

## An impact assessment of the Child Growth, Development and Care Program in the Caribbean Region of Colombia

Evaluación del Programa de Crecimiento y Desarrollo y el Cuidado del Niño en Colombia: sus efectos en la región Caribe

Avaliação do Programa de Crescimento, Desenvolvimento e Cuidado Infantil na Colômbia: seus efeitos na Região Caribe

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### Abstract

*This article aims to assess the impact of the Child Growth, Development and Care Program in the Caribbean region of Colombia by analyzing variables such as maternal childcare practices and indicators of the nutritional status and health of children under the age of five. To this end, the authors used the quasi-experimental technique Propensity Score Matching. Positive impacts included a decrease in acute diarrheal disease, and an increase in immunization and seeking treatment for acute respiratory infection or fever symptoms. However, the program had little influence on chronic and acute malnutrition in the region.*

*Child Welfare; Regional Development; Statistics; Program Evaluation*

### Resumen

*Este artículo tiene como objetivo evaluar el impacto del Programa de Crecimiento y Desarrollo y el Cuidado del Niño en la región Caribe de Colombia. La evaluación se efectúa sobre variables como el estado nutricional, indicadores antropométricos y salud de los niños menores de cinco años de edad y las prácticas maternas de cuidado infantil. Para este propósito se emplean técnicas cuasi-experimentales de emparejamiento tipo Propensity Score Matching. Entre los resultados de la evaluación se encuentran una disminución de la enfermedad diarreica aguda, una inmunización más alta y la búsqueda de tratamiento para atender síntomas de infección respiratoria aguda o fiebre. Sin embargo, el programa tuvo poca influencia sobre la desnutrición crónica y desnutrición aguda en la región.*

*Bienestar del Niño; Desarrollo Regional; Estadística; Evaluación de Programas y Proyectos de Salud*

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## Introduction

One of the main priorities of governments is the design and implementation of public policies to improve welfare and enhance the quality of life of the population as a whole, and particularly children. The general lack of child welfare is a major concern for governments. According to a report by the World Health Organization (WHO) <sup>1</sup>, approximately 6.9 million children under the age of five died in 2011 from causes including malnutrition, respiratory infections and diarrheal diseases. Children who survive such diseases are left with sequelae which affect their growth and development, and several studies confirm that educational productivity and performance depend largely on early childhood development <sup>2</sup>. Governments in developing countries have invested significant resources in various policies and social programs to tackle this problem; however, there is a continuing need to ensure a more efficient use of these resources <sup>3</sup>. Interventions include the provision of nutritional supplements, subsidized prices, cash benefits, and childcare programs. Despite these efforts, child care remains a public health priority.

Various social protection schemes addressing maternal and child health have been implemented in Latin America and the Caribbean, including: the Universal Mother and Child Insurance program (Seguro Universal Materno-Infantil – SUMI) in Bolivia, the Family Health Program (Programa Saúde da Família – PSF) in Brazil, the Free Maternity and Child Care Law (Ley de Maternidad Gratuita y Atención a la Infancia – LMGYAI) in Ecuador, the Maternity-Child Bonus (Bono Materno-Infantil – BMI) in Honduras, and the Education, Health, and Nutrition Program (Programa de Educación, Salud, y Alimentación – PROGRESA) in Mexico. In Colombia, the first mother and child health protection program was the Mother and Child Protective Services Extension Program (Programa de Extensión de Servicios de Protección Materno Infantil), which was renamed the Mother and Child Program (Programa Materno Infantil – PMI) in 1973. This program aimed to reduce rates of maternal and child mortality and morbidity resulting from infectious and parasitic diseases, improve the coverage of preventive services, and reduce the prevalence of protein-calorie malnutrition <sup>4</sup>. These programs have led to a marked improvement in child malnutrition indicators since the 1970s <sup>5</sup>.

