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Parenting and child development in rural Mexico: examination of a large-scale parenting program

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requirements for the degree of
Doctor of Philosophy
in
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Committee in charge:
Professor Lia Fernald, Chair
Professor William Dow
Professor Emily Ozer

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Abstract

Parenting and child development in rural Mexico: examination of a large-scale parenting
program
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Poverty, and its downward effects, compromises the development of 250 million
children under age 5 years in low- and middle- income countries (LMIC) globally, and
nearly 10 million (18%) children in Latin America. Conditional cash transfer programs
(CCTs) have shown mixed effects on child development outcomes in the context of
poverty. Parenting programs may improve the effectiveness of CCTs for children's
development, and benefits could occur via improvements in parenting practices or the
home environment. To understand how social programs, such as CCTs and parenting
programs, may improve family and child outcomes in LMIC, it is important to
understand how parenting practices are influenced other factors, such as knowledge
and education, cultural and ethnic values, attitudes and expectations, and other
contextual factors, such as social marginalization and poverty. Parental warmth,
responsiveness, and stimulation are associated with positive child development across
global contexts, but it is unclear how parenting quality in early versus later
developmental periods contributes to disparities in child cognitive and socioemotional
development in LMIC. This dissertation examined: 1) pathways of a parenting program's
effects on child development outcomes in Mexico; 2) demographic characteristics
associated with parenting behaviors, and the interaction between ethnicity and
community; and 3) the association between parenting quality during two
developmental periods and early childhood development. There were several key
findings from this research. The first was that the parenting program, *Educación Inicial,*
had a positive effect on stimulating parenting behaviors, and that the effect on these
behaviors mediated program effects on child development outcomes. Program effects
did not differ between indigenous and non-indigenous communities. Children in
indigenous families or living in indigenous communities were the most vulnerable to
having less stimulating parenting and home environments, however living in an
indigenous community was protective of parenting for indigenous families. Finally, a
longitudinal analysis found that parenting quality during infancy and prekindergarten
were independently associated with later child development. There were no differences
in the association between parenting and child development between indigenous and
non-indigenous communities.

For the thousand winds that blow,
And the diamond glints on snow.
For the sunlight on ripened grain,
And the gentle autumn rain.
For quiet birds in circled flight,
And the soft stars that shine at night.
                                        Mary Elizabeth Frye

For Hope

Acknowledgements

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Introduction

Early childhood is a critical period for child growth and cognitive and behavioral development (Shonkoff, Boyce, & McEwen, 2009). During this time, biological and social risk factors may have profound and lasting effects on child growth, and language, cognitive, socio-emotional and motor development (Lu & Halfon, 2003). The impact of an exposure to these risk factors depends on the context in which the exposures occur, and risk factors often co-occur, meaning that children are more likely to be exposed to multiple risks (Britto, Engle, & Super, 2013; Wachs & Rahman, 2013). The co-occurrence of risks leads children to be exposed to repeating risks over time that have cumulative effects, essentially, additive or synergistic wear and tear that affect health and wellbeing (Hertzman & Power, 2003). This is especially so for children living in poverty in low- and middle-income countries (LMIC) (Wachs & Rahman, 2013). Cumulative and pathways effects of exposures alter the trajectories of children's development (Halfon & Hochstein, 2002). In such, poverty serves as a fundamental cause of poor childhood development, with indirect rather than direct effects on child development (Fernald, Burke, & Gunnar, 2008; Link & Phelan, 1995). The accumulation of risk during early childhood negatively affecting early child development operate over time to increase the likelihood of exposure to future risks, as well as increases the child's sensitivity (sensitization) to future occurring risks (Hertzman & Boyce, 2010; Hill-Soderlund et al., 2008; Kuh, Ben-Shlomo, Lynch, Hallqvist, & Power, 2003). For example, poor child development subsequently affects school achievement, and adult health and employment (Brooks-Gunn & Duncan, 1997; Grantham-McGregor et al., 2007). As a result of the downward effects of poverty, the development of 250 million children under age 5 years in LMIC globally, and nearly 10 million (18%) children in Latin America is compromised (Hackman, Gallop, Evans, & Farah, 2015).

In 2008, the Mexican government implemented a randomized controlled trial (RCT) of a group parenting program (*Educación Inicial*) overlaid on an existing, national conditional cash transfer (CCT) program, *Prospera*, to address the risks of nutrition, infection, and lack of stimulation on early childhood development in poor, rural, and indigenous communities in Mexico. The *Prospera + Educación Inicial* intervention targets several of the pathways from poverty to child development. *Prospera* (formerly *Oportunidades, originally Progresa)* is one of the first conditional cash transfer programs to be established, and one of only a few to examine CCT effects on child development (Fernald, Gertler, & Neufeld, 2009). The cash transfer addresses poverty directly by providing income-support for eligible families (P. J. Gertler, Martinez, Premand, Rawlings, & Vermeersch, 2011). Biological and psychosocial risks are targeted indirectly through poverty alleviation, as well as directly through the condition- wherein children must regularly attend school and receive health care (P. J. Gertler et al., 2011). *Progresa* has been found to improve school enrollment, reduce the incidence of child and adult illness, and reduce the risk of stunting among children ages 1 to 3 years old (Behrman & Hoddinott, 2000; P. Gertler, 2004; Paul Schultz, 2004). *Prospera* has shown small but positive effects on child behavior, as well as better cognitive, language and motor development in children whose households received greater cash transfers (Fernald et al., 2008; Fernald, Gertler, & Neufeld, 2009). The addition of *Educación Inicial* targets younger children specifically through improved care (safety and hygiene) and parenting quality (warmth and responsiveness, stimulating practices and home environments). *Educación Inicial* has operated in parts of

Mexico since the early 1990s, with the goal to improve the knowledge and parenting practices of caregivers in poor, rural, underserved communities and promote the optimal development of at-risk children (Miguel et al., 2010).

The impact evaluation of the *Prospera + Educación Inicial* RCT found significant program effects found that *Educación Inicial* had a positive effect on child development (*Cohen's d*= 0.25) (Fernald et al., 2016). The program improved developmental outcomes among the most vulnerable children, those living in indigenous communities and with developmental scores in the bottom 20% at baseline. However, the program also had greater effects on children whose mothers had formal education and in households with greater resources. In addition, the RCT of the *Educación Inicial* program only found significant program effects in one of the treatment arms, in which *Prospera* and *Educación Inicial* collaborated, and did not find an impact on child development or parenting outcomes in the intervention group in which the two social programs did not coordinate or collaborate. The research presented in this dissertation seeks to examine the pathways connecting parenting practices and child development in poor and indigenous communities in rural Mexico, and understand the mechanisms through which the parenting program did and did not achieve effects on early childhood development. Figure 1 depicts the conceptual framework used for this research, presenting the associations that will be examined in three papers, corresponding to three primary aims.
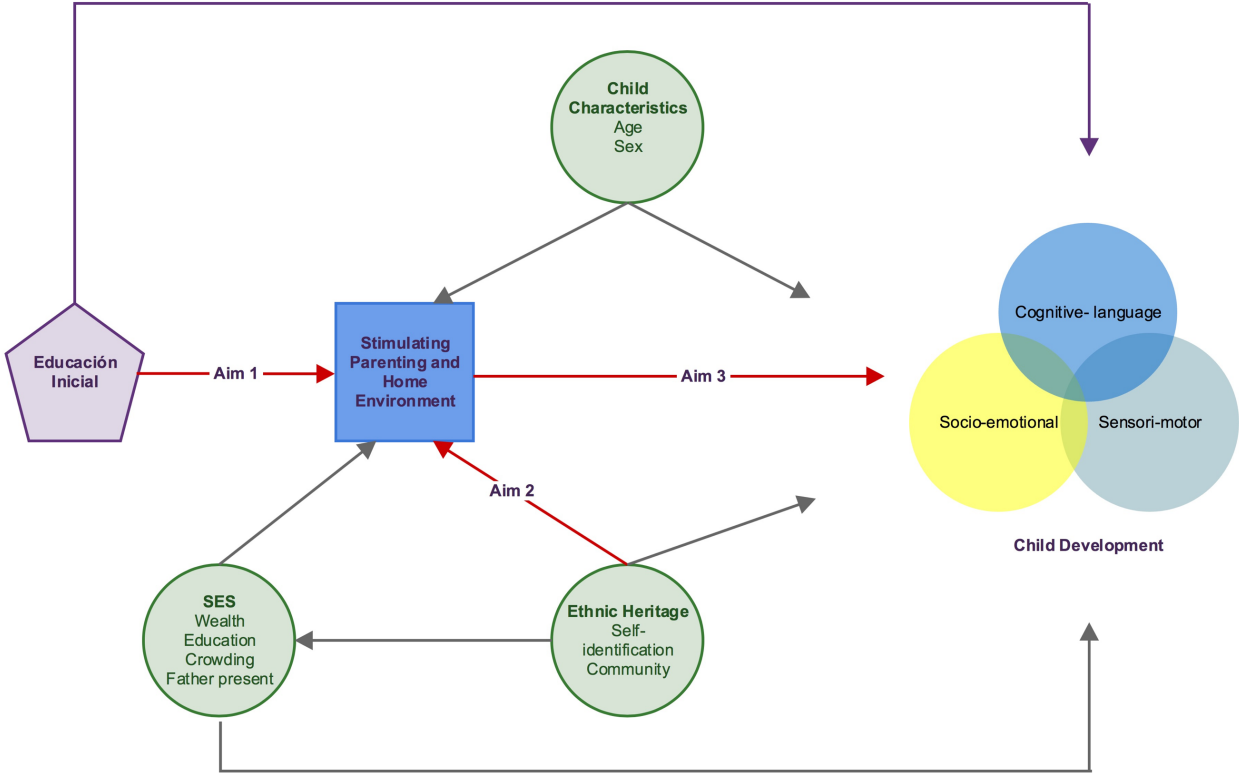
Figure 1. Conceptual framework depicting associations examined in the study.

The first paper examines determine the effects of randomization to a scaled-up, cluster-randomized, group-based parenting program, *Educación Inicial,* integrated with a conditional

cash transfer program (*Prospera*), on parenting behaviors and the home learning environment (**Aim 1**). A statified analysis examines whether program effects vary by whether the community is predominantly indigenous or non-indigenous. Finally, the paper also examines whether changes in parenting practices and the home environment resulting from participation in the program act as mediators of the impact of the program on child development outcomes.

The second paper uses cross-sectional data to examinee differences in parenting practices between indigenous and non-indigenous communities in rural Mexico, accounting for differences in community marginalization and individual SES (**Aim 2**). The paper explores demographic characteristics associated with parenting practices in indigenous and non-indigenous communities, and how demographic and SES factors may modify the relation between indigenous community and parenting practices. The potential differential association between self-identification as indigenous and parenting practices in indigenous as compared to non-indigenous communities is also examined. Finally, this study examines the association between parenting and current measures of child development in these communities.

The third paper uses longitudinal data to examine parenting quality during infancy and early childhood and their independent associations with child development outcomes at age 3 to 5 years in the study population (**Aim 3**). The association between parenting subscales (such as responsiveness, acceptance, learning materials) and child development are further examined to gain a greater understanding of whether there are specific aspects of parenting and the home learning environment that are more predictive of child development. The study then extends the analyses of the relation between ethnicity, parenting, and child development, to examine whether the association between parenting quality and child development is different in indigenous and non-indigenous communities.

In summary, this dissertation examines: 1) pathways of a parenting program's effects on child development outcomes in Mexico; 2) demographic characteristics associated with parenting behaviors, and the interaction between ethnicity and community; and 3) the association between parenting quality during two developmental periods and early childhood development.

References

Behrman, J., & Hoddinott, J. (2000). An evaluation of the impact of PROGRESA on preschool child height. *International Food Policy Research Institute, Washington, DC*.

Britto, P. R., Engle, P. L., & Super, C. M. (2013). *Handbook of early childhood development research and its impact on global policy*: Oxford University Press.

Brooks-Gunn, J., & Duncan, G. J. (1997). The effects of poverty on children. *The future of children*, 55-71.

Fernald, L. C. H., Burke, H. M., & Gunnar, M. R. (2008). Salivary cortisol levels in children of low-income women with high depressive symptomatology. *Development and Psychopathology, 20*(02), 423-436.

Fernald, L. C. H., Gertler, P. J., & Neufeld, L. M. (2009). 10-year effect of Oportunidades, Mexico's conditional cash transfer programme, on child growth, cognition, language, and behaviour: a longitudinal follow-up study. *The Lancet, 374*(9706), 1997-2005.

Fernald, L. C. H., Kagawa, R., Knauer, H., García Guerra, A., Schnaas, M. d. L., & Neufeld, L. M. (2016). Promoting Child Development through Group-Based Parent Support within a Cash Transfer Program: Experimental Effects on Children's Outcomes. *Developmental psychology*, Advance online publication.

Gertler, P. (2004). Do conditional cash transfers improve child health? Evidence from PROGRESA's control randomized experiment. *American economic review*, 336-341.

Gertler, P. J., Martinez, S., Premand, P., Rawlings, L. B., & Vermeersch, C. M. (2011). *Impact evaluation in practice*: World Bank Publications.

Grantham-McGregor, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L., & Strupp, B. (2007). Developmental potential in the first 5 years for children in developing countries. *The Lancet, 369*(9555), 60-70.

Hackman, D. A., Gallop, R., Evans, G. W., & Farah, M. J. (2015). Socioeconomic status and executive function: developmental trajectories and mediation. *Developmental science, 18*(5), 686-702.

Halfon, N., & Hochstein, M. (2002). Life course health development: an integrated framework for developing health, policy, and research. *Milbank Quarterly, 80*(3), 433-479.

Hertzman, C., & Boyce, T. (2010). How experience gets under the skin to create gradients in developmental health. *Annual Review of Public Health, 31*, 329-347.

Hertzman, C., & Power, C. (2003). Health and human development: understandings from life-course research. *Developmental neuropsychology, 24*(2-3), 719-744.

Hill-Soderlund, A. L., Mills-Koonce, W. R., Propper, C., Calkins, S. D., Granger, D. A., Moore, G. A., . . . Cox, M. J. (2008). Parasympathetic and sympathetic responses to the strange situation in infants and mothers from avoidant and securely attached dyads. *Developmental Psychobiology, 50*(4), 361-376.

Kuh, D., Ben-Shlomo, Y., Lynch, J., Hallqvist, J., & Power, C. (2003). Life course epidemiology. *Journal of epidemiology and community health, 57*(10), 778.

Link, B. G., & Phelan, J. (1995). Social conditions as fundamental causes of disease. *Journal of health and social behavior*, 80-94.

Lu, M. C., & Halfon, N. (2003). Racial and ethnic disparities in birth outcomes: a life-course perspective. *Matern Child Health J, 7*(1), 13-30.

Paul Schultz, T. (2004). School subsidies for the poor: evaluating the Mexican Progresa poverty program. *Journal of development Economics, 74*(1), 199-250.

Shonkoff, J. P., Boyce, W. T., & McEwen, B. S. (2009). Neuroscience, molecular biology, and the childhood roots of health disparities: building a new framework for health promotion and disease prevention. *JAMA, 301*(21), 2252-2259.

Wachs, T. D., & Rahman, A. (2013). The nature and impact of risk and protective influences on children's development in low-income countries. *Handbook of early childhood development research and its impacton global policy*, 85-122.

Pathways to improved development for children living in poverty: A randomized effectiveness trial in rural Mexico

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Abstract:
Conditional cash transfer programs (CCTs) have shown mixed effects on child development outcomes in the context of poverty. Parenting programs may improve the effectiveness of CCTs for children's development, and benefits could occur via improvements in parenting practices or the home environment. Here, we use data from a randomized effectiveness trial to examine the pathways connecting parenting support and child development; the parenting program (*EI: Educación Inicial*) was implemented at scale among beneficiaries of *Prospera* (a CCT, previously *Oportunidades* and *Progresa*). Participants included 3-5 year old children (n=1,362) from 91 rural communities in three Mexican states. Communities were stratified by indigenous classification and randomized to one of three arms: (T_0) Comparison group (CCT benefits only); (T_1) CCT benefits plus availability of *EI* in the community; or (T_2) CCT benefits plus promotion and encouragement by the CCT program to participate in *EI*. Findings were that participation in the T_2 arm of the study was associated with a 13% increase in the number of play activities that parents engaged in with their children, particularly shared storybook reading and singing. Parents in T_2 showed nearly two times greater odds of reading daily to their children. In mediation analyses, the amount of play activities and shared book reading explained up to 32% of the effects of the *EI* parenting program on child development outcomes. In this study collaboration and integration of two social programs was critical for program impact, and could have implications for other programs promoting child development within the context of poverty.

Introduction

To reach their developmental potential, children must have stimulating home environments and engaged parents who actively promote learning through behavioral modeling, teaching, and providing new opportunities (Walker et al., 2011). For example, parents' verbal engagement with their children, through activities such as reading books and telling stories, promotes cognitive development (Bradley & Corwyn, 2002) and the acquisition of language skills (McCartney, Dearing, Taylor, & Bub, 2007). Poverty can negatively affect parenting and the home-environment, creating less stimulating environments for children, and thus compromising early childhood physical, cognitive and social-emotional development (Vernon-Feagans, Garrett-Peters, Willoughby, Mills-Koonce, & Investigators, 2012).

Parents living in poverty often lack resources, knowledge, and capabilities to promote the optimal development of their children (B. D. Johnson, Berdahl, Horne, Richter, & Walters, 2014; Linver, Brooks-Gunn, & Kohen, 2002). As a consequence, parents living in poverty are less likely to read or share storybooks with their children, they engage less in play with their children, and they have fewer age and development appropriate play materials in the home (Bradley, Corwyn, McAdoo, & García Coll, 2001; Duncan, Brooks-Gunn, & Klebanov, 1994). The quality of the home environment and child development outcomes are worse when mothers have fewer years of formal education or less knowledge relating to child development (Harding, Morris, & Hughes, 2015). In a study of 28 low- and middle-income countries (LMICs), fewer than 25% of mothers had read to their children in the previous 3 days, and only about a third had told stories to their children in that same time frame (Bornstein & Putnick, 2012). As a result of poverty and its downstream effects, including insufficient stimulation, hundreds of millions of children under 5 years old worldwide fail to meet their developmental potential.

Several types of interventions – such as conditional cash transfer programs (CCTs), home-visiting programs, responsive parenting promotion or parenting support groups - have attempted to reduce the effects of poverty on child development by encouraging parents to make greater investments in their children's health and development (Engle et al., 2011; Grantham-McGregor, Fernald, Kagawa, & Walker, 2013; Reynolds, 2004). Studies from Ecuador, Nicaragua and Peru have shown mixed effects of cash transfers on child development outcomes, for example (Fernald, Gertler, & Hidrobo, 2012). These findings argue that just providing cash to poor families is not sufficient, and promoting home stimulation to improve the development of children from poor families in low-income countries is also needed. Early childhood interventions that include direct parent support and/or education have shown the largest effects on child cognitive development in comparison to interventions that are only focused on nutrition or poverty alleviation (Engle et al., 2011). However, there is a demonstrated need to integrate interventions focused on promotion of child development within existing services and sectors, such as health and education (Grantham-McGregor et al., 2013).

The study described here adds to the existing literature by reporting on an evaluation of the integration of two at scale programs (a conditional cash transfer program and a parenting support program), which provide parenting education in a group setting. This study expands our understanding of the findings on child development outcomes by examining effects of the combination of at-scale programs on parenting practices and the home environment, measured using Family Care Indicator (FCI) subscales and play activity frequency measures.

There are three objectives of the current study. The first objective is to determine the effects of randomization to a scaled-up, cluster-randomized, group-based parenting program, *Educación Inicial,* integrated with a conditional cash transfer program (*Prospera*), on parenting behaviors and the home learning environment in rural Mexico. The second objective is to determine if the program effects vary by whether the community is predominantly indigenous or non-indigenous. The third objective is to examine whether changes in parenting practices and the home environment resulting from participation in the program act as mediators of the impact of the program on child development outcomes.

Methods

Description of interventions

The Mexican government has created several social 'compensatory' programs to address disparities in nutrition, health, primary school attendance, and early childhood education, as well as poverty alleviation. Among the first of these programs was Mexico's conditional cash transfer program (CCT) *Prospera* (first called *Progresa, then Oportunidades*), which provides cash payments to parents if they comply with certain conditions, such as taking their children to preventative health check-ups and/or making sure their school-aged children attend school at least 80% of the time. Details of the program have been described previously (Fernald, Gertler, & Neufeld, 2008). *Prospera* is among only a handful of CCTs that have examined effects on child development outcomes. *Prospera* has shown small but positive effects on child behavior, as well as better cognitive, language and motor development in children whose households received greater cash transfers (Fernald et al., 2008; Fernald, Gertler, & Neufeld, 2009).

Another large scale program in Mexico, *Educación Inicial,* has operated since the early 1990s, with the goal to improve the knowledge and parenting practices of caregivers in poor, rural, underserved communities and promote the optimal development of at-risk children (Miguel et al., 2010). To date, the program has reached more than 23,000 communities and 400,000 families (Silva, Ulloa, & Ramirez, 2009). *Educación Inicial* targets pregnant women and caregivers of children 0 to 4 years old, operating weekly sessions for nine months out of the year (Miguel et al., 2010). The program is delivered by local community educators, "*promotoras*", using a well-developed, evidence-based curriculum that addresses safety and hygiene, nutrition, and early childhood stimulation at age-specific intervals. Each session is approximately two hours long, with an average of 14 mothers attending the sessions (Instituto National de Salud Publica, 2012).

Study design

This study was designed as a randomized controlled effectiveness evaluation. There were two intervention arms testing two different levels of promotion of *Educación Inicial* in comparison with a third arm, which did not receive the *EI* parenting program. Other available social services continued to operate as normal in all three treatment arms. The treatment arms are described as follows:

The comparison arm (T_0) received the usual benefits of *Prospera,* the CCT program, which includes a combination of interventions in health, nutrition, and education, and the

receipt of cash transfers. Communities assigned to this arm did not have access to the *EI* parenting program.

The first treatment arm (T_1) had access to the *EI* parenting education program in their community in addition to receiving the benefits of *Prospera*, but *Prospera* staff did not promote or give logistical support to the parenting program.

The second treatment arm (T_2) had access to the *EI* parenting education program in their community, in addition to receiving the benefits of *Prospera.* In this arm, *Prospera* provided additional promotion and support to encourage participation in the parenting program. The original intention was to make attendance in *Educación Inicial* one of the conditions of the cash transfer in this arm, but enforcement was not feasible.

Sampling

A sample of 204 eligible communities was stratified by indigenous designation (102 indigenous and 102 non-indigenous) and then randomly assigned within each stratum to one of the three study arms. Community designation as "indigenous" or "non-indigenous" was based on the prominence of the indigenous population in the community (at least 80% speaks an indigenous language) according to the National Institute of Statistics and Geography (INEGI) census classifications. Eligibility criteria for inclusion of communities in the study were: (1) being located in a rural area (population <2500) in the Mexican states of Chiapas, Puebla or Oaxaca; (2) having a minimum of 15 families with children ages 0-2 years of age; (3) having at least 70% of families in the community receiving benefits from *Prospera*; and (4) having no current or prior operation (within the past 5 years) of *Educación Inicial*. Participation in other social programs was not an exclusion criterion.

Data collection

All *Prospera* beneficiary families in the eligible treatment and comparison communities were invited to participate in the study, with baseline data collection occurring in 2008, 1-2 months before program implementation. Baseline data were collected on 2,472 children ages 0-18 months and their families through in-home interviews with the mother or caregiver of each child. Investigators returned in 2012 to collect follow-up data from the same children assessed at baseline. Due to budgetary limitations, a smaller sample of children (N=1383) was selected for follow-up at that time. In general, the children excluded from follow-up were from the most remote villages, due to the costs associated with travel. Of those interviewed, we lost some (n=19) because the Family Care Indicators (FCI) were not applied, and others (n=2) because they were missing data on two or more of the subscale components, resulting in a sample size of n=1362 for the FCI subscales analyses. For our analyses of program impact on the frequency with which parents engaged their children in specific play activities, we included only those caregivers who reported that they engaged in any of the play activities listed (singing, reading, and talking and playing), resulting in a sub-samples for singing (n=560), shared book reading (n=717), and talking and playing analyses (n=742). Finally, we tracked implementation of the *Educación Inicial* program in all enrolled communities to monitor contamination. Of the communities in the final sample, some in the treatment arm failed to implement the program (n=1 in T_1, n=7 in T_2); and some in the comparison arm (n=2 in T_0) had actually implemented *Educación Inicial.*

Measurement of parental engagement and home environment

Family Care Indicators (FCI) are a set of indicators that measure the quality and quantity of stimulation available to a child in his or her home environment. The FCI was originally derived from the Home Observation for Measurement of the Environment (HOME) Inventory (Caldwell & Bradley, 1984). The FCI is validated and used worldwide in the UNICEF Multiple Indicator Cluster Survey (Kariger et al., 2012) and is associated with early child development (Hamadani et al., 2010). The FCI consists of several sets of yes/no questions, including the sources of play materials (household objects or things from outside, homemade toys, or toys purchased from a toy store), the variety of play materials (items to make/play music, items to use to draw and/or write, picture books for children, objects to stack/construct/build, things for moving around, objects for learning shapes and colors, and items for pretend play), and parent-child play activities in the previous three-days (reading/looking at picture books; telling stories; singing songs; taking child outside the home; playing with toys; and spending time naming things, drawing and counting). The last part of the FCI is a count of the number of books in the household, capped at 10 or more. Finally, separate questions were asked about the frequency with which parents engaged in singing, reading, and talking and playing with their child. These questions were asked of parents who reported that they engaged in the play activities, but relevant activities were not restricted to the previous three days. The response categories for the frequency question were not conducive to a linear examination of frequency (everyday, 2-6 times per week, 1 time per week, and less than 1 time per week). Therefore, we examined these variables as "parents who engaged in the activity on a daily basis" vs. "parents who engaged in the activity less than daily".

Our analyses focus on four key outcomes: 1) the variety of *play materials* in the household, 2) the variety of *parent-child play activities*, 3) the presence of *books* in the household, and 4) the *frequency* of parental engagement in specific play activities. We hypothesized that these characteristics would be the most likely to change as a result of exposure to the program and thus would likely mediate the associations between *Educación Inicial* and child development outcomes.

Less than 1% of the follow-up analysis sample was missing data on the FCI subscales. For children missing only one subscale component (n=14 for play activities and n=12 for play materials), a conservative imputation of zero was applied to retain a score for the total subscale. Subscale scores missing more than one indicator measure were excluded (n=2).

Measurement of child development

Child development was measured using the McCarthy Scales of Children's Abilities (MSCA), which is a psychological test that can be administered to children ages 2 to 8 years old to assess their abilities in five domains; Verbal Ability, Perceptual- Performance (non-verbal reasoning), Quantitative, Memory and Fine and Gross Motor Skills (McCarthy, 1972). The Verbal, Perceptual, Quantitative and Memory scales of the MSCA were applied in this study. The General Cognitive Index (GCI) is a sum of the Verbal, Perceptual and Quantitative Scale scores. The MSCA was translated and adapted for the local context by one of the authors [LS], who also trained field staff that applied the instrument. Test scores were converted to age-adjusted standard scores using two-month age intervals. The standard scores have a mean of

100 and standard deviation of 15. Each two-month age category included between 10-13% of the sample except for the categories at the two extremes (youngest category: 9%, oldest category: 6%).

Other household, parent and child variables

Data were collected on household socio-economic status and demographic structure, characteristics of household members, state of residence (Chiapas, Oaxaca or Puebla), and whether or not the community was indigenous or non-indigenous. 70% of residents in the study communities were recipients of *Prospera*, a welfare program, and thus designated as poor. Other relevant variables included child age (in 6 month categories) and sex (boy, girl), parent education (kindergarten or less, completed primary school, completed secondary school, completed high school or higher), whether the father was present in the household, and household wealth. Household wealth was measured using an inventory of household assets (21 items: e.g., refrigerator, TV, iron). The average number of household assets owned in the sample was 4. A principal components analysis was used to consolidate this index, and we retained the first component (Falkingham & Namazie, 2002; Jolliffe, 2002). This first component was then rotated using the varimax rotation and logged to account for rightward skew (Vyas & Kumaranayake, 2006). Wealth was included in the model as a continuous variable. In addition to the above, variables for household composition (number of adults and children in the house) and household crowding (number of people in the house / number of rooms), as well as the presence of electricity and piped water in the home, were used to assess baseline differences among the treatment and comparison arms in the follow-up group. Fewer than 1% of follow-up observations were missing data for mother's education, father present or household wealth, while 4.8% of observations were missing data for father's education. No data were missing for child age or sex. Where demographic data were missing, values were imputed using the community mean.

Statistical analysis

Our specific statistical approach for addressing each of our stated objectives is described below. For all of the three objectives described, we included indicator variables for state of residence (Chiapas, Oaxaca, and Puebla) and clustered standard errors at the community level. We assessed the robustness of the findings from our parsimonious models by comparing these results to the results from models in which we controlled for potential confounding by including the following variables: child age and sex, parent education, whether the father was present in the household, whether the community was indigenous or non-indigenous and household wealth. We conducted our statistical analyses using STATA 13 (STATA Corporation, College Station, TX, USA).

To address our first objective, which was to examine the effectiveness of *Educación Inicial* on parenting behaviors and the home learning environment, we analyzed the variety of play materials and parent-child play activities using Poisson regressions, and then examined the play activities items individually using logistic regression. In these models, assignment to the *EI* parenting program was the independent variable and each measure of parenting behavior was the dependent variable in repeated independent models. The number of books in the household (two categories: 0 & ≥1), and the frequency of play activities (every day / less than

every day) conditional on engaging in the play activities to avoid a problem of excess zeros and over dispersed data, were also analyzed using logistic regression. All regressions were run incorporating both treatment groups as dummy variables within the same regression (R. A. Johnson & Wichern, 2012). We did not adjust for multiple testing as it was not justified by the design of the study or the intentions of the analyses (Bender & Lange, 2001).

$$Y_{ij} = \beta_0 + \beta_1 T_{1ij} + \beta_2 T_{2ij} + \beta_3 S_k + \gamma X_{ij} + e_{ij}$$

Where Y is the parenting outcome, T_1 and T_2 are treatment group assignments, S is state fixed effects, X is a vector of covariates, i is the individual level, j is the community level, and k is the state level.

To address our second objective, which was to determine if the program effects vary by whether the community is predominantly indigenous or non-indigenous, we analyzed effects for indigenous and non-indigenous communities using the parsimonious model for each of the outcomes (FCI subscales, individual play activity measures, and frequency measures).

To address the third objective, which was to examine whether changes in parenting practices and the home environment resulting from participation in *Educación Inicial* acted as mediators of the impact of the program on child development outcomes, we used mediation analyses (*paramed* command in Stata) (Emsley & Liu, 2013). In these models, the independent variable was randomized assignment to *Educación Inicial*, the dependent variable was child development scores (MCSA), and the mediators were the Family Care Indicators and frequency of play activities that were found to be significantly influenced by the *EI* parenting program in the first objective. For the mediation analyses we only examined the T_2 group, because assignment to T_1 did not have statistically significant effects on the mediators. To examine mediation, we used parametric regression techniques from (Valeri & VanderWeele, 2013), which require four key assumptions: 1) the exposure-outcome relationship; and 2) the exposure-mediator relationship are not confounded conditional on the covariate set; 3) the mediator-outcome relationship is not confounded conditional on the covariate set and the exposure; and 4) the exposure does not affect the mediator-outcome confounders (T. VanderWeele & Vansteelandt, 2009). Because our exposure was randomized, we assume the exposure-outcome and exposure-mediator relationships are not confounded. To address the third assumption, we controlled for child age and sex, parents' education, father presence, household wealth, indigenous community and state of residence. Finally, the fourth assumption was met because the mediator-outcome confounders were present and measured before initiation of the program and therefore could not have been influenced by randomization to *Educación Inicial*.

For play activities subscale (count):
$E[M|a,c] = \beta_0 + \beta_1 a + \beta_2 c$
$E[Y|a,m,c] = \theta_0 + \theta_1 a + \theta_2 m + \theta_3 am + \theta_4 c$

For shared book reading, singing, and daily reading (dichotomous):
$E[Y|a,m,c] = \theta_0 + \theta_1 a + \theta_2 m + \theta_3 am + \theta_4 c$
$logit[P(M = 1|a,c)] = \beta_0 + \beta_1 a + \beta_2 c$
Where a=treatment group, Y=child development score, M=parenting mediator and c= vector of covariates.

In a linear mediation model, the total effect of the intervention is the overall average change in the outcome in T_2 compared with T_0; this total effect can then be decomposed into the direct and indirect effects (Valeri & VanderWeele, 2013; T. J. VanderWeele, 2014). The direct (DE) and indirect (IE) effects for the change in exposure from level $a*$ to level a are given by

For play activities subscale (count):
$$DE = [\theta_1 + \theta_3(\beta_0 + \beta_1 a^* + \beta_2 c)](a - a^*)$$
$$IE = (\theta_2\beta_1 + \theta_3\beta_1 a)(a - a^*)$$

For shared book reading, singing, and daily reading (dichotomous):
$$DE = \theta_1(a - a^*) + [\theta_3(a - a^*)]\frac{exp(\beta_0 + \beta_1 a^* + \beta_2 c)}{1 + exp(\beta_0 + \beta_1 a^* + \beta_2 c)}$$

$$IE = (\theta_2 + \theta_3 a)\left\{\frac{exp(\beta_0 + \beta_1 a + \beta_2 c)}{1 + exp(\beta_0 + \beta_1 a + \beta_2 c)} - \frac{exp(\beta_0 + \beta_1 a^* + \beta_2 c)}{1 + exp(\beta_0 + \beta_1 a^* + \beta_2 c)}\right\}$$

The percent of the effect of randomization to *Educación Inicial* on child development scores that was mediated by the family care variables was calculated by dividing the indirect effect by the total effect. The indirect effect is the effect of the mediator holding treatment constant (Pearl, 2012). A separate model was run for each mediator. We used bootstrapping (1,000 samples) to ensure accuracy of the inferences due to the smaller sample sizes.

Results
Descriptive statistics
Baseline characteristics between the followed and not followed groups were not significantly different for child and parental characteristics or household wealth, and attrition did not differ between study arms (**Supplementary Table 1**). However, there were a greater proportion of households with piped water in the follow up group (74% followed vs 62% not followed) and less crowding (3.06 followed vs 3.43 not followed).

At follow-up, the three groups (T_0, T_1, T_2) were well balanced across a range of child, parent and household characteristics, suggesting that despite the loss to follow up, randomization at baseline was successful (**Supplementary Table 2**). There was wide variability in the types of play materials owned at follow-up, as well as the play activities that parents engaged in with their children (**Supplementary Table 3**). For example, the majority of parents reported owning toys for pretend play, such as dolls (>85%), but only about 12% of parents reported having toys for building, such as blocks. Over 75% of parents reported taking their children outside the home within the last three days, whereas only 33% or fewer reported telling stories to their children in the same time period. More than 50% of households owned over 10 books in total, but these books were not limited to children's picture books, and could have included schoolbooks, bibles, or other adult books. Despite high book ownership, fewer than half of all parents reported engaging in shared storybook reading with their children.

Effect of Educación Inicial on parenting practices and home environment

Parents in T_2 were more likely than parents in T_0 to participate in play activities with their children (3.37 vs 2.85 activities); the magnitude of the coefficient decreased but remained significant in adjusted analyses (**Table 1**). Parents in T_2 were also more likely to engage in shared storybook reading (52% vs 39%) and singing (49% vs 38%) than parents in T_0, but these differences became non-significant with the inclusion of covariates. Spending time drawing, or counting and naming things displayed a non-significant trend when comparing T_2 and T_0 (data not shown). There were no differences in play activities, reading or singing between T_1 and T_0.

Parents in both treatment groups (T_1 and T_2) had significantly greater odds of reading with their children every day than parents in the comparison group T_0 (T_1 and T_2 >11% vs 7% T_0). The difference in frequency of reading remained significant with the inclusion of covariates. There were no additional significant differences between T_2 or T_1 and T_0.

As a test of sensitivity, unadjusted and adjusted analyses were repeated using inverse probability censored weights. After including weights, the differences in the total FCI play activities and the odds ratios for the individual play activity frequencies remained nearly unchanged with the inclusion of weights (**Supplementary Table 4**). However, the log count difference comparing T_2 to T_0 in the adjusted model became non-significant.

Mediation analysis: home environment and parenting practices

Mediation was considered significant if the indirect effect (the effect of the mediator on the outcome holding treatment constant) was significant at the 0.05 level. The FCI play activities subscale was a significant mediator for the General Cognitive Index (GCI) and all subscales of the McCarthy. Shared storybook reading significantly mediated the program effect on the GCI and the Perceptual Scale. No other mediators reached statistical significance. The percent of the total effect of *Educación Inicial* that was mediated through changes in parenting behaviors (as measured by the FCI play activities subscale) was 18% for the Verbal Scale, 32% for the Quantitative Scale, 26% for the Perceptual Scale, 13% for the Memory Scale, and 23% for the GCI (**Table 2**). One-fifth (21%) of the effect of the program on the GCI was mediated by engagement in shared storybook reading. Shared storybook reading also mediated 32% of the effect on Perceptual Scale scores. There was no mediation by parents singing with or frequency of reading to their children. The percent of the mediated effect cannot be compared across models, as the mediators are not mutually exclusive (e.g., shared book reading and singing are components of the FCI play activities subscale, and frequency of reading is a measure for parents that engage in shared booking reading), and because each model does not account for the effects of the other mediators.

Effect modification by indigenous status

We found no significant differences in program effects between indigenous and non-indigenous communities (data not shown). When we stratified and analyzed each subpopulation, there were no statistically significant treatment effects for either treatment group compared to the comparison group (**Supplementary Table 5**).

Discussion

In this study, we have shown that participation in a weekly, group-based, parenting education program in Mexico (*Educación Inicial*) had positive effects on parenting practices and the home environment. Even after adjustment for covariates, there was a 13% increase (calculated by exponentiating the log count difference) in the number of different play activities parents engaged in with their children, and nearly 2 times greater odds of parents reading daily with their children in the T_2 intervention group. Using mediation analyses, we also showed that these changes in parenting behavior were partially responsible for explaining the positive effects that the *EI* program had on child development outcomes, with up to 32% of the effect explained. The treatment effects were significant only when comparing the T_2 treatment arm with T_0. The T_2 arm received support in terms of program promotion and encouragement of participation from the CCT program, and was also the only arm where children showed benefits to child development (Fernald et al., In Press).

The effect size of the intervention on FCI play activities (d=0.29) is slightly smaller than that found on HOME scores (from which the FCI is derived) in two similar but smaller studies of group based parenting programs in Bangladesh (d=0.34-0.38) (Aboud, 2007; Aboud & Akhter, 2011), and substantially smaller than effects on HOME based parenting measures in programs that include home visiting in Bangladesh (d=0.55-0.68) (Aboud, Singla, Nahil, & Borisova, 2013), and Jamaica (d=0.50). It is possible that effect sizes reported here are smaller than those found in other studies because the Mexican program was group-based and not as intensive as existing parenting support programs.

All of the results reported here occurred in the context of an existing CCT (*Prospera*). It is likely that in the T_2 arm, the collaboration and support from a large and well-established social program aided *Educación Inicial* in achieving its effects on parenting through increased awareness of and participation in the program. There may also have been increased community and participant buy-in of the new program due to community familiarity with *Prospera*. It is possible that parents may have believed that *Educación Inicial* was in fact a part of *Prospera*, or that attendance and participation in sessions was a condition of their cash transfer benefits as a result of the collaboration between the two programs in the T_2 arm, in spite of the fact that there were no monetary consequences or benefits related to attendance at the group-based *Educación Inicial* sessions.

There were no effects on parenting practices, the home environment or child development in the T_1 arm, which did not receive institutional support from *Educación Inicial* by *Prospera*. Qualitative reports suggest that recruitment of caregivers to participate in the *EI* parenting program was more difficult in the T_1 arm when compared with T_2 because *Prospera* program *promotoras* encouraged mothers to attend *Educación Inicial* in the T_2 arm, but there was no support from *Prospera* in the T_1 arm (Instituto National de Salud Publica, 2012). These findings suggest that a CCT may be an effective platform through which a parenting program can reach particularly vulnerable children.

Our findings have encouraging implications for resource-limited settings. For example, we found that parenting support programs can be successful simply by teaching parents to use what they have available and to be creative in their developmentally supportive play; this technique has been used previously by the well-known Jamaican home visiting program (Grantham-McGregor, Powell, Walker, & Himes, 1991), among others. There is good evidence

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that combining nutritional and child development activities, or integrating child development support into existing systems and structures can have additional benefits for young children (Grantham-McGregor et al., 2013). This existing evidence suggests that integrating parenting support into an existing conditional cash transfer program may be a cost-effective and at-scale approach to improving child development in the context of poverty.

The primary limitation of this study is the lack of complete follow-up data for the original sample. Due to budget constraints, children who were the most difficult to reach were not followed. Our sensitivity analyses indicate that more crowded households, and households without piped water were less likely to be followed; their non-inclusion affects the generalizability of the results found especially given that these are documented developmental risk factors in multiple countries (Walker et al., 2011). This caveat is especially important as the intention of the program is to target the most poor, rural and marginalized children who are at the greatest nutritional and psychosocial risk. This limitation does not appear to affect the internal validity of the study, as balance was maintained among the three treatment arms at follow-up. An additional limitation is that independent effects of the two programs cannot be disentangled, as it was not possible to have a control group that did not receive *Prospera,* since the program exists throughout Mexico.

This study demonstrates that a well-designed group parenting program such as *Educación Inicial*, implemented in coordination with an existing CCT program can have a positive effect on parenting behaviors and the home environment, which are known to improve early childhood development. Collaboration and integration of social programs may provide cost savings through economies of scale, and may be critical for program impact, as suggested by our finding that *Educación Inicial* had significant effects on parenting and the home environment only when the program received promotional support from *Prospera*. The results reported here have implications for policies on and the design of parenting education programs in LMICs. Group-based, weekly, parent education programs can be an effective solution for resource-limited contexts where early education services or home-visiting programs are not available, but their effects may be enhanced when working in collaboration with an established social infrastructure.

Table 1. Unadjusted and adjusted analyses[1]: Effects of Randomization to *Educación Inicial* on Family Care Indicators (n=1362)

	Unadjusted		Adjusted	
	Conditional cash transfer program with *Educación Inicial* available **vs** Conditional cash transfer program only[1]	Conditional cash transfer program with promotion and encouragement of participation in *Educación Inicial* among participants **vs** Conditional cash transfer program only[1]	Conditional cash transfer program with *Educación Inicial* available **vs** Conditional cash transfer program only[1]	Conditional cash transfer program with promotion and encouragement of participation in *Educación Inicial* among participants **vs** Conditional cash transfer program only[1]
Family Care Indicator Subscales[2]	**Log count difference (CI)**	**Log count difference (CI)**	**Log count difference (CI)**	**Log count difference (CI)**
Play activities	0.05 (-0.09, 0.18)	0.16 (0.03, 0.30)*	0.04 (-0.08, 0.15)	0.12 (0.003, 0.25)*
Individual Play Activities[3]	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**
Shared Book Reading	1.01 (0.69, 1.47)	1.60 (1.06, 2.40)*	1.00 (0.67, 1.42)	1.50 (0.98, 2.32)
Singing	1.35 (0.91, 2.01)	1.52 (1.01, 2.29)*	1.34 (0.91, 1.93)	1.43 (0.97, 2.17)
Play Activity Frequencies[4]	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**
Daily Reading	1.89 (1.08, 3.31)*	1.89 (1.04, 3.42)*	1.90 (1.07, 3.29)*	1.90 (1.03, 3.41)*

Note. All analyses compare treatment groups to control using indicator variables. Unadjusted analyses combine indigenous strata, adjust for community level clustering and control for state fixed effects. Adjusted analyses combine indigenous strata, adjust for community level clustering and control for state fixed effects, child age and sex, mother and father education, father present, household wealth and indigenous community. [1] The conditional cash transfer program only group is the comparison group. [2] Family Care Indicator Subscales are sums of number of play materials (7 items), and parent-child play activities (6 items). [3] Individual play activities are measured as yes/no. [4] Play- activity frequencies are measured as every day/ less than every day. Sample sizes for individual play- activities are: singing=1358; and for play activity frequencies are: reading= 717. ** p<0.01, * p<0.05

Table 2. Mediation Analysis: The percent of the total effect of *Educación Inicial* on McCarthy Scores mediated by Family Care Indicators, and the decomposed direct and indirect effects, comparing the sonditional cash transfer program with promotion and encouragement of participation in *Educación Inicial* among participants group and the conditional cash transfer program only group[1]

McCarthy Score	Mediator	% of TE that is mediated[2]	Direct effect (CI)			Indirect effect (CI)		
General Cognitive Index[3]	Play activities subscale[4]	23	2.33	(0.40, 4.65)	*	0.70	(0.21, 1.47)	**
	Shared Book Reading	21	2.32	(0.49, 4.60)	*	0.61	(0.08, 1.19)	*
	Singing	8	2.76	(0.84, 5.04)	*	0.23	(-0.10, 0.77)	
	Daily Reading	2	3.45	(0.79, 6.51)	*	-0.07	(-0.65, 0.30)	
Verbal	Play activities subscale	18	2.45	(0.56, 4.69)	*	0.55	(0.15, 1.19)	*
	Shared Book Reading	13	2.55	(0.67, 4.71)	*	0.37	(-0.07, 0.88)	
	Singing	8	2.74	(0.76, 4.93)	**	0.25	(-0.06, 0.78)	
	Daily Reading	6	3.09	(0.50, 5.88)	*	-0.17	(-0.72, 0.20)	
Quantitative	Play activities subscale	32	1.38	(-0.82, 3.53)		0.66	(0.22, 1.52)	*
	Shared Book Reading	21	1.57	(-0.74, 3.76)		0.41	(-0.07, 0.98)	
	Singing	11	1.80	(-0.51, 3.99)		0.22	(-0.10, 0.75)	
	Daily Reading	6	1.98	(-1.07, 4.93)		0.12	(-0.38, 0.67)	
Perceptual	Play activities subscale	26	1.76	(-0.18, 3.95)		0.62	(0.15, 1.34)	*
	Shared Book Reading	32	1.56	(-0.48, 3.68)		0.73	(0.14, 1.33)	*
	Singing	5	2.21	(0.11, 4.39)		0.10	(-0.28, 0.59)	
	Daily Reading	4	3.36	(0.27, 6.45)	*	-0.005	(-0.57, 0.43)	
Memory	Play activities subscale	13	2.74	(0.87, 4.87)	*	0.43	(0.04, 1.05)	*
	Shared Book Reading	7	2.92	(1.05, 5.01)	**	0.22	(-0.19, 0.80)	
	Singing	7	2.87	(1.01, 4.94)	**	0.22	(-0.08, 0.74)	
	Daily Reading	6	2.80	(0.04, 6.00)		-0.15	(-0.79, 0.23)	

Note. Coefficients are the difference in McCarthy Scores. 95% CI are bootstrapped with 1,000 samples. All models adjust for child age and sex, parent's education, father present, household wealth, indigenous community, and state fixed effects. [1] The conditional cash transfer program only group is the comparison group. [2] Percent of Total Effect (TE) mediated is calculated using the indirect effect divided by the total effect. [3] The General Cognitive Index is a sum of the Verbal, Perceptual and Quantitative Scale scores. [4] Play Activities Subscale is the sum of Family Care Indicator parent-child play-activities (6 items). [3] Shared Book Reading and Singing are measured as yes/no. [4] Play- activity frequencies (Daily Reading) are measured as every day/ less than every day. ** $p<0.01$ * $p<0.05$

Supplementary Table 1. Comparison of baseline characteristics of children by inclusion in the follow up to examine loss to follow up effects on generalizability to the baseline target population

	Not Included (n=1110)	Included (n=1362)	P-value
Child Characteristics			
Girl			0.787
Age (months)	577 (52%)	694 (51%)	0.654
Parental Characteristics	8.92 (0.18)	9.03 (0.18)	
Indigenous (by self-identification)			0.164
Father Present	699 (63%)	749 (55%)	0.660
Father Education[1]	1032 (93%)	1267 (93%)	0.072
Kinder or less			
Primary	167 (15%)	191 (14%)	
Secondary and above	688 (62%)	959 (70%)	
Mother Education[1]	204 (19%)	209 (15%)	0.148
Kinder or less			
Primary	266 (24%)	272 (20%)	
Secondary and above	722 (65%)	913 (67%)	
Household Characteristics	111 (10%)	177 (13%)	
Indigenous community[2]			0.407
Crowding[3]	655 (59%)	7375(54%)	0.001
Household composition	3.43 (0.10)	3.06 (0.06)	
Household members			0.129
Children	6.85 (0.10)	6.66 (0.09)	0.297
Adults	4.37 (0.10)	4.25 (0.08)	0.677
Piped water to home	2.42 (0.04)	2.40 (0.03)	0.002
Electricity in home	688 (62%)	1012 (74%)	0.987
Asset index (log)[4]	1041 (94%)	1008 (94%)	0.135
Study Group	0.70 (0.02)	0.75 (0.03)	0.903
Conditional cash transfer program with *Educación Inicial* available			
Conditional cash transfer program with promotion and encouragement of participation in *Educación Inicial* among participants	433 (39%)	490 (36%)	
Conditional cash transfer program only (Comparison group)	333 (30%)	422 (31%)	

Note. Data are n (%) or mean (SE) and are stratified by inclusion in the final sample. P-values are generated from t-tests (for continuous variables) and chi-squared tests (for dichotomous variables) and adjusted for state of residence and clustering at the community level. [1] Education denotes the highest level completed. [2] Indigenous community is defined as those in which more than 70% of the community population speaks an indigenous language. [3] Crowding is number of people in the household divided by the number of rooms (including kitchen but not bathroom). [4] Asset index is a log of a PCA of a standard summary index of household possessions.

Supplementary Table 2. Baseline characteristics of children in follow-up sample

	Conditional cash transfer program only[1]	Conditional cash transfer program with *Educación Inicial* available	Conditional cash transfer program with promotion and encouragement of participation in *Educación Inicial* among participants
	n=437	n=502	n=423
Child Characteristics			
Girl	217 (50%)	234 (47%)	217 (51%)
Age (months)			
0 to 6	201 (46%)	189 (38%)	160 (38%)
7 to 12	126 (29%)	163 (32%)	130 (31%)
13 to 18	112 (26%)	150 (30%)	133 (31%)
Parent Characteristics			
Father Present	407 (93%)	472 (94%)	384 (91%)
Father Education[2]			
Kindergarten or less	64 (15%)	77 (15%)	53 (13%)
Primary	315 (72%)	341 (68%)	307 (73%)
Secondary and above	60 (14%)	84 (17%)	63 (15%)
Mother Education[2]			
Kindergarten or less	83 (19%)	90 (18%)	83 (19%)
Primary	295 (67%)	355 (71%)	295 (67%)
Secondary and above	62 (14%)	57 (11%)	61 (14%)
Household Characteristics			
Indigenous community [3]	258 (59%)	270 (54%)	211 (50%)
Crowding[4]	3.12 (1.63)	3.14 (1.79)	2.94 (1.69)
Household Composition			
Children	4.46 (1.97)	4.26 (1.83)	4.02 (1.90)
Adults	2.42 (0.94)	2.38 (0.95)	2.40 (1.04)
Piped Water to home	315 (72%)	375 (75%)	323 (76%)
Electricity in home	412 (94%)	473 (94%)	390 (92%)
Asset Index (log)[5]	0.73 (0.42)	0.71 (0.45)	0.78 (0.42)

Note. Data are n (%) or mean (SD) and are stratified by assignment to the three treatment arms. [1] The conditional cash transfer program only group is the comparison group. [2] Education denotes the highest level completed. [3] Indigenous community is defined as those in which more than 70% of the community population speaks an indigenous language. [4] Crowding is number of people in the household divided by the number of rooms (including kitchen, but not bathroom). [5] Asset index is a log of a PCA of a standard summary index of household possessions.

Supplementary Table 3. Frequency Distributions of Family Care Indicators in follow-up sample

	Conditional cash transfer program only[1] n=437	Conditional cash transfer program with *Educación Inicial* available n=502	Conditional cash transfer program with promotion and encouragement of participation in *Educación Inicial* among participants n=423
Family Care Indicators Subscales			
Variety of Play Materials (yes/no):			
Making music (% answering yes)	124 (28%)	122 (24%)	92 (22%)
Drawing, writing	237 (54%)	206 (41%)	202 (48%)
Picture books	125 (29%)	136 (27%)	112 (26%)
Building, i.e., blocks	54 (12%)	61 (12%)	46 (11%)
Active play, i.e., balls	323 (74%)	375 (75%)	305 (72%)
Learning colors, shapes	84 (19%)	90 (18%)	79 (19%)
Pretend play, i.e., dolls	374 (86%)	436 (87%)	379 (90%)
mean number of play materials	3.02 (1.61)	2.84 (1.62)	2.87 (1.57)
Play Activities (in the previous 3 days):			
Reading or looking at picture books with child (% answering yes)	171 (39%)	199 (40%)	222 (52%)
Tell stories to child	118 (27%)	147 (29%)	141 (33%)
Sing songs with child	164 (38%)	230 (46%)	205 (49%)
Take child outside home	333 (76%)	384 (77%)	338 (80%)
Play with toys with child	272 (62%)	332 (66%)	297 (71%)
Spend time with child in naming things, counting, drawing	190 (43%)	219 (44%)	223 (53%)
mean number of play activities	2.85 (1.75)	3.01 (1.76)	3.37 (1.81)
Number of Books in the Household[2]			
None	65 (15%)	76 (15%)	56 (13%)
1 to 4	49 (11%)	58 (12%)	78 (18%)
5 to 9	67 (15%)	73 (15%)	66 (16%)
10 or more	258 (59%)	294 (59%)	222 (52%)
Play Activity Frequency with Parent[3]			
Daily Reading	29 (7%)	56 (11%)	52 (12%)
Daily Singing	38 (9%)	59 (12%)	54 (13%)
Daily Talking and Playing for 1/2 hour	86 (20%)	121 (24%)	101 (24%)

Note. Data are n (%) or mean (SD) and are stratified by assignment to the treatment arms. [1] The conditional cash transfer program only group is the comparison group. [2] The number of books in the household include any books (not just child story books). [3] These variables are derived from a separate set of questions from the play activities subscales, asking parents how often they engaged in certain activities. Frequencies are measured as every day/ less than every day. Sample sizes for individual play activities are: storytelling=1361, singing=1358, leave home=1361, playing=1360, drawing, etc=1361.

Supplementary Table 4. Weighted unadjusted and adjusted analyses[1]: Effects of Randomization to *Educación Inicial* on Family Care Indicators (n=1362)

	Unadjusted		Adjusted	
	Conditional cash transfer program with *Educación Inicial* available **vs** Conditional cash transfer program only[1]	Conditional cash transfer program with promotion and encouragement of participation in *Educación Inicial* among participants **vs** Conditional cash transfer program only[1]	Conditional cash transfer program with *Educación Inicial* available **vs** Conditional cash transfer program only[1]	Conditional cash transfer program with promotion and encouragement of participation in *Educación Inicial* among participants **vs** Conditional cash transfer program only[1]
Family Care Indicator Subscales[2]	**Log count difference (CI)**	**Log count difference (CI)**	**Log count difference (CI)**	**Log count difference (CI)**
Play activities	0.05 (-0.09, 0.19)	0.16 (0.02, 0.30)*	0.03 (-0.08, 0.15)	0.12 (-0.00, 0.25)
Individual Play Activities[3]	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**
Shared Book Reading	0.97 (0.66, 1.44)	1.52 (1.00, 2.32)*	0.94 (0.64, 1.40)	1.42 (0.93, 2.26)
Singing	1.36 (0.91, 2.03)	1.55 (1.01, 2.38)*	1.31 (0.92, 1.96)	1.44 (0.98, 2.26)
Play Activity Frequencies[4]	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**
Daily Reading	1.98 (1.12, 3.48)*	1.98 (1.08, 3.61)*	1.93 (1.09. 3.39)*	1.95 (1.06, 3.57)*

Note. All weighted analyses use inverse probability censored weights to account for bias that may have been introduced through attrition. Logistic regressions calculate the probability of remaining in the study based on baseline covariates (e.g., piped water and crowding). Each treatment group is compared to the comparison group using dummy variables. Unadjusted analyses combine indigenous strata, adjust for community level clustering and control for state fixed effects (not shown). Adjusted analyses combine indigenous strata, adjust for community level clustering and control for state fixed effects, child age and sex, mother and father education, father present, household wealth and indigenous community (not shown). [1] The conditional cash transfer program only group is the comparison group. [2] Family Care Indicator Subscales are simple sums of variety of play materials (7 items), and parent-child play activities (6 items). [3] Individual play activities are measured as yes/no. [4] Play- activity frequencies are measured as every day/ less than every day Sample sizes for individual play- activities are: singing=1358; and for play activity frequencies are: reading= 717 ** p<0.01, * p<0.05

Supplementary Table 5. Effects of randomization to *Educación Inicial* on Family Care Indicators among indigenous and non-indigenous communities (n=1362)

	Indigenous (n=737)		Non-Indigenous (n=625)	
	Conditional cash transfer program with *Educación Inicial* available **vs** Conditional cash transfer program only[1]	Conditional cash transfer program with promotion and encouragement of participation in *Educación Inicial* among participants **vs** Conditional cash transfer program only[1]	Conditional cash transfer program with *Educación Inicial* available **vs** Conditional cash transfer program only[1]	Conditional cash transfer program with promotion and encouragement of participation in *Educación Inicial* among participants **vs** Conditional cash transfer program only[1]
Family Care Indicator Subscales[2]	**Log count difference (CI)**	**Log count difference (CI)**	**Log count difference (CI)**	**Log count difference (CI)**
Play activities	-0.05 (-0.23, 0.12)	0.11 (-0.09, 0.32)	0.09 (-0.03, 0.22)	0.11 (-0.03, 0.24)
Individual Play Activities[5]	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**
Shared Book Reading	0.67 (0.39, 1.16)	1.51 (0.83, 2.74)	1.52 (0.92, 2.51)	1.60 (0.94, 2.71)
Singing	1.21 (0.74, 1.97)	1.40 (0.78, 2.52)	1.37 (0.83, 2.28)	1.22 (0.77, 1.92)
Play Activity Frequencies[6]	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**	**Odds Ratio (CI)**
Daily Reading 314/394	1.88 (0.81, 4.40)	1.71 (0.73, 3.98)	1.79 (0.82, 3.94)	1.83 (0.80, 4.21)

Note. All analyses compare treatment groups to control using indicator variables, adjust for community level clustering and control for state fixed effects. [1] The conditional cash transfer program only group is the comparison group. [2] Family Care Indicator Subscales are sums of number of parent-child play activities (6 items). [3] Individual play activities are measured as yes/no. [4] Play- activity frequencies are measured as every day/ less than every day. Sample sizes for individual play- activities are: singing=1358; and for play activity frequencies are: reading= 717. ** $p<0.01$, * $p<0.05$

References

Aboud, F. E. (2007). Evaluation of an early childhood parenting programme in rural Bangladesh. *Journal of health, population, and nutrition, 25*(1), 3-13.

Aboud, F. E., & Akhter, S. (2011). A cluster-randomized evaluation of a responsive stimulation and feeding intervention in Bangladesh. *Pediatrics, 127*(5), e1191-e1197.

Aboud, F. E., Singla, D. R., Nahil, M. I., & Borisova, I. (2013). Effectiveness of a parenting program in Bangladesh to address early childhood health, growth and development. *Social science & medicine, 97*, 250-258.

Bender, R., & Lange, S. (2001). Adjusting for multiple testing—when and how? *Journal of clinical epidemiology, 54*(4), 343-349.

Bornstein, M. H., & Putnick, D. L. (2012). Cognitive and Socioemotional Caregiving in Developing Countries. *Child development, 83*(1), 46-61.

Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual review of psychology, 53*(1), 371-399.

Bradley, R. H., Corwyn, R. F., McAdoo, H. P., & García Coll, C. (2001). The home environments of children in the United States part I: Variations by age, ethnicity, and poverty status. *Child development, 72*(6), 1844-1867.

Caldwell, B. M., & Bradley, R. H. (1984). *Home observation for measurement of the environment*: University of Arkansas at Little Rock

Duncan, G. J., Brooks-Gunn, J., & Klebanov, P. K. (1994). Economic deprivation and early childhood development. *Child development, 65*(2), 296-318.

Emsley, R., & Liu, H. (2013). PARAMED: Stata module to perform causal mediation analysis using parametric regression models. *Statistical Software Components*.

Engle, P., Fernald, L. C., Alderman, H., Behrman, J., O'Gara, C., Yousafzai, A., . . . Ertem, I. (2011). Strategies for reducing inequalities and improving developmental outcomes for young children in low-income and middle-income countries. *The Lancet, 378*(9799), 1339-1353.

Falkingham, J., & Namazie, C. (2002). Measuring health and poverty: a review of approaches to identifying the poor. *London: DFID Health Systems Resource Centre*.

Fernald, L. C. H., Gertler, P., & Hidrobo, M. (2012). Conditional cash transfer programs: effects on growth, health, and development in young children. *The Oxford handbook of poverty and child development. Oxford University Press, New York*.

Fernald, L. C. H., Gertler, P. J., & Neufeld, L. M. (2008). Role of cash in conditional cash transfer programmes for child health, growth, and development: an analysis of Mexico's *Oportunidades*. *The Lancet, 371*(9615), 828-837.

Fernald, L. C. H., Gertler, P. J., & Neufeld, L. M. (2009). 10-year effect of Oportunidades, Mexico's conditional cash transfer programme, on child growth, cognition, language, and behaviour: a longitudinal follow-up study. *The Lancet, 374*(9706), 1997-2005.

Fernald, L. C. H., Kagawa, R., Knauer, H., García Guerra, A., Schnaas, M. d. L., & Neufeld, L. M. (In Press). Promoting Child Development through Group-Based Parent Support within a Cash Transfer Program: Experimental Effects on Children's Outcomes. *Developmental psychology*.

Grantham-McGregor, S. M., Fernald, L. C. H., Kagawa, R., & Walker, S. (2013). Effects of integrated child development and nutrition interventions on child development and nutritional status. *Annals of the New York Academy of Sciences, 1308*(1), 11-32.

Grantham-McGregor, S. M., Powell, C. A., Walker, S. P., & Himes, J. H. (1991). Nutritional supplementation, psychosocial stimulation, and mental development of stunted children: the Jamaican Study. *The Lancet, 338*(8758), 1-5.

Hamadani, J. D., Tofail, F., Hilaly, A., Huda, S. N., Engle, P., & Grantham-McGregor, S. M. (2010). Use of family care indicators and their relationship with child development in Bangladesh. *Journal of Health, Population, & Nutrition, 28*(1), 23-33.

Harding, J. F., Morris, P. A., & Hughes, D. (2015). The Relationship Between Maternal Education and Children's Academic Outcomes: A Theoretical Framework. *Journal of Marriage and Family, 77*(1), 60-76.

Instituto National de Salud Publica. (2012). *Impact evaluation of the program Educacion Initial CONAFE (PEI-CONAFE) on Oportunidades beneficiaries*. Retrieved from http://www.conafe.gob.mx/libroblanco/Documents/2-%20Anexos%20Libro%20Blanco%20Programa%20de%20Educaci%C3%B3n%20Inicial/Anexo%2098/Producto_4_Informe_final_PEI-CONAFE_6Agosto2012%20%282%29.pdf.

Johnson, B. D., Berdahl, L. D., Horne, M., Richter, E. A., & Walters, M.-g. (2014). A Parenting Competency Model. *Parenting, 14*(2), 92-120.

Johnson, R. A., & Wichern, D. W. (2012). *Applied multivariate statistical analysis.* (Vol. 4). Englewood Cliffs, NJ: Prentice Hall.

Jolliffe, I. (2002). *Principal component analysis* (2nd ed.). New York: Springer-Verlag New York, Inc.

Kariger, P., Frongillo, E. A., Engle, P., Britto, P., Sywulka, S. M., & Menon, P. (2012). Indicators of family care for development for use in multicountry surveys. *Journal of health, population, and nutrition, 30*(4), 472-486.

Linver, M. R., Brooks-Gunn, J., & Kohen, D. E. (2002). Family processes as pathways from income to young children's development. *Developmental psychology, 38*(5), 719.

McCarthy, D. (1972). *McCarthy scales of children's abilities*: Psychological Corporation.

McCartney, K., Dearing, E., Taylor, B. A., & Bub, K. L. (2007). Quality child care supports the achievement of low-income children: Direct and indirect pathways through caregiving and the home environment. *Journal of Applied Developmental Psychology, 28*(5), 411-426.

Miguel, M. E., Mendez, A., Galicia, S., Lazarin, R., Morales, L., & Silva, S. (2010). *Model of Educacion Inicial CONAFE*. Mexico.

Pearl, J. (2012). The causal mediation formula—a guide to the assessment of pathways and mechanisms. *Prevention Science, 13*(4), 426-436.

Reynolds, A. J. (2004). Research on early childhood interventions in the confirmatory mode. *Children and Youth Services Review, 26*(1), 15-38.

Silva, J., Ulloa, I., & Ramirez, A. (2009). *Executive Analysis of results of the impact evaluation of Educacion Inicial 2008*. Mexico.

Valeri, L., & VanderWeele, T. J. (2013). Mediation analysis allowing for exposure–mediator interactions and causal interpretation: Theoretical assumptions and implementation with SAS and SPSS macros. *Psychological methods, 18*(2), 137-150.

VanderWeele, T., & Vansteelandt, S. (2009). Conceptual issues concerning mediation, interventions and composition. *Statistics and its Interface, 2*, 457-468.

VanderWeele, T. J. (2014). A unification of mediation and interaction: a 4-way decomposition. *Epidemiology, 25*(5), 749-761.

Vernon-Feagans, L., Garrett-Peters, P., Willoughby, M., Mills-Koonce, R., & Investigators, F. L. P. K. (2012). Chaos, poverty, and parenting: Predictors of early language development. *Early Childhood Research Quarterly, 27*(3), 339-351.

Vyas, S., & Kumaranayake, L. (2006). Constructing socio-economic status indices: how to use principal components analysis. *Health policy and planning, 21*(6), 459-468.

Walker, S. P., Wachs, T. D., Grantham-McGregor, S., Black, M. M., Nelson, C. A., Huffman, S. L., . . . Lozoff, B. (2011). Inequality in early childhood: risk and protective factors for early child development. *The Lancet, 378*(9799), 1325-1338.

Parenting practices and concurrent child development in indigenous and non-indigenous communities in rural Mexico

Abstract

Parenting practices can be influenced by knowledge and education, cultural and ethnic values, attitudes and expectations, and other contextual factors, such as social marginalization and poverty. This secondary analysis of a cluster-randomized control trial examined associations between characteristics of children (age, sex, cognitive and socio-emotional development), households (indigenous ethnicity, poverty, and parental education), and communities (marginalization) and stimulating parenting practices among 1893 children ages 4-18 months in poor, rural communities in Mexico. We also explored if household indigenous status, poverty, and parental education modified the association between indigenous community and parenting practices. We found that parents of older children (indigenous: β= 0.28 SE= 0.04, non-indigenous: β= 0.21 SE= 0.04, p< 0.001 for both) and with greater household wealth (indigenous: β=0.90 – 1.99 p=0.39 to <0.001, non-indigenous: β= 1.74 to 4.14 p=0.61 to < 0.001) displayed more stimulating parenting practices, Maternal education was associated with more stimulating parenting practices only in indigenous communities (primary school: β= 1.46 SE= 0.36, secondary school β= 2.73 SE= 0.68, p< 0.001 for both). Less stimulating parenting practices were associated with living in an indigenous community and self-identifying as indigenous (β= -4.25 SE= 0.98 p<0.001; β= -1.58 SE= 0.83 p= 0.060 respectively), and with household crowding in non-indigenous communities (β= -0.38 SE= 0.12 p= 0.002). There were no significant associations between stimulating parenting practices and child sex, father's presence or education, and community marginalization. Individuals identifying as indigenous in indigenous communities demonstrated significantly more stimulating parenting practices compared to those who did not identify as indigenous but lived in indigenous communities (β= 2.96 SE= 1.25 p= 0.019). Child global cognitive and socio-emotional scores were significantly associated with stimulating parenting practices in both indigenous (Global: β= 1.70 SE= 0.17 p<0.001, Socio-emotional: β= 0.40 SE= 0.20 p=0.045) and non-indigenous communities (Global: β= 1.89 SE= 0.20, Socio-emotional: β= 1.07 SE= 0.22, p<0.001 for both).

Introduction

Understanding of the interplay between ethnicity, poverty, parenting, and child development in ethnic minority populations in low- and middle- income countries (LMIC) is important, because enriching parenting practices and stimulating home environments can promote and sustain positive child development (M. H. Bornstein & Putnick, 2012). Parenting practices may be influenced by many factors, including parents knowledge, culture, and socioeconomic variables, such as social marginalization and poverty. Therefore, this study examines demographic characteristics of parents who engage in more stimulating behaviors, and provide more stimulating home learning environments for their children, and the association between these behaviors and child development in poor, rural indigenous and non-indigenous communities in Mexico.

Socioeconomic status influences on parenting and early childhood development

Household wealth and parental education are consistently associated (for example, via housing quality, crowding, and father's presence) with more stimulating parenting practices across cultural and ethnic contexts. (Baker-Henningham, Powell, Walker, & Grantham-McGregor, 2003; Bradley & Corwyn, 2002, 2005; Bradley, Corwyn, Burchinal, McAdoo, & García Coll, 2001). There is a gradient effect of socioeconomic status (SES) on early child development outcomes in LMIC, in which children of higher income or more educated mothers perform better than those in lower income households or with less educated mothers (Fernald, Gertler, & Hidrobo, 2012). SES has been shown to be associated with parenting expectations and practices in Mexico, demonstrated in a population of urban mothers in Guadalajara, Mexico. In this population, mothers with higher SES had increased expectations of their children achieving developmental milestones, increased use of nurturing practices, and decreased use of harsh punishments when compared to mothers with lower SES (Solís-Cámara & Fox, 1996).

Cultural influences on parenting styles and practices

Baumrind (1996) developed a 2 x 2 typology of parenting warmth and control, in which parents who exude high warmth and high control are described as having an authoritative parenting style, while parents who exude low warmth and high control are described as having an authoritarian style. Parents who exhibit high warmth and low control are described as permissive, and parents who exhibit low warmth and low control are described as neglectful (Baumrind, 1966). Parenting style is the emotional milieu in which parents express their attitudes and values of affection, sensitivity, and discipline. Parenting styles are reflected in parenting practices, specific behaviors that parents employ to achieve their parenting goals (Darling & Steinