫Index of use of pedagogical material in the HCB [c]	0,447	(0,232)	*	62
▫Index of routines and pedagogic materials combined [c]	0,421	(0,232)	*	62
▫Frequency of pedagogical activities outside the HCB [d]	0,478	(0,278)	*	62
INTERACTION WITH PARENTS [e]				
▫Provided information to parents the last 7 days about:				
Nutrition	0,182	(0,094)	*	61
Health	-0,027	(0,086)		61
Breastfeeding	0,419	(0,173)	**	61
Discipline practices	0,046	(0,079)		61
Quality summary index [5]	0,301	(0,109)	***	61

*** Statistically significant difference at 1%, ** at 5%, * at 10%

[1] Estimated by PSM as in Table 7 but includes as additional controls MCs' household income, schooling, SISBEN score and level as reported in SISBEN survey (2002-2008) and baseline average weight-for-height Z-score in HCB (Metrix 2006-2008).
PSM is estimated by the nonparametric kernel algorithm and standard errors are calculated by bootstrapping with 50 repetitions.

[a] Family Day Care Rating Scale (from 1 min to 7 max).

[b] Items correspond to principal component of questions related to compliance of ICBF administrative guidelines in the HCB

[c] Principal component of frequency of pedagogic routines in HCB and the use of pedagogical materials.

[d] Principal components of the frequency of visits to libraries, museums, parks, recreational facilities and others.

[e] Scale from 1 (never) to 3 (very frequently).

Table 9.
Program effects on beneficiary children estimated by PSM[1]

Outcome variable	Control group		All treated MCs[2]			Only MC treated in 2008 [3]			
	Mean	Std. dev.	Effect	Standard error	No. obs.	Effect	Standard error		No. obs.
HEALTH									
Health Summary Index	0,00	(0,64)	0,046	(0,046)	1.307	0,093	(0,052)	*	861
Incidence of diarrhea (%)	0,02	(0,13)	-0,006	(0,009)	1.307	-0,014	(0,009)		861
Incidence of cough, flu, cold (%)	0,11	(0,31)	-0,035	(0,020) *	1.307	-0,052	(0,025)	**	861
Incidence of other illness (%)	0,04	(0,19)	0,004	(0,011)	1.307	0,000	(0,016)		861
NUTRITION									
Nutrition Summary Index	0,00	(0,85)	0,008	(0,066)	1.013	0,051	(0,074)		660
Height for age (Z-score)	-0,83	(1,13)	-0,007	(0,067)	1.013	0,081	(0,105)		660
Weight for age (Z-score)	-0,60	(1,03)	0,018	(0,079)	1.013	0,073	(0,106)		660
Weight for height (Z-score)	-0,05	(0,91)	0,011	(0,065)	1.013	0,010	(0,096)		660
PSYCHOSOCIAL DEVELOPMENT									
Psychosocial Summary Index	0,04	(0,84)	0,003	(0,076)	1.279	0,173	(0,096)	*	841
PIPPS - Aggression [4]	2,01	(0,46)	0,027	(0,062)	590	-0,019	(0,074)		406
PIPPS - Isolation [4]	1,54	(0,42)	0,097	(0,073)	590	-0,037	(0,118)		406
PIPPS - Adequate interaction 6[5]	2,84	(0,60)	-0,031	(0,071)	590	0,120	(0,081)		406
ASQ – Socio-emotional (score)	54,53	(20,81)	-1,050	(1,503)	1.279	-3,559	(1,975)	*	841
Risk of socio-emotional lag	0,32	(0,47)	-0,042	(0,028)	1.279	-0,088	(0,028)	***	841
COGNITIVE DEVELOPMENT									
Cognitive Summary Index	0,00	(2,59)	0,078	(0,144)	699	0,382	(0,239)		456
ASQ - Communication (score)	46,35	(12,62)	1,612	(1,548)	309	0,614	(1,583)		192
Risk of communication lag	0,12	(0,33)	-0,043	(0,033)	309	-0,019	(0,034)		192
ASQ - Problem solving (score)	46,61	(11,78)	1,878	(1,394)	309	4,844	(1,312)	***	192
Risk of problem solving lag	0,08	(0,27)	-0,010	(0,028)	309	-0,070	(0,021)	***	192
ASQ - Cognitive	92,96	(20,95)	3,490	(1,997) *	309	5,458	(2,069)	***	192
WM - Brief intellectual ability	88,95	(17,71)	-2,113	(2,079)	398	0,019	(2,315)		269
WM - Verbal ability	80,51	(16,15)	-0,870	(1,455)	396	0,996	(2,348)		268
WM - Mathematical reasoning	81,73	(19,27)	2,930	(2,579)	396	3,739	(2,980)		268
WM - General knowledge	81,75	(13,34)	0,943	(1,327)	400	3,267	(1,903)	*	270
PSYCHOMOTOR DEVELOPMENT									
Psychomotor Summary Index	0,00	(1,70)	-0,064	(0,204)	309	0,237	(0,250)		192
ASQ - Fine motor skills	42,45	(14,53)	-0,425	(1,817)	309	3,332	(2,534)		192
Risk of fine motor lag	0,07	(0,26)	0,048	(0,039)	309	-0,016	(0,034)		192
ASQ - Gross motor skills	49,57	(11,06)	-0,381	(1,273)	309	0,087	(1,384)		192
Risk of gross motor lag	0,14	(0,34)	0,001	(0,026)	309	-0,040	(0,042)		192
Overall Summary Index	0,01	(0,68)	0,013	(0,052)	1.309	0,146	(0,056)	***	863

