Effect of *Bono de Desarrollo Humano* (Conditional Cash Transfer Programme) on childhood mortality: a nationwide analysis of Ecuadorian counties

Guillermo Granizo M.[1], Davide Rasella[2], Mario J. Grijalva[1,3], Ana-Lucía Moncayo[1].

Author details

[1] Center for Research on Health in Latin America. College of Exact and Natural Sciences, Pontificia Universidad Católica del Ecuador, Quito, Ecuador.

[2] Instituto Gonçalo Muniz, Fundação Oswaldo Cruz, Salvador, Bahia, Brazil

[3] Infectious and Tropical Disease Institute, Department of Biomedical Sciences, Heritage College of Osteophatic Medicine, Ohio University, USA

Correspondig author: Ana-Lucía Moncayo, Center for Research on Health in Latin America, College of Exact and Natural Sciencies, Pontificia Univerisdad Católica del Ecuador, Calle Pambacienda s/n y San Pedro del Valle, campus Nayón, Quito-Ecuador.

E-mail: amoncayo708@puce.edu.ec

Abstract

Background: The mortality rate in children under five years old (U5MR) has decreased considerably in Ecuador; however, thousands of children continue to die from causes related to poverty. A social program known as *Bono de Desarrollo Humano* (BDH) was created to guarantee a minimum level of consumption for families and to reduce chronic malnutrition and preventable childhood diseases.

Objective: To evaluate the effect of the *Bono de Desarrollo Humano* programme on mortality of children younger than 5 years, particularly from malnutrition, diarrheal diseases, and lower respiratory tract infections.

Methods: Mortality rates and the BDH coverage from 2009 to 2014 was evaluated from the 144 (of 222) Ecuadorian counties with intermediate and adequate quality of vital information. A multivariable regression analyses for panel data was conducted by using a negative binomial regression model with fixed effects, adjusted for relevant demographic and socioeconomic covariates.

Results: For each 1% increase in BDH coverage, calculated from the county population (CP) or the eligible population (EP), there would be a decrease in U5MR of 3% (RR 0.971, 95% CI 0.953-0.999) and 1.5% (RR 0.985, CI 0.973-0.998), respectively. A lower effect of BDH on mortality resulting from respiratory infections was observed (BDH-CP coverage: reduction of 0.8%, 95% CI 0.984-0.999 and BDH-PE coverage: reduction of 0.5%, 95% CI 0.989-0.999). The BDH also reduced hospital discharge rates in children younger than 5 years, resulting from all causes and for diarrhea.

Conclusion:

A conditional cash transfer program such as *Bono de Desarrollo Humano* could contribute to the reduction of mortality due to causes related to poverty, such as malnutrition and respiratory infections. Ecuador, being a country that has recently

increased the amount of the BDH, requires making a careful monitoring and evaluation of the impact of the program to ensure that truly reduce inequities and improves health.

Keywords: Conditional cash transfer, *Bono de Desarrollo Humano*, social determinants, under-5 mortality rates, Ecuador.

Background

The world has made substantial progress in improving child survival in the past 25 years in order to reach the Millennium Development Goal (MDG) 4 of a two-thirds reduction in the under-five mortality rate (U5MR) between 1990 and 2015. The global under-five mortality rate dropped 56 percent, from 93 deaths per 1,000 live births in 1990 to 41 in 2016. Latin American and the Caribbean (LAC) have reduced the under-five mortality rate by 67% since 1990. Ecuador is among the 24 (of 81) low- and lower-middle income countries that met MDG 4. The U5MR declined from 57 deaths per 1,000 live births in 1990 to 22 in 2015 with an annual rate of reduction of 3.9% [1].

However, despite this progress, millions of children continue to live and die in conditions that are unacceptable. It has been described that the majority of children deaths are due to poverty [2] and as a result of diseases that can be prevented and treated easily and economically [3]. To improve the socioeconomic conditions of disadvantages citizens, social assistance programs has been implemented by many countries around the world. Globally, 77% and 42% of countries have unconditional and conditional cash transfers, respectively; however, significant variations in spending are observed across countries and regions [4].

Conditional Cash Transfer Programs (CCTPs) offer cash benefits to poor families to meet certain conditions associated with human capital development such as children´s school attendance and health checkups. In Ecuador, the largest social assistance program is *Bono de Desarrollo Humano* (BDH) which provided conditional cash transfers of US$50 per month to low-income mothers below the poverty line according to the Social Registry [5]. The required behaviors included both mother and children attending to preventive health check-ups and requiring a minimum percentage of attendance at school for school-age children. The aim of the program is guarantee a minimum level of consumption for families and contribute to the reduction of the chronic malnutrition and preventable diseases for under-five children [5]. As a result of the education conditionality, it is expected that children will have better opportunities later in life. Processes of social mobility have been promoted by the government which has allowed that fewer families require this monetary transfer. For instance, the number of beneficiaries decreased by 56.7% between 2013 and 2014 [6].

These programs have been shown to have led to reduction in poverty [7] and to have positive effects on education [8] and health [9–11]. Rasella et al., 2013 [12] and Barham et al., 2011 [13] found that *Bolsa Familia* (Brazil) and *Progresa* (Mexico), respectively, helped to reduce child mortality and morbidity due to causes associated with poverty, such as malnutrition and diarrhea. According these studies, BDH should reduce childhood mortality by acting on social determinants of health and by stimulating health care through its conditions [12, 13]. In Ecuador, some studies have reported the effectiveness of BDH on child development and nutrition [14–16], but no studies have addressed its effect on childhood mortality and morbidity. Therefore, the aim of this study was evaluating the effect of BDH on under-5 mortality rates in Ecuadorian counties, particularly on poverty-related causes, including diarrhea,

malnutrition and low respiratory infections and on some of the potential intermediate mechanisms (hospital discharges).

Methods

Study design

This study has a mixed ecological design, because it combined an ecological multiple-group design with a time-trend design [12]. The county was the unit of analysis. A longitudinal dataset from many databases for the years 2009–2014 were created. We analyzed the quality of information on births and deaths for all 222 counties and included counties in the study only if they presented intermediate and adequate information for the study period according to Andrade & Szwarcwald criterion [17]. This criterion considered five indicators: age-standardized mortality rate; the ratio between registered and estimated birth rates; mean relative deviation of the mortality rate; mean relative deviation of the birth rate; and proportion of poorly defined deaths [17].

We defined as dependent variables: a) U5MR (number of deaths of children under five years per 1,000 live births); b) cause-specific U5MR (number of deaths of children under five years resulting from diarrhea diseases, malnutrition or lower respiratory tract infections per 1,000 live births); c) under-five hospital discharges rate (number of children under five years who leave a hospital after receiving care due to diarrhea diseases, malnutrition or lower respiratory infections per 1,000 live births. The specific causes of mortality and hospital discharges were created according the International Classification of Diseases (ICD), 10th revision: diarrheal diseases (A00, A01, A03, A04, A06-A09); malnutrition (E40-E46); lower respiratory infections (J10-J18, J20-

J22); and external causes (V01–99). External causes were included as a control variable because of there is not expected effects of the program over these causes. All these dependent variables were obtained by direct calculation.

The primary explanatory variable was BDH coverage and two indicators were created: 1) coverage of the eligible population (EP): number of families enrolled in BDH program in a county / number of eligible families in the same county; 2) coverage of the county population (CP): number of individuals enrolled [obtained by multiplying the number of beneficiary families by the average family size of the county] / total population of the same county).

Based on a literature review, we identified a set of covariates as determinants of under-five mortality given their potential to confound the effect of the principal dependent variable. The following covariates were used in the analysis [12, 18, 19]: per capita income, iliteracy, percentage of households with inadequate sanitation, total fertility rate, number of physicians per 10,000 residents and bed rate per 1,000 residents.

Data sources

The data sources for this study were the National Institute of Statistics and Censuses [20] (Database of births and deaths and Population Census 2001-2010) and the National System of Information [21] (Integrated System of Knowledge and Social Statistics of Ecuador and Projections and demographic studies). Data were obtained at county level, which is the lowest level with information about BDH. Because some covariates were obtained from 2001 and 2010 national censuses databases, the annual values for 2009-2014 were calculated by linear interpolation or extrapolation as has been done in previous studies [12, 18, 19, 22].

Statistical analyses

We used conditional negative binomial regression models for panel data with fixed effects specification (counties as units of analysis with observations repeated over time) [12, 23]. Negative binomial regression is used when the outcome to be analyzed is a count. Fixed-effect models include a term to control for unmeasured time-invariant municipal characteristics (such as geography and local cultural practices) and to correct for serial correlation of repeated measures. To evaluate the association between U5MR (overall and specific) and BDH coverage, we calculated mortality rate ratios (95% CI), both crude and adjusted for a set of demographic, social and economic determinants as covariates. This approach assessed whether yearly differences on U5MR mortality rates were associated with yearly changes in *Bono de Desarrollo Humano* program coverage, while controlling for potential confounders.

Results

After we applied the criteria for inclusion (vital statistics quality criterion), we selected 144 counties (64.9%) with intermediate and adequate registration of vital statistics (death and live births) of the 222 Ecuadorian counties. From 2009 to 2014, the under-5 mortality rate decreased from 15.2 to 13.2 (13.3%) per 1,000 live births in the studied counties, and among the causes selected, the greatest decrease occurred in diarrheal diseases (68%) (Table 1). The BDH coverage showed a progressive decrease from 2009 to 2014 (CP: 69.6%; EP: 67.8%). Although, the overall under-5 hospital discharges rate increase slightly during study period, the rate by diarrheal diseases and malnutrition decreased by 13,7% and 21,9%, respectively. Socioeconomic conditions improved during the study period, with per capita income growing by 53.5%, the percentage of households with inadequate sanitation decreasing by 8.1% and the proportion of

illiterate individuals decreasing by 14.4%. There were also reductions in the total fertility rate (12.0%) (Table 1).

Table 2 shows the crude and adjusted associations between BDH coverage (eligible and county population) and under-5 mortality rate. In the analysis, both measures of BDH coverage did not show a statistically significant association with decreasing under-5 mortality rate, even after the adjustment for socio-economic covariates.