In 1987, in response to research conducted by the Colombian Institute of Family Wellbeing (Instituto Colombiano de Bienestar Familiar – ICBF) focusing on comprehensive infant health, nutrition and stimulation in families living in

extreme poverty and suffering from malnutrition, the Colombian government implemented the Community Homes Program (Programa de Hogares Comunitarios – HCB). To achieve greater efficiency in resource allocation and targeting, the government made a number of changes to this program, including conditional transfers that led to the creation of the Families in Action Program (Programa Familias en Acción). Another social protection program is the Growth and Development Program (Programa de Crecimiento y Desarrollo – PCD), which targets mother and child health and emerged as a result of UNICEF's (United Nations Children's Fund) request to include information on childcare and types of play related to early childhood development <sup>6</sup>. The PCD was created in the 1970s and has been subject to a number of changes since then, including *Resolution n. 0412* of 2000 <sup>7</sup>, which introduced the so-called Technical Standard for the Early Detection of Changes in Growth and Development in Children Aged under the Age of Ten (Norma Técnica para la Detección Temprana de las Alteraciones del Crecimiento y Desarrollo en el Menor de 10 Años).

This standard comprises as a set of activities, procedures and interventions focused on the child population, including the need for regular and systematic care to ensure the timely detection of diseases, facilitate diagnoses and treatments, reduce the length of illness, prevent sequelae, reduce disability and prevent death <sup>7</sup>. The standard focuses on children enrolled in the contributory and subsidized regimes from birth up to the age of 10 years, and the program's basic strategy is to educate parents about comprehensive health care for children. Typical services provided under the PCD include the development of medical histories, growth assessment, guidance to parents about the warning signs that require prompt consultation, investigation of the fulfillment of recommendations from previous consultation by physicians or nurses, performing physical assessments according age, and revising the vaccination schedule.

The program's main objective is the prevention of child mortality, in line with the current Millennium Development Goals set out by the United Nations Development Program (UNDP) which aim to reduce the mortality rate among children under the age of five by two thirds by 2015 <sup>8</sup>. Colombia is committed to reducing mortality rates to 17 deaths per 1,000 live births in children under the age of five and to 14 deaths per 1,000 live births in children under the age of one. Through its Expanded Immunization Program (Programa Ampliado de Inmunizaciones – PAI), Colombia also seeks to achieve and main-

tain 95% vaccination coverage for children under the age of five throughout the country.

According to the National Administrative Department of Statistics (Departamento Administrativo Nacional de Estadística – DANE)<sup>9</sup>, the Caribbean region of Colombia accounts for 21% of total projected population, and 24% of the population of children under the age of five. Poverty levels in the region are the highest in the country: 37.2% of the country's population live below the national poverty line and 12.3% live in extreme poverty, compared to 56.7% and 22.6%, respectively, in the Caribbean region. The Departments of Córdoba, La Guajira, Magdalena, Sucre and Cesar are ranked as the poorest in the country<sup>10</sup>. These figures demonstrate the extent of the problem faced by the Caribbean region of Colombia and the need to assess the impact of national poverty alleviation policies on the region.

Although there is a lack of assessment of the impacts of this kind of intervention at regional level, other programs targeting children have been the focus of national-scale evaluations, including the National Department of Planning's (Departamento Nacional de Planeación – DNP)<sup>11</sup> assessment of the Families in Action program (Familias en Acción), which showed that activities led to a reduction in the probability of children suffering chronic wasting of 7%. The common denominator of these programs is their relative success in tackling nutrition problems, despite less favorable results in other areas of child development.

Similar social programs exist in other countries, such as “Conditional Cash Transfers” (Transferencias Monetarias Condicionadas), which provide monetary benefits to mothers if their children keep up-to-date with their vaccinations and preventive health visits, and/or attend school. The Oportunidades program in Mexico aims to help families to overcome extreme poverty and has the long term specific aim of reducing poverty and promoting the development of human capital in poor households through improvements in child nutrition, health and education<sup>12</sup>. In Brazil, the Family Grant (Bolsa Família) program, initially called the School Grant (Bolsa Escola) program, provides a monthly cash benefit to vulnerable families, provided that all school-age children achieve a 90% school attendance rate<sup>13</sup>. Other programs include the “Head Start” in the United States, and the Health and Education Program for Early Childhood Development in Jamaica. In Colombia, the design and implementation of Familias en Acción was inspired by the success of its Brazilian counterpart, the Bolsa Família. The main goal of these interventions is to promote maternal education and

improve the nutritional status of children during early childhood.