*** Statistically significant difference at 1%, ** at 5%, * at 10%

[1] The Propensity Score is estimated using child's age and gender, household average monthly expenses, mother's education and marital status, household size and number of children under 18, indicator for lowest income quintile and all MCs characteristics in Table 5 except SISBEN level, household's average monthly income and expenditures, ICBF monthly grant and parental copayments.
PSM is estimated by kernel using a bootstrap of 50 repetitions for the calculation of standard errors clustered at the HCB level.

[2] All HCBs in the common support (65) whose MCs participated and graduated from the ECDC program.

[3] The treatment group only includes MCs in the common support (21) who finalized the ECDC program in December 2008.

[4] Scale 1 to 4, less is better.

[5] Scale 1 to 4, more is better.

Table 10.
Program effects on children by duration of exposure to treatment
Treated MC 1st cohort vs. treated MC 2nd cohort estimated by PSM[1]

Outcome variable	Effect	Standard error		No. obs.
HEALTH				
Health Index	0,0869	(0,0539)		607
Incidence of diarrhea (%)	-0,0165	(0,0098)	*	607
Incidence of cough, flu, cold (%)	-0,0303	(0,0225)		607
Incidence of other illness (%)	-0,0069	(0,0251)		607
NUTRITION				
Nutrition Summary Index	0,0625	(0,0751)		447
Height for age (Z-score)	0,1389	(0,0917)		447
Weight for age (Z-score)	0,0799	(0,0979)		447
Weight for height (Z-score)	-0,0118	(0,1050)		447
PSYCHOSOCIAL DEVELOPMENT				
Psychosocial summary index	0,3076	(0,1052)	***	598
PIPPS - Aggression [2]	-0,0764	(0,0811)		267
PIPPS - Isolation [2]	-0,2221	(0,0986)	**	267
PIPPS - Adequate interaction [3]	0,2928	(0,0925)	***	267
ASQ – Socio-emotional (score)	-4,4677	(2,1211)	**	598
Risk of socio-emotional lag	-0,0869	(0,0366)	**	598
COGNITIVE DEVELOPMENT				
Cognitive Summary Index	0,4729	(0,3114)		315
ASQ - Communication (score)	-0,7336	(2,2531)		147
Risk of communication lag	0,0078	(0,0434)		147
ASQ - Problem solving (score)	4,4258	(1,6407)	***	147
Risk of problem solving lag	-0,0825	(0,0284)	***	147
ASQ - Cognitive	3,6922	(3,2630)		147
WM - Brief intellectual ability	3,1929	(2,7440)		172
WM - Verbal ability	2,5798	(2,3328)		171
WM - Mathematical reasoning	1,7045	(3,9772)		171
WM - General knowledge	3,6758	(1,8339)	**	173
PSYCHOMOTOR DEVELOPMENT				
Psychomotor Summary Index	0,5212	(0,2813)	*	147
ASQ - Fine motor skills	6,4977	(2,5904)	**	147
Risk of fine motor lag	-0,1043	(0,0442)	**	147
ASQ - Gross motor skills	0,8186	(1,8501)		147
Risk of gross motor lag	-0,0540	(0,0484)		147
Overall Summary Index	0,2269	(0,0764)	***	608