Table 3 and Table 4 shows adjusted associations between BDH coverage and under-5 mortality rate for some relevant group of causes. The strongest effect of the BDH was on under-5 mortality resulting from malnutrition. One percent increase in BDH coverage (EP and CP) was associated with a reduction of 1.5% (95% CI 0.973-0.998) and 2.9% (95% CI 0.953-0.989) in under-5 mortality rate associated with malnutrition, respectively. Lower effect was observed for under-5 mortality resulting from lower respiratory infections (reduction of 0.5% (95% CI 0.989-0.999) and 0.8% (95% CI 0.984-0.999, respectively). When we select only the counties with adequate vital statistics, the observed reductions were higher (BDH-EP: reduction of 2.9% (95% CI 0.954-0.989) and BDH-CP: reduction of 4.8%, 95% CI 0.992-0.983). BDH had no effect on external causes used as a control group.

Table 5 shows adjusted associations between BDH coverage and under-5 hospital discharge rates. One percent increase in BDH coverage (EP and CP) was associated with a reduction of 0.1% (95% CI 0.998-0.999) and 0.2% (95% CI 0.996-0.999) in the overall rate of under-5 hospital discharges. In addition, both measures of coverage

reduced hospital discharges rates resulting from diarrheal diseases (BDH-EP: reduction of 0.4%, 95% CI 0.994-0.998 and BDH-CP: 0.6%, 95% CI 0.991-0.997).

Discussion

Our results show that the implementation of the BDH from 2009-2014 was associated with a reduction in under-5 mortality rate from poverty related-causes such as malnutrition and lower respiratory infections at county level. The effect remained statistically significant after we controlled for social and economic determinants. With regard to factors involved in the causal chain of mortality reduction, BDH reduced rates of under-5 hospital discharge by diarrheal diseases.

There is consistent evidence that CCTP had a positive impact on child health and nutrition outcomes, especially among the most vulnerable children. These programs have been effective in increasing the use of preventive services, consumption of healthy foods, improving immunization coverage, and encouraging healthy behaviors [9, 11, 24].

The findings of our study are consistent with other studies that have reported an important positive impact of CCTP on childhood mortality. The Mexican program (*Progresa*) [13] and Brazilian program (*Bolsa Familia*) [19], were able to reduce infant mortality. CCTP in Bolivia increase the survival rates of birth cohorts exposed to the program by 3.5% to 16.8% [25]. In addition, a national Brazilian study showed that *Bolsa Familia* contributed substantially on reduction of under-5 mortality rates, particularly on poverty-related causes such as malnutrition and diarrhea [12]. Our study, using a similar approach to the Brazilian study, showed that BDH programme had a

positive effect on under-5 mortality resulting from malnutrition and lower respiratory infections but not in the same magnitude that the previous study. It is probably because in Ecuador the conditionalities were neither effectively communicated nor controlled or enforced.

Malnourished children, particularly those with severe acute malnutrition, have a higher risk of death from common childhood illness such as diarrhea, pneumonia, and malaria [26]. The contribution of CCTPs to the reduction of child undernutrition has been shown in some studies. Colombian programme *Familias en Acción*, was found to have improved the nutritional status of newborns and infants but only for those less than 2 years [27]. The Mexican programme, *Progresa* was associated with a better nutritional status and greater growth of children [28, 29]. In Nicaragua, the programme was found to have significantly reduced the proportion of underweight and stunted children among the beneficiaries [30]. No significant effects on height and height-for-age z-scores were observed in program from Brazil [31] and Ecuador [15], respectively. In addition, Búser, et al. (2014) [14], in Ecuador, showed that two years after families lost the transfer, which they had received for seven years, their young children weight less, and shorter and more likely to be stunted than young children in families that kept the cash transfer. Research has already shown that poor families enrolled in CCTP increased food expenditures and improved food security in their households [32]. Families that benefitted from CCTPs reported increased consumption of cereals, meat, and dairy in studies from Brazil [33] and Kenya [24].

Although our results showed that BDH programme have a positive effect on under-5 mortality resulting from malnutrition, we did not obtain the same effect on under-5

246 mortality resulting from diarrhea. CCTPs are considered powerful child nutrition-
247 sensitive interventions as they address the underlying causes of undernutrition and can
248 enhance the effectiveness of nutrition-specific interventions [34]. CCT programs may
249 be less effective at improving outcomes like diarrhea, as it may be more sensitive to
250 interventions like improved sanitation and better built environments.

251

252 Conditional cash transfer programs could affect survival through two main mechanisms.
253 1) CCT interventions lead to an increase in use of preventive health services among the
254 poor who are under-utilising these, including prenatal care, postnatal care, health and
255 nutrition educational activities for mothers, vaccination schedule, checkups and growth
256 monitoring visits for children younger than 7 years [19, 30, 31, 35]. However, the
257 benefits of improved access may be limited by the quality of existing services [32] and
258 2) CCT allows the household to improve health-related purchases (for example, higher
259 quality foods or medicines or of household materials and equipment that could reduce
260 exposure to infections [12, 32].

261

262 CCTPs appear to decrease the incidence and prevalence of severe illness [32]. Mexican
263 programme showed a 58% reduction in hospital visits for zero to two years old children
264 [35]. We found an effect of CCTP on rates of under-5 hospital discharges, overall and
265 for diarrhea. This fact could be explained by two mechanisms: 1) greater and opportune
266 use of preventive care and higher levels of health knowledge may lead to reduce severe
267 cases of illness that needing hospitalization and 2) decreasing the incidence of the
268 diseases by affecting social determinants of health [32].