This article aims to assess the impact of the Child Growth, Development and Care Program (Programa de Crecimiento, Desarrollo y Cuidado del Niño – PCDCN) in the Caribbean region, by analyzing variables such as maternal childcare practices and indicators of the nutritional status and health of children under the age of five. This study represents a step forward by becoming the first assessment of the regional impact of a national public health policy in Colombia.

## Methodology

### Data

The study used data obtained from Colombia's Demographic and Health Survey (DHS) conducted in 2010 by PROFAMILIA (Asociación Pro-bienestar de la Familia Colombiana). The DHS used a multistage probability sample design involving stratification and clustering to obtain a nationally representative sample of women of childbearing age, their spouses, and children under the age of five. The questionnaires used in the survey included questions about household socioeconomic and demographic characteristics. Mothers were asked whether their children under the age of five were enrolled in the PCDCN and to show their membership cards. The questionnaires contained modules on health, nutrition and childcare practices, from which we extracted the group of relevant variables used to assess the impact of the PCDCN.

Children were eligible to participate in the PCDCN if they were enrolled in the contributory or subsidized health regimes. The first of these systems is directed at people with formal labor income, while the second targets the poorest sector of the population. Eligible children were classified into two groups: “participants” and “nonparticipants”. The first group consists of children enrolled in the PCDCN at time of the survey. Children who reported being PCDCN beneficiaries, but who did not show their membership cards were not included in the analysis. The use of this exclusion criterion did not result in a substantial loss of sample numbers (4% of all children enrolled in the PCDCN). The nonparticipant group includes all potential beneficiaries who were not enrolled in the program at time of the survey. These variables are summarized in Table 1.

The total sample consisted of 3,648 children between zero and five years of age, of which approximately 74% participated in the program.

Table 1

Description of the outcome variables.

Outcome variable	Description
Health	
Acute diarrheal diseases (ADD)	Soft or watery defecation more than three times a day (or more often than normal for the person). Structured as a <i>dummy</i> variable with a value of 1 if the person had ADD.
Acute respiratory infection (ARI)	Group of diseases produced in the respiratory system caused by different microorganisms, such as viruses and bacteria, which begin suddenly and last less than two weeks. Structured as a <i>dummy</i> variable with a value of 1 if the person had ARI.
Comprehensive vaccination *	Colombia has a comprehensive vaccination program for children aged under five years which includes the following immunizations: Bacillus Calmette-Guerin (BCG) vaccine (one dose for children aged under a year), Polio vaccine (four doses, newborns, two, four, and six months), Hepatitis B (three doses, newborn, two and six months), Diphtheria, Pertussis and Tetanus (DPT) (three doses, two, four and six months), MMR (Measles, Rubella, Mumps and Congenital Rubella) (one dose, one year), Tetanus/Diphtheria toxoids TT or Td (Neonatal Tetanus and Diphtheria) (five doses), MEF (10 to 49 years), Haemophilus Influenzae Type B Hib (Pneumonia and Meningitis) (three doses, two, four and six months), Yellow fever (one dose, over one year). <i>Dummy</i> variable that takes the value of 1 if the individual has received the full vaccination, or otherwise 0.
Severe wasting	Low weight-for-height. World Health Organization. Structured as a <i>dummy</i> variable with a value of 1 if the person had severe wasting.
Moderate wasting	Low weight-for-height and for sex, regardless of age. World Health Organization. Structured as a <i>dummy</i> variable with a value of 1 if the person had moderate wasting.
Child care practices	
Treatment of ADD	Use of oral rehydration salts with low concentrations of glucose and salt, and zinc supplement, which can drastically reduce the number of childhood deaths. Besides the prevention and treatment of dehydration with appropriate fluids, breastfeeding, continued feeding and selective antibiotics, new methods reduce not only the duration and severity of diarrheal episodes, but also frequency. <i>Dummy</i> variable that takes the value of 1 if the individual had received treatment for ADD, or otherwise 0.
Treatment of ARI/fever	The treatment of ARI involves different levels of care, beginning with the pre hospital care. The primary assessment steps are: airway with cervical spine control, proper ventilation, stable hemodynamic circulation, and state of consciousness. Treatment beyond primary assessment involves three levels of care which depend on the degree of complexity. <i>Dummy</i> variable that takes the value of 1 if the individual had received treatment for ARI, or otherwise 0.

\* Information about immunization was only available for children under two years of age.

Source: authors' estimates.

In addition to the total sample, the PCDCN also evaluates three categories of characteristics: individual, household and place of residence. The first includes the following variables: age of the head of household; age of the child's mother's; the child's mother's employment status; the child's mother's marital status; the child's mother's number of years of schooling; prenatal visits; whether the delivery was institutional; the child's sex; the child's age in months; and the child's birth order. The second category included the variables total number of family members, and the number of children under the age of five. The third category was divided into urban or rural.

The sample was stratified into three age sub-samples: zero to two years, two to four years, and four to five years. The geographical study region

was the Caribbean region of Colombia, divided into four sub-regions: the first sub-region, consisting of the Departments of La Guajira, Cesar and Magdalena; the second sub-region, comprising the District of Barranquilla (metropolitan area); the third sub-region, made up of the Departments of the Atlántico (without Barranquilla), San Andrés, and Bolívar (north); and the fourth sub-region, consisting of the Departments of Bolívar (the rest of the territory), Sucre and Cordoba.

A discriminate analysis of age and health scheme type was not performed, since this would considerably reduce sample size. For this reason, the effect of the program on the treatment of acute diarrheal diseases (ADD) was not analyzed by age sub-sample.

### Empirical strategy

The quasi-experimental technique Propensity Score Matching (PSM) was used for two reasons. First, due to the differences in characteristics related to the relevant variables between the participants and nonparticipants, which could lead to bias. Second, because the program does not provide universal coverage, allowing for a large control group with adequate variability. The study took into account the place of residence of the children, thus providing a technical evaluation of a program that, despite its importance for children's health in the Caribbean region, has never been assessed. The method used assesses the impact of the intervention by answering the hypothetical question: "what would have happened to the participants if the intervention had not been implemented?"<sup>14</sup> (p. 3). The counterfactual of the participants was derived by calculating the conditional probability of participation in the program as follows:

$$P(Z = 1|X) \quad [1]$$

More specifically, a nonparticipant (control group) represents the counterfactual of a participant (treatment group) when both are equally likely to participate in the program, based on a given set of covariables. One advantage of this procedure is that it summarizes the important characteristics of a number of individuals, which facilitates pairing. The underlying assumption behind this strategy is that the probability of participation in the program and the target variables depend only on the variables being observed by the researcher.

Thus, the average treatment effect (ATT) on the participants is given as follows:

$$ATT = E\{E\{Y(1) \mid Z = 1, P(X)\} - E\{Y(0) \mid Z = 0, P(X)\} \mid Z = 1\} \quad [2]$$

Where  $Y(1)$  and  $Y(0)$  denote the observed result of the target variable in the control and treatment group, respectively. In this study, [2] is estimated by imposing the common support restriction; or more specifically, by using the minimum-maximum criterion, which discards the observations in each group whose participation is less likely/more likely than that of the minimum/maximum of the other group. We used a logit model with robust errors in the functional form to estimate probability of participation. To identify counterfactual results in the control group, pairing was performed using two techniques: maximum distance (CM) and local linear regression (LLR).

### Maximum distance

Often called caliper matching, the CM method matches the participants  $i$  with the nonparticipant  $j$  with the highest probability of participation in a previously set neighborhood. The counterfactual  $j$ ,  $C(i)$ , of participant  $i$  is given by:

$$C(i) = \{j \in Z = 0 \mid \|P_i(X) - P_j(X)\| \leq \delta\} \quad [3]$$

where  $\delta$  is the maximum difference between the participation probabilities of the counterfactual  $j$  and the participants  $i$ . We set  $\delta$  equal to 0.2 of the standard deviation of the participation probability<sup>15</sup>.

### Local linear regression pairing

This algorithm is used to pair each participant with a weighted average of several or all individuals in a control group. The weight,  $W_{ij}$ , allocated to each control group individual depends on the distance between the participants  $i$  in terms of participation probability: the more disparate the participation probabilities, the lower the weight allocated to the control group individual. Each weight was obtained by performing a weighted regression of  $Y(0)$  against the participation probability in a given neighborhood by participant group. It was therefore necessary to choose a kernel function, and we used the Gaussian kernel matching with a bandwidth of 0.06. Thus, the ATT estimator can be expressed as follows:

$$ATT = \sum_{i \in Z=1} [Y_i - \sum_{i \in Z=0} W_{ij}(Y_j)] \quad [4]$$

Standard error was calculated using bootstrap or Monte-Carlo simulation and adjusted for household clusters.

### Results

Table 2 presents the descriptive statistics for the variables that may influence the probability of program participation and the outcome variables. These variables correspond with those commonly used by impact assessments of child health and nutrition interventions<sup>16</sup>. Significant differences can be observed between the PCDCN participants and nonparticipants. It can also be noted that the number of PCDCN participants exceeds the number of nonparticipants.

It can be seen that the prevalence of moderate and severe wasting is higher among nonparticipants: a difference of 5 p.p. and 3 p.p. (participation probability), respectively. The indicator of nutritional status used in this analysis was the variable height-for-age which we standardized based on the difference between the child's height and the median height of healthy children of the same age (Z-score). In Figure 1, we present

Table 2

Means of demographic, geographic and economic variables of participants and nonparticipants for the overall sample and place of residence. Caribbean region, Colombia.

	Variable	Total observation	Global mean	Caribbean region				Difference
				Nonparticipants	Participants			
	0			n	Mean	n	Mean	
Output variables								
Moderate wasting	Categorical	2,567	0.16	841	0.19	1,726	0.14	0.05 *
Severe wasting	Categorical	2,567	0.05	841	0.07	1,726	0.04	0.03 *
ADD	Categorical	2,598	0.42	876	0.59	1,722	0.36	0.23 *
ARI	Categorical	1,498	0.16	472	0.17	1,026	0.17	0.003 *
Comprehensive vaccination	Categorical	471	0.88	177	0.82	294	0.89	-0.07 *
Treatment of ARI/fever	Categorical	759	0.53	511	0.41	248	0.57	-0.15 *
Treatment of ADD	Categorical	1,252	0.46	156	0.33	1,096	0.50	-0.16 *
Individual characteristics								
Age of head of household	Continuous	2,611	44.76	880	40.53	1,731	41.83	-1.30 *
Age of mother	Continuous	2,611	19.56	880	19.70	1,731	20.20	-0.50
Mother employed	Continuous	2,611	4.55	880	6.10	1,731	4.80	1.30 *
Mother married	Categorical	2,611	2.21	880	2.12	1,731	2.14	-0.02
Maternal years of schooling	Continuous	2,604	6.83	877	7.25	1,727	8.41	-1.16 *
Prenatal visits	Discrete	2,611	0.87	880	0.80	1,731	0.92	-0.11 *
Institutional delivery	Categorical	2,611	20.14	880	19.70	1,731	20.68	-0.97 *
Boy	Categorical	2,611	0.52	880	0.54	1,731	0.53	0.01
Child's age in months	Categorical	2,568	26.31	851	19.09	1,717	24.97	-5.87 *
First-born	Categorical	2,611	0.36	880	0.31	1,731	0.37	-0.06 *
Second-born	Categorical	2,611	0.27	880	0.27	1,731	0.27	0.00
Household characteristics								
Number of family members	Discrete	2,611	5.83	880	6.20	1,731	5.87	0.32 *
Number of children aged under 5 years	Discrete	2,611	0.90	880	1.84	1,731	1.66	0.18
Place of residence								
Urban	Categorical	2,611	0.66	880	0.59	1,731	0.68	-0.09

ADD: acute diarrhoeal diseases; ARI: acute respiratory infection.

\* Statistically significant at the 1% level.

Source: Colombia's Demographic and Health Survey (DHS) 2010, World Health Organization (WHO) and authors' estimates.

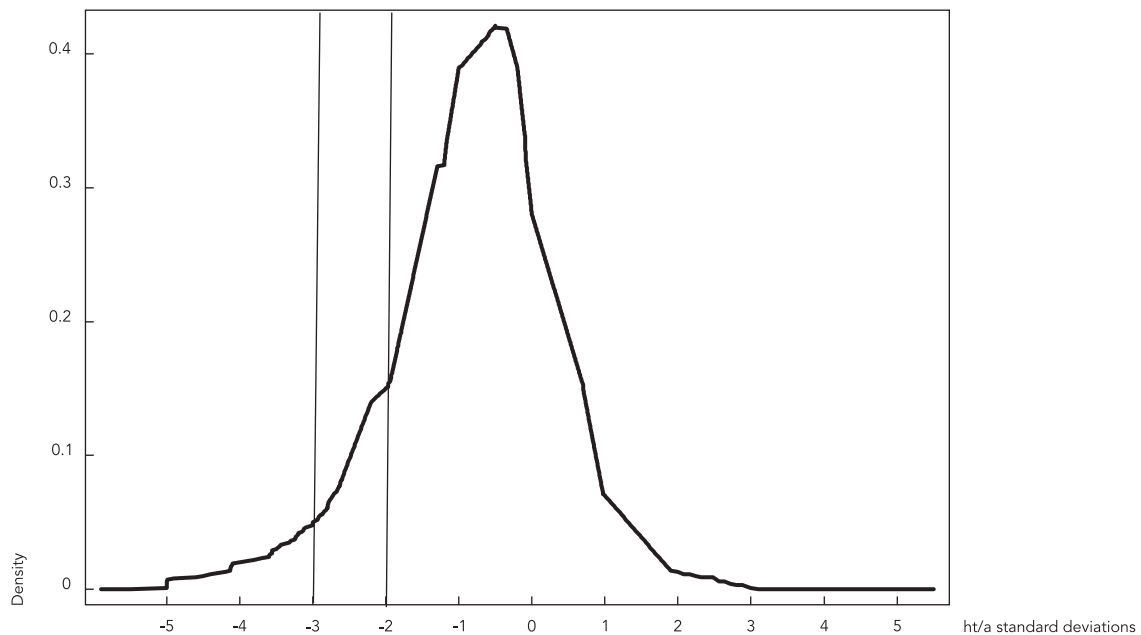
the kernel density estimation of height-for-age (Z-score) for children under the age of five in the reference region. According to WHO standards, a child whose height is between two and three standard deviations below the median height-for-age is suffering from moderate and severe wasting, while a child whose height is more than three standard deviations below the median is suffering from severe wasting<sup>17</sup>. The results indicate that chronic wasting in children in the Caribbean region is a concern, despite the existence of programs to mitigate this problem.

The prevalence of ADD was significantly higher (a difference of approximately 0.23 p.p.) among nonparticipants. However, the results for acute respiratory infection (ARI) and ADD treatment for both participants and nonparticipants

were very similar (difference of 16 p.p. and 17 p.p., respectively). The average number of antenatal visits was higher among mothers of participating children. The average age of the head of household is approximately 45 years, while the average age of mothers, considering the last childbirth, is 19 years. As for schooling, mothers of participating children completed an average of one more year of schooling than nonparticipants. Mothers of participating children had worked approximately 1.31 days less in the past week than mothers of nonparticipants. The results for certain variables (for example institutional delivery, mother's marital status, child's sex and number of children under the age of five) were similar for both participants and nonparticipants. The participation probability for place of residence

Figure 1

Height-by-age. Children under the age of five. The Caribbean region of Colombia.



Note: the black line represents the standard deviations (-2 to -3).

Kernel density estimation (Z Score)

Kernel = espanchnikov, band with = 0.1584

Source: authors' estimates.

(urban) for participants and nonparticipants was 0.68 and 0.59, respectively.

The average age of participants and nonparticipants was 24.97 and 19.09 months, respectively. Thirty-seven percent of the children participating in the PCDCN and 31% of nonparticipants were first-borns.

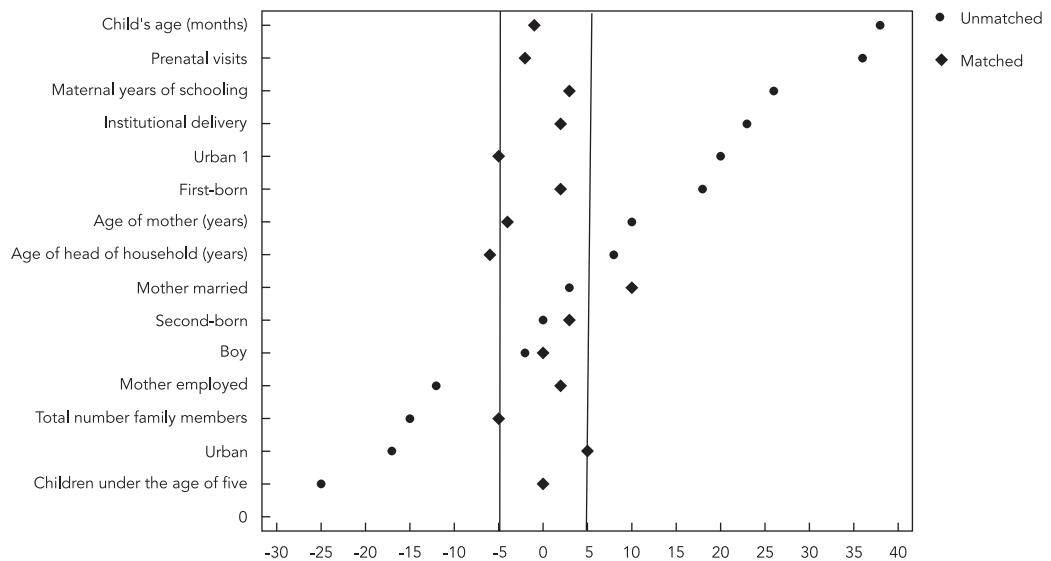
In summary, the evidence suggests that the majority of program participants lived in urban areas and were from households with fewer members than nonparticipants. The mothers of children participating in the program tended to make more prenatal visits, were more likely to give birth in a hospital, worked shorter hours, and had a higher level of education than the mothers of nonparticipants. Impact assessments should consider the socioeconomic and demographic differences between program participants and nonparticipants. Failure to do so could result in a biased estimate of the impact of the PCDCN.

### Results of estimates

The logit model used to estimate participation probability presents a good fit with all estimated models. The final specification for each model was obtained recursively. We performed iterations until there was no significant difference from one iteration to the next in the explanatory variables of participants and nonparticipants for each "strata" of participation probability. The average number of observations was 2,561. The significant variables were age of head of household, mother's occupation, years of maternal schooling, prenatal visits, institutional delivery, child's age in months, first-born child, and total number of family members. A criterion was established to choose the optimal number of strata<sup>18</sup>. The optimal number of strata was 8. The variables that have the greatest influence on participation in the program are household composition, mother's characteristics and geographic location (Figure 2).

Figure 2

Standardized bias.



Note: the black line represents the threshold of tolerance (3.5% to 5%).

In addition, children from families with fewer children aged between zero and five years and whose mothers do not work are more likely to be enrolled in the PCDCN. The likelihood of enrolling children in the program also increases with increasing number of prenatal visits and years of maternal schooling. Territoriality was not considered a determinant among program participants due to collinearity and nonsignificance problems with the rural variable.

The ATT estimates for the Caribbean region are shown in Table 3. The results indicate that the PCDCN has a positive impact on ADD reduction, comprehensive vaccination and the treatment of ARI/fever. More specifically, participation in the program increases the probability of a child completing the full series of immunizations for his/her age by almost 6 p.p., while participants are 12 p.p. more likely than nonparticipants to receive medical treatment for ARI or fever symptoms. The program has no impact on other outcome variables and the impact on the prevalence of ADD is negative.

## Discussion

The assessment of the impact of the PCDCN in the Caribbean region of Colombia showed that there was a decrease in ADD and an increase in immunization and seeking treatment for ARI or fever symptoms due to the program. It can be observed that there was a loss of values in the sample related to both vaccination and ARI treatment. However, the robustness of the PSM results and the fact that the sample remained significant meant that this did not limit the results (Table 2). It is important to note that the program had no impact on severe wasting and moderate wasting in the region. Lack of maternal education regarding early childhood care, a factor which seems to play a major role in the region, may partly explain this finding. There is evidence to suggest that wasting is a major cause of the high prevalence of ADD<sup>19</sup>. The data provides irrefutable evidence of a problem regarding the relationship between ADD and nutritional status, implying that the effects of the PCDCN are essentially confined to children from the region's poorest families. The results regarding acute and chronic malnutrition are similar at the regional level. Possible reasons to explain this fact are the heterogeneity of regions and different health programs<sup>20</sup>.



Table 3

Estimates of the average treatment effect (ATT) on program participants in the Caribbean region, Colombia.

Variable	Caribbean region	
	ATT *	ATT **
Moderate wasting	0.00116 (0.02145)	-0.01921 (0.01593)
Severe wasting	-0.012865 (0.01359)	-0.01518 (0.01149)
ADD	-0.00116 (0.05264)	-0.06904 *** (0.04173)
ARI	0.02150 (0.02846)	0.00460 (0.02479)
Comprehensive vaccination	0.04421 (0.04958)	0.06445 *** (0.03696)
Treatment of ARI/fever	0.14692 # (0.03649)	0.12355 # (0.03306)
Treatment of ADD	0.09274 (0.06936)	0.08617 (0.07073)

ADD: acute diarrhoeal diseases; ARI: acute respiratory infection.

Estimates were made using replacement and common support:

\* PSM using caliper matching;

\*\* PSM using local linear regression and bootstrap simulation to calculate standard error and determine statistical significance.

Bootstrap standard error adjusted by imposing the common support restriction:

\*\*\* Statistically significant at the 10% level;

# Statistically significant at the 1% level.

Source: Colombia's Demographic and Health Survey (DHS) 2010, World Health Organization (WHO) and authors' estimates.

Regarding the prevalence of ADD, considered one of the leading causes of death among children aged under five years worldwide <sup>21</sup>, the program showed positive results: a difference of 23 p.p. between children participating in the program and nonparticipants can be observed (see Table 2). Estimates based on data from the DHS (2010) show that overall prevalence of ADD in the region is 14%. Prevalence rates are highest in the Departments of Atlántico and Magdalena (10% and 18%, respectively).

The PCDCN had no impact on severe wasting across all of the evaluated groups. A similar result was found by an assessment of the Bangladesh Integrated Nutrition Project (PINB) which also showed that the project had no significant impact on wasting in children <sup>22</sup>. However, our results differ from those found by an assessment of the Bolsa Familia program in Brazil which found that the intervention led to an improvement in nutritional status among participating children <sup>23</sup>. Our results also differ from the findings of a study conducted by the ICBF of the HCB program. Ambiguous evidence of the impact of this program has been found. While there have been gains with respect to chronic wasting among children aged between two and four years, the program had a negative effect on the prevalence of acute respiratory infection and diarrhea. The impact of the subsidized health scheme was also determined. One possible reason for this difference is that the HCB program only targets poor families, and we did not perform a discriminate

analysis of household economic status and age group in the present study <sup>24</sup>.

With regard to measuring program impact, it is important to note that PSM enabled the fulfillment of the conditional independence assumption. In other words, after controlling for all relevant observed characteristics, the control group should show the same average results as the treatment group in the absence of intervention.

One of this study's limitations is that it is not adequate for making predictions about long term impact assessments.

The Families in Action Program mentioned above uses more variables related to child growth, development and care in Colombia than the PCDCN. The lack of variables used by the PCDCN can be considered a limitation. However, although it is advisable to assess the maximum possible number of determinants of participation, controlling this amount of variables is often complex. This consideration is particularly important when it comes to the fulfillment of the common support hypothesis, which is critical for correctly characterizing PSM. Finally, we recommend that future studies should use a larger sample size to allow for the simultaneous comparison of different variables, thus facilitating the observation of various program impacts. In addition, future studies should also consider the length of time that children have been in the program and use temporal information to improve estimates related to the household income of participating children.

## Resumo

*Este artigo tem como objetivo a avaliação do impacto do Programa de Crescimento, Desenvolvimento e Cuidado Infantil na região do Caribe colombiano. A avaliação é realizada em variáveis como status nutricional, indicadores antropométricos, saúde das crianças menores de cinco anos de idade e as práticas de cuidados infantis maternos. Para isso, são utilizadas técnicas quase experimentais do tipo Propensity Score Matching. Entre os resultados da avaliação, verificou-se uma diminuição da doença diarreica aguda, uma imunização mais alta e a busca pelo tratamento de sintomas de infecção respiratória aguda ou febre. Porém, o programa teve pouca influência sobre a desnutrição crônica e a desnutrição aguda na região.*

*Bem-Estar da Criança; Desenvolvimento Regional; Estatística; Avaliação de Programas e Projetos de Saúde*

## Contributors

A. J. Padilla participated in study design, the writing of this article, and read and approved the final version of this manuscript. J. C. Trujillo participated in data collection, the writing of this article, and read and approved the final version of this manuscript.

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