*** Statistically significant difference at 1%, ** at 5%, * at 10%

[1] The Propensity Score is estimated using child's age and gender, household average monthly expenses, mother's education and marital status, household size and number of children under 18, indicator for lowest income quintile and all MCs characteristics as in Table 7.
PSM is estimated by kernel using a bootstrap of 50 repetitions for the calculation of standard errors clustered at the HCB level.

[2] Scale 1 to 4, less is better.

[3] Scale 1 to 4, more is better.

Table 11.
Program effects on beneficiary children by gender estimated by PSM[1,2]

Outcome variable	Boys				Girls			
	Effect	Standard error		No. obs.	Effect	Standard error		No. obs.
HEALTH								
Health index	0,122	(0,069)	*	438	0,067	(0,057)		423
Incidence of diarrhea (%)	-0,028	(0,013)	**	438	-0,001	(0,017)		423
Incidence of cough, flu, cold (%)	-0,038	(0,037)		438	-0,067	(0,029)	**	423
Incidence of other illness (%)	-0,006	(0,020)		438	0,004	(0,029)		423
NUTRITION								
Nutrition Index	0,030	(0,099)		335	0,058	(0,122)		325
Height for age (Z-score)	0,201	(0,126)		335	-0,043	(0,143)		325
Weight for age (Z-score)	0,040	(0,105)		335	0,089	(0,147)		325
Weight for height (Z-score)	-0,114	(0,109)		335	0,114	(0,123)		325
PSYCHOSOCIAL DEVELOPMENT								
Psychosocial Index	0,071	(0,132)		429	0,258	(0,072)	***	412
PIPPS - Aggression	0,047	(0,110)		207	-0,069	(0,089)		199
PIPPS - Isolation	0,052	(0,161)		207	-0,115	(0,072)		199
PIPPS - Adequate interaction	-0,019	(0,117)		207	0,210	(0,090)	**	199
ASQ – Socio-emotional (score)	-1,528	(2,557)		429	-5,178	(1,946)	***	412
Risk of socio-emotional lag	-0,082	(0,054)		429	-0,085	(0,043)	**	412
COGNITIVE DEVELOPMENT								
Cognitive Index	0,483	(0,349)		227	0,268	(0,286)		229
ASQ - Communication (score)	-4,855	(2,938)	*	95	5,775	(2,337)	**	97
Risk of communication lag	0,026	(0,070)		95	-0,060	(0,058)		97
ASQ - Problem solving (score)	1,944	(1,675)		95	7,598	(1,856)	***	97
Risk of problem solving lag	-0,056	(0,030)	*	95	-0,085	(0,042)	**	97
ASQ - Cognitive	-2,911	(3,442)		95	13,373	(3,119)	***	97
WM - Brief intellectual ability	3,904	(3,444)		133	-3,425	(2,670)		136
WM - Verbal ability	3,612	(3,156)		133	-1,298	(3,023)		135
WM - Mathematical reasoning	4,745	(4,449)		133	2,555	(2,682)		135
WM - General knowledge	3,101	(2,869)		133	3,076	(2,162)		137
PSYCHOMOTOR DEVELOPMENT								
Psychomotor Index	-0,246	(0,489)		95	0,702	(0,344)	**	97
ASQ - Fine motor skills	-1,648	(5,480)		95	8,062	(3,094)	***	97
Risk of fine motor lag	0,027	(0,063)		95	-0,056	(0,028)	**	97
ASQ - Gross motor skills	-1,465	(2,409)		95	1,624	(2,108)		97
Risk of gross motor lag	-0,015	(0,065)		95	-0,064	(0,063)		97
Overall Summary Index	0,099	(0,077)		440	0,185	(0,066)	***	423

*** Statistically significant difference at 1%, ** at 5%, * at 10%

[1] The treatment group includes only MCs that graduated in 2008 in the common support (21).

[2] The Propensity Score is estimated using child's age and gender, household average monthly expenses, mother's education and marital status, household size and number of children under 18, indicator for lowest income quintile and all MC characteristics as in Table 7.

PSM is estimated by kernel using a bootstrap of 50 repetitions for the calculation of standard errors clustered at the HCB level.

Appendix A. Structure of the ECDC Curriculum

The program is structured in five modules:

(1) Educational processes during early childhood. The objective of this module is to develop the ability to implement teaching-learning-evaluation strategies based on modern pedagogical methodologies; design and implement activities that integrate the three dimensions according to early childhood cognitive developmental stages and milestones; and design individualized teaching and learning strategies that take into account the child's individual potential and the family and cultural context.

(2) Promote the development of socio-emotional abilities during early childhood. The objective of the module is to develop the ability to design and implement activities that promote socio-emotional development according to early childhood developmental stages; develop the ability to design individual teaching and learning strategies that take into account the child's individual potential and specific family and cultural contexts and are aimed at promoting socio-emotional development; guide families and communities in issues related to the non-cognitive development of children between the ages of 0 and 6.

(3) Assistance in cases of accident and sudden illness. The objective is to develop the ability to inform users, parents and the community about health services available in their community and develop the ability to offer CPR in cases of accident or sudden illness to children and adults.

(4) Children's nutritional and health status from gestation to 6 years of age. The objective is to develop the ability to inform families about the fundamental rights and obligations for peaceful coexistence within the family and the community; provide guidance and assistance to expectant mothers and newborns with a specific emphasis on the prevention of malnutrition and the importance of breastfeeding; promote health and illness prevention for children younger than six; provide basic assistance during illness episodes of young children in the household, the community and the institution in accordance with existing protocols.

(5) Ethics, transformation and leadership within the community. Taking advantage of MCs' role as leaders in their communities, this module has the objective of developing the ability to appropriately inform the community about the various services that they may have access to, including health, judicial, nutritional, welfare, and more, while taking advantage of their leadership role to promote children's wellbeing in their communities.

Appendix B.
Comparison of MC matched and not matched with SISBEN and METRIX

	1 if merged with SISBEN, 0 otherwise	1 if merged with METRIX, 0 otherwise
VARIABLES	(1)	(3)
Treatment	0.0273	-0.152
	(0.0728)	(0.0896)
Age	-0.0117**	0.0230***
	(0.00538)	(0.00660)
MC is head of household (%)	-0.239	-0.236
	(0.246)	(0.216)
MC is head of household's spouse (%)	-0.208	0.154
	(0.196)	(0.254)
MC is married or cohabiting (%)	0.169	-0.363**
	(0.181)	(0.161)
Household size	-0.0518	0.0426
	(0.0370)	(0.0472)
Number of children under 18 in household	0.0251	0.0615
	(0.0519)	(0.0646)
Contributive health insurance	-0.0378	0.0226
	(0.184)	(0.246)
Subsidized health insurance	-0.554*	0.191
	(0.312)	(0.294)
Observations	140	140

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1