269

Our study´s potential limitations include the use of an ecological or aggregated approach. Additionally, because of problems in the quality of nationwide data systems, only counties with intermediate and adequate recording of vital statistics data were included in the analysis. This limited the generalization of the results but improved the study´s internal validity. Another potential limitation was the linear interpolation and extrapolation of annual values for sociodemographic indicators derived from decennial census data. However, it is unlikely that it introduced any major bias, because slightly fluctuations in these macro-structural determinants or changes in the direction of the trends are not expected.

Conclusions

CCTPs like *Bono de Desarrollo Humano* have great potential to improve population health. BDH programme had a positive effect on under-5 mortality resulting from malnutrition and lower respiratory infections and on under-5 hospital discharges. These results are the reflection of a successful government social policy on guarantee a minimum level of consumption for families and to reduce chronic malnutrition and preventable childhood diseases. However, conditional requirements should be effectively communicated, controlled and enforced to achieve a greater effect on health outcomes.

Given the important relation between CCTP and the utilization of health and educational facilities, policy makers should assess the adequacy and quality of the existing health and educational infrastructure. Conditionality requirements of these programmes rely on the availability of basic health services and schools to meet the increased demand created by the programmes.

Processes of social mobility have been promoted by the government which has allowed that fewer families require this monetary transfer in the last years. In addition, Ecuadorian government has increased the amount of the BDH since 2018 and the money transfer will be allocated according to the number of children by household. These changes will require careful monitoring and evaluation of the impact of the program to ensure that truly reduce inequities, poverty and improves health.

Abbreviations

MDG: Millennium Development Goal; U5MR: Under-five mortality rate; LAC: Latin American and the Caribbean; MDG 4: Millennium Development Goal 4; BDH: Bono de Desarrollo Humano; CCTP: Conditional Cash Transfer Programs; ICD: International Classification of Diseases; RR: Rate Ratio; CI: Confidence Interval; EP: Eligible population; CP: County Population.

Acknowledgments

The Pontificia Universidad Católica del Ecuador supported this study by paying salary (to ALM) and offering material support for data processing and analysis.

Funding

Funding for this work included a full scholarship awarded by Pontificia Universidad Católica to Guillermo Granizo for the completion of his master degree, as well as PUCE´s Research Grant No.M13398 awarded to Ana Lucía Moncayo.

Authors' contributions

ALM and DR were involved in designing the study. GG, ALM, DR participated in data analysis and interpretation, and writing the article.

Ethics approval and consent to participate

No institutional review board protocol approval was needed for this study

Competing interests

The authors declare no competing interests

References

1**. You D, Hug L, Ejdemyr S, Beise J, Idele P, Gerland P, et al. Levels & Trends in Child Mortality. Report Estimates Developed by the UN Inter-Agency Group for Child Mortality Estimation. Unicef. 2017.**

2. Bhalla, G., Handa, S., Angeles, G., Seidenfeld D. **The Effect of Cash Transfers and Household Vulnerability on Food Insecurity in Zimbabwe.** 2016; September. https://www.unicef-irc.org/publications/pdf/IWP_2016_22.pdf.

3. Unicef. **70 AÑOS POR TODOS LOS NIÑOS. ESTADO MUNDIAL DE LA INFANCIA. Una oportunidad para cada niño**. 2016. https://www.unicef.org/spanish/publications/files/UNICEF_SOWC_2016_Spanish.pdf

4. World Bank. The State of Social Safety Nets 2017 **"Safety Nets where Needs are Greatest"**. 2017; April. http://documents.worldbank.org/curated/en/811281494500586712/pdf/114866-WP-PUBLIC-10-5-2017-10-41-8-ClosingtheGapBrochure.pdf.

5. Ministerio de Inclusión Económica y Social. Bono de Desarrollo Humano. http://www.inclusion.gob.ec/bono-de-desarrollo-humano1/. Accessed 26 Jan 2018.

6. Ministerio Coordinador de Desarrollo Social. **Informe de Desarrollo Social 2007-2017**. 2017. http://www.todaunavida.gob.ec/wp-content/uploads/2017/03/libro_social-2007-2017.pdf

7. Fiszbein A, Schady NR. **Conditional cash transfers. Reducing present and future poverty**. World Bank. 2009. https://siteresources.worldbank.org/INTCCT/Resources/5757608-1234228266004/PRR-CCT_web_noembargo.pdf

8. Saavedra JE, Garcia S. **Impacts of Conditional Cash Transfer Programs on Educational Outcomes in Developing Countries**. 2012.

9. Ranganathan M, Lagarde M. **Promoting healthy behaviours and improving health outcomes in low and middle income countries: A review of the impact of conditional cash transfer programmes.** Prev Med (Baltim). 2012;55 SUPPL.:S95–105. doi:10.1016/j.ypmed.2011.11.015.

10. Gentilini U, Honorati M, Yemtsov R. **The state of social safety nets 2014.** Washington, DC. World Bank Group. 2014. http://documents.worldbank.org/curated/en/302571468320707386/850097536_20140517511410 3/additional/879840WP0FINAL00Box385208B00PUBLIC0.pdf

11. Segura-pérez S, Grajeda R, Pérez-escamilla R. **Conditional cash transfer programs and the health and nutrition of Latin American children**. 2016;40:124–37.

12. Rasella D, Aquino R, Santos CAT, Paes-Sousa R, Barreto ML. **Effect of a conditional cash transfer programme on childhood mortality: A nationwide analysis of Brazilian municipalities**. Lancet. 2013;382:57–64. doi:10.1016/S0140-6736(13)60715-1.

13. Barham T. **A healthier start: The effect of conditional cash transfers on neonatal and infant mortality in rural Mexico**. J Dev Econ. 2011;94:74–85. doi:10.1016/j.jdeveco.2010.01.003.

14. Buser T, Oosterbeek H, Plug E, Ponce J, Rosero J. **The Impact of Positive and Negative Income Changes on the Height and Weight of Young Children**. World Bank Econ Rev. 2016;:lhw004. doi:10.1093/wber/lhw004.

15. Fernald LCH, Hidrobo M. **Effect of Ecuador's cash transfer program (Bono de Desarrollo Humano) on child development in infants and toddlers**: A randomized effectiveness trial. Soc Sci Med. 2011;72:1437–46. doi:10.1016/j.socscimed.2011.03.005.

16. Paxson C, Schady N. **Does money matter? The effects of cash transfers on child development in rural Ecuador**. Econ Dev Cult Change. 2010;59:187–229. doi:10.1086/655458.

17. Andrade CLT de, Szwarcwald CL. **Desigualdades sócio-espaciais da adequação das informações de nascimentos e óbitos do Ministério da Saúde, Brasil, 2000-2002**. Cad Saude Publica. 2007;23:1207–16. doi:10.1590/S0102-311X2007000500022.

18. Aquino R, De Oliveira NF, Barreto ML. **Impact of the Family Health Program on infant mortality in brazilian municipalities**. Am J Public Health. 2009;99:87–93.

19. Shei A. **Brazil's conditional cash transfer program associated with declines in infant mortality rates.** Health Aff. 2013;32:1274–81.

20. Instituto Nacional de Estadística y Censos (INEC). Consultas: Vdatos. Población y demografía. Nacimientos y Defunciones. http://www.ecuadorencifras.gob.ec/estadisticas/. Accessed 01 Jul 2016.

21. Sistema Nacional de Información (SNI). http://sni.gob.ec/inicio. Accessed 01 Jul 2016.

22. Rasella D, Aquino R, Barreto ML. **Reducing Childhood Mortality From Diarrhea and Lower Respiratory Tract Infections in Brazil**. Pediatrics. 2010;126:e534–40. doi:10.1542/peds.2009-3197.

23. Hilbe JM. **Negative Binomial Regression Second Edition**. 2011;:141–218.

24. Davis B, Gaarder M, Handa S, Yablonski J. E**valuating the impact of cash transfer programmes in sub-Saharan Africa: An introduction to the special issue**. J Dev Eff. 2012;4:1–8.

25. Celhay P, Vidal C, Johannsen J, Martinez S. **Paying patients for prenatal care: The effect of a small cash transfer on stillbirths and survival**. 2017; August. https://publications.iadb.org/handle/11319/8475.

26. World Health Organization (WHO). Media centre. Children: reducing mortality. http://www.who.int/mediacentre/factsheets/fs178/en/. Accessed 02 Mar 2018.

27. Attanasio O, Mesnard A. T**HE IMPACT OF A CONDITIONAL CASH TRANSFER PROGRAMME ON CONSUMPTION IN COLOMBIA.** 2005. https://www.ifs.org.uk/edepo/rs_fam02.pdf.

28. Behrman JR, Hoddinott J. **Programme evaluation with unobserved heterogeneity and selective implementation: The mexican PROGRESA impact on child nutrition**. Oxf Bull Econ Stat. 2005;67:547–69.

29. Rivera JA, Sotres-alvarez D, Shamah T, Villalpando S. on **Rates of Growth and Anemia in Infants and Young Children A Randomized Effectiveness Study**. J Am Med Assoc. 2004;291:2563–70.

30. Maluccio J a, Flores R. **Impact Evaluation of a Conditional Cash Transfer Program : the Nicaraguan Red De Protección Social**. Int Consupmtion Nutr Div. 2004.

31. Morris SS, Olinto P, Flores R, Nilson E a F, Figueiró AC. **Conditional cash transfers are associated with a small reduction in the rate of weight gain of preschool children in northeast Brazil**. J Nutr. 2004;134:2336–41.

431 32. Gaarder MM, Glassman A, Todd JE. **Conditional cash transfers and health:**
432 **unpacking the causal chain.** J Dev Eff. 2010;2:6–50.

433 33. De Bem Lignani J, Sichieri R, Burlandy L, Salles-Costa R. **Changes in food**
434 **consumption among the Programa Bolsa Família participant families in Brazil**.
435 Public Health Nutr. 2010;14:785–92.

436 34. Ruel MT, Alderman H. **Nutrition-sensitive interventions and programmes: How**
437 **can they help to accelerate progress in improving maternal and child nutrition?**
438 Lancet. 2013;382:536–51. doi:10.1016/S0140-6736(13)60843-0.

439 35. Gertler P. International Food Policy **Research Institute: Food Consumption and**
440 **Nutrition Division.** Final Report. The Impact of Progresa on Health. 2000.
441

442

Table 1. Descriptive analysis of study variables (N=144), 2009-2014, Ecuador

	2009	2010	2011	2012	2013	2014	Percentage change 2009-14
Mortality rate for children younger than 5 years (per 1000 live births)							
Overall	15.19	14.91	13.83	13.55	14.27	13.17	-13.30
For diarrhoeal diseases	0.5	0.32	0.33	0.29	0.21	0.16	-68.00
For malnutrition	0.27	0.23	0.14	0.15	0.13	0.19	-29.63
For lower respiratory infections	1.86	1.61	1.28	1.38	1.25	1.26	-32.26
For external causes	0.45	0.39	0.41	0.33	0.37	0.32	-28.89
Hospital discharges rate for children younger than 5 years (per 100 inhabitants)							
Overall	14.80	17.30	15.11	15.06	16.24	15.14	2.30
For diarrhoeal diseases	67.79	83.11	66.14	57.2	58.45	58.49	-13.72
For malnutrition	2.01	2.32	2.08	1.92	1.72	1.57	-21.89
For lower respiratory infections	78.17	87.55	82.92	91.48	102.21	91.37	16.89
BDH coverage							
BDH coverage of the county population (%)	30.69	28.57	28.65	27.94	23.29	9.33	-69.60
BDH coverage of eligible population (poor households) in the county (%)	58.07	54.76	55.65	55.00	46.37	18.68	-67.83
Determinants of children mortality							
Income per person (monthly, in USD)	346	384	437	472	504	531	53.47
Proportion of households with inadequate sanitation (%)	45.56	44.74	43.97	43.24	42.54	41.88	-8.08
Rate of individuals older than 15 years who are illiterate	6.52	6.32	6.13	5.94	5.76	5.58	-14.42
Total fertility rate	2.42	2.36	2.3	2.24	2.18	2.13	-11.98
Hospital bed rate (per 1000 habitants)	1.63	1.7	1.72	1.59	1.6	1.64	0.61
Hospital discharges rate (per 100 habitants)	7.22	7.48	7.66	7.66	7.71	7.65	5.96
Physicians rate (per 10000 habitants)	12.63	13.33	14.33	16.12	16.9	17.23	36.42

Table notes: Data are mean (SD). Causes of death were defined according to the International Classification of Diseases, 10th revision: diarrhoeal diseases (A00, A01, A03, A04, A06–09), malnutrition (E40–46), lower respiratory infections (J10–18, J20–22), and external causes (V01–98). Hospital discharges rate was calculated as the number of hospital discharges for all ages and all causes of one county divided by the total population of the same county and multiplied by 100. BDH=Bono de Desarrollo Humano

443

Table 2. Fixed-effect negative binomial models for association between *Bono de Desarrollo Humano* (BDH) coverage and under-5 mortality rate, 2009-2014, Ecuador.

	Counties with intermediate and adequate quality criterion			Counties with adequate quality criterion		
	RR crude (95% CI)	**RR adjusted (95% CI)**		**RR crude (95% CI)**	**RR adjusted (95% CI)**	
BDH coverage on eligible population	1.002 (1.001-1.004)	**1.000 (0.998-1.002)**		1.003 (1.001-1.004)	**0.999 (0.997-1.002)**	
BDH coverage on county population	1.004 (1.002-1.006)		**1.000 (0.997-1.003)**	1.005 (1.002-1.008)		**0.998 (0.993-1.002)**
Hospital discharges rate		1.001 (0.998-1.004)	1.000 (0.998-1.004)		1.001 (0.997-1.006)	1.001 (0.997-1.006)
Income monthly per person in USD		1.000 (0.999-1.000)	1.000(0.999-1.000)		1.000 (1.000-1.001)	1.001 (1.000-1.001)
Proportion of households with inadequate sanitation		1.013 (0.995-1.031)	1.013 (0.996-1.030)		1.010 (0.984-1.038)	1.010 (0.983-1.037)
Rate of individuals older than 15 years who are illiterate		1.029 (0.962-1.100)	1.028 (0.962-1.099)		1.168 (1.027-1.329)	1.170 (1.028-1.332)
Total fertility rate		1.401 (0.993-1.975)	1.396 (0.988-1.974)		0.839 (0.494-1.424)	0.853 (0.502-1.449)
Hospital bed rate (per 1000 inhabitants)		0.994 (0.937-1.055)	0.995 (0.937-1.055)		0.952 (0.875-1.036)	0.949 (0.872-1.033)
Physicians rate (per 10000 inhabitants)		1.002 (0.993-1.012)	1.000 (0.993-1.012)		0.995 (0.982-1.008)	0.996 (0.983-1.008)
Number of observations	864	864	864	432	432	432
Number of counties	144	144	144	72	72	72

Table notes: RR = rate ratio; CI = Confidence Interval.

Table 3. Fixed-effect negative binomial models for adjusted associations between *Bono de Desarrollo Humano* (BDH) coverage on eligible population and under-5 mortality rate for some relevant group of causes, 2009-2014, Ecuador.

	Mortality rate caused by diarrheal diseases		Mortality rate caused by malnutrition		Mortality rate caused by lower respiratory infections		Mortality rate caused by external causes	
	Intermediate and adequate quality criterion RR adjusted (95% CI)	Adequate quality criterion RR adjusted (95% CI)	Intermediate and adequate quality criterion RR adjusted (95% CI)	Adequate quality criterion RR adjusted (95% CI)	Intermediate and adequate quality criterion RR adjusted (95% CI)	Adequate quality criterion RR adjusted (95% CI)	Intermediate and adequate quality criterion RR adjusted (95% CI)	Adequate quality criterion RR adjusted (95% CI)
BDH coverage on eligible population	1.011 (0.999-1.023)	1.000 (0.983-1.017)	**0.985 (0.973-0.998)**	**0.971 (0.954-0.989)**	**0.995 (0.989-0.999)**	0.994 (0.987-1.002)	1.003 (0.994-1.012)	1.003 (0.991-1.014)
Hospital discharges rate	1.008 (0.990-1.026)	0.992 (0.968-1.017)	1.003 (0.977-1.030)	0.990 (0.956-1.027)	0.997 (0.988-1.006)	1.001 (0.988-1.014)	0.994 (0.975-1.013)	0.992 (0.969-1.016)
Income monthly per person in USD	0.999 (0.999-1.000)	1.002 (0.999-1.004)	0.999 (0.999-1.001)	0.997 (0.993-1.000)	1.000 (0.999-1.001)	1.000 (0.999-1.002)	1.000 (0.999-1.000)	0.999 (0.998-1.002)
Proportion of households with inadequate sanitation	1.009 (0.956-1.064)	1.044 (0.966-1.129)	1.096 (0.956-1.257)	0.955 (0.844-1.080)	1.047 (0.989-1.109)	1.049 (0.994-1.107)	1.054 (0.980-1.134)	1.082 (0.990-1.182)
Rate of individuals older than 15 years who are illiterate	1.059 (0.873-1.285)	1.029 (0.738-1.437)	0.841 (0.559-1.265)	0.9001 (0.610-1.330)	1.090 (0.882-1.348)	1.471 (0.971-2.230)	0.828 (0.654-1.047)	0.573 (0.356-0.922)
Total fertility rate	3.010 (0.593-15.274)	0.441 (0.037-5.290)	5.334 (0.489-58.165)	2.833 (0.082-98.351)	0.795 (0.264-2.397)	0.306 (0.057-1.648)	0.742 (0.121-4.574)	2.028 (0.156-26.415)
Hospital bed rate (per 1000 inhabitants)	1.177 (0.863-1.605)	1.307 (0.840-2.034)	0.867 (0.509-1.478)	0.610 (0.285-1.304)	0.971 (0.822-1.147)	0.802 (0.639-1.006)	1.098 (0.796-1.512)	0.997 (0.636-1.564)
Physicians rate (per 10000 inhabitants)	0.933 (0.881-0.988)	0.989 (0.910-1.076)	0.927 (0.861-0.999)	0.987 (0.899-1.082)	1.012 (0.984-1.042)	1.001 (0.963-1.041)	0.956 (0.913-1.001)	0.958 (0.903-1.017)
Number of observations	552	300	468	258	792	408	624	360
Number of counties	92	50	78	43	132	68	104	60

Table notes: RR = rate ratio; CI = Confidence Interval.

447

Table 4. Fixed-effect negative binomial models for adjusted associations between *Bono de Desarrollo Humano* (BDH) coverage on county population and under-5 mortality rate for some relevant group of causes, 2009-2014, Ecuador.

	Mortality rate caused by diarrheal diseases		Mortality rate caused by malnutrition		Mortality rate caused by lower respiratory infections		Mortality rate caused by external causes	
	Intermediate and Adequate quality criterion RR adjusted (95% CI)	Adequate quality criterion RR adjusted (95% CI)	Intermediate and adequate quality criterion RR adjusted (95% CI)	Adequate quality criterion RR adjusted (95% CI)	Intermediate and adequate quality criterion RR adjusted (95% CI)	Adequate quality criterion RR adjusted (95% CI)	Intermediate and adequate quality criterion RR adjusted (95% CI)	Adequate quality criterion RR adjusted (95% CI)
BDH coverage on county population	1.015 (0.997-1.034)	0.999 (0.971-1.028)	**0.971 (0.953-0.989)**	**0.952 (0.922-0.983)**	**0.992 (0.984-0.999)**	0.991 (0.980-1.003)	1.004 (0.989-1.019)	1.002 (0.982-1.022)
Hospital discharges rate	1.009 (0.992-1.027)	0.992 (0.968-1.017)	1.002 (0.976-1.029)	0.991 (0.955-1.028)	0.996 (0.987-1.006)	1.000 (0.988-1.013)	0.994 (0.976-1.013)	0.992 (0.969-1.016)
Income monthly per person in USD	0.999 (0.999-1.000)	1.002 (0.999-1.004)	1.000 (0.999-1.001)	0.998 (0.992-1.005)	1.000 (0.999-1.001)	1.000 (0.999-1.002)	1.000 (0.999-1.000)	0.999 (0.998-1.001)
Proportion of households with inadequate sanitation	1.006 (0.953-1.062)	1.044 (0.965-1.130)	1.085 (0.950-1.240)	0.965 (0.827-1.126)	1.050 (0.995-1.108)	1.052 (0.996-1.110)	1.056 (0.982-1.135)	1.083 (0.990-1.184)
Rate of individuals older than 15 years who are illiterate	1.057 (0.865-1.291)	1.031 (0.737-1.443)	0.858 (0.561-1.312)	0.940 (0.526-1.678)	1.106 (0.896-1.366)	1.499 (0.993-2.263)	0.824 (0.649-1.048)	0.574 (0.357-0.923)
Total fertility rate	3.144 (0.604-16.374)	0.445 (0.037-5.340)	7.802 (0.663-91.795)	4.385 (0.120-159.713)	0.851 (0.283-2.560)	0.312 (0.058-1.675)	0.767 (0.116-5.060)	2.298 (0.168-31.507)
Hospital bed rate (per 1000 habitants)	1.174 (0.864-1.595)	1.305 (0.838-2.032)	0.857 (0.498-1.473)	0.582 (0.271-1.251)	0.968 (0.818-1.145)	0.798 (0.636-1.002)	1.096 (0.796-1.509)	0.998 (0.637-1.565)
Physicians rate (per 10000 habitants)	0.929 (0.878-0.983)	0.990 (0.910-1.076)	0.926 (0.862-0.994)	0.983 (0.896-1.079)	1.012 (0.984-1.041)	1.001 (0.963-1.041)	0.955 (0.911-0.999)	0.958 (0.903-1.017)
Number of observations	552	300	468	258	792	408	624	360
Number of counties	92	50	78	43	132	68	104	60

Table notes: RR = rate ratio; CI = Confidence Interval.

Table 5. Fixed-effect negative binomial models for adjusted associations between *Bono de Desarrollo Humano* (BDH) coverage and under-5 hospital discharge rates, 2009-2014, Ecuador

	Under-5 hospital discharge rate		Under-5 hospital discharge rate for diarrhoeal diseases		Under-5 hospital discharge rate for malnutrition		Under-5 hospital discharge rate for lower respiratory infections	
	Intermediate and adequate quality criterion		Intermediate and adequate quality criterion		Intermediate and adequate quality criterion		Intermediate and adequate quality criterion	
	RR adjusted (95% CI)	RR adjusted (95% CI)	RR adjusted (95% CI)	RR adjusted (95% CI)	RR adjusted (95% CI)	RR adjusted (95% CI)	RR adjusted (95% CI)	RR adjusted (95% CI)
BDH coverage on eligible population	**0.999 (0.998-0.999)**		**0.996 (0.994-0.998)**		0.999 (0.994-1.005)		0.999 (0.997-0.999)	
BDH coverage on county population		**0.998 (0.996-0.999)**		**0.994 (0.991-0.997)**		0.999 (0.991-1.007)		0.999 (0.995-1.002)
Hospital discharges rate	1.017 (1.015-1.020)	1.017 (1.015-1.020)	1.019 (1.016-1.022)	1.019 (1.016-1.022)	1.014 (1.006-1.022)	1.014 (1.006-1.023)	1.014 (1.011-1.017)	1.014 (1.012-1.017)
Income monthly per person in USD	0.999(0.999-1.000)	0.999 (0.999-1.000)	0.999 (0.999-1.000)	0.999 (0.999-1.000)	0.999 (0.999-1.000)	0.999 (0.999-1.000)	1.000 (0.999-1.000)	0.999 (0.999-1.000)
Proportion of households with inadequate sanitation	1.029 (1.022-1.036)	1.029 (1.022-1.036)	1.032 (1.023-1.040)	1.033 (1.025-1.042)	1.056 (1.030-1.082)	1.056 (1.030-1.083)	1.022 (1.014-1.031)	1.022 (1.014-1.030)
Rate of individuals older than 15 years who are illiterate	1.059 (1.026-1.093)	1.059 (1.026-1.092)	1.109 (1.061-1.159)	1.112 (1.064-1.162)	1.049 (0.948-1.161)	1.049 (0.948-1.161)	1.033 (0.999-1.068)	1.036 (1.002-1.072)
Total fertility rate	0.809 (0.681-0.960)	0.812 (0.683-0.966)	0.838 (0.657-1.069)	0.875 (0.688-1.113)	1.091 (0.550-2.166)	1.099 (0.554-2.182)	0.697 (0.570-0.852)	1.149 (0.913-1.447)
Hospital bed rate (per 1000 habitants)	0.940 (0.891-0.992)	0.938 (0.889-0.990)	0.897 (0.835-0.963)	0.894 (0.832-0.960)	0.843 (0.715-0.994)	0.841 (0.714-0.992)	0.922 (0.867-0.981)	0.972 (0.918-1.029)
Physicians rate (per 10000 habitants)	1.000 (0.994-1.007)	1.000 (0.994-1.007)	0.997 (0.988-1.006)	0.997 (0.988-1.007)	1.001 (0.979-1.024)	1.001 (0.979-1.024)	1.007 (0.999-1.014)	0.994 (0.986-1.001)
Number of observations	864	864	870	870	798	798	870	870
Number of counties	144	144	145	145	133	133	145	145

Table notes: RR= rate ratio, CI= confidence interval

448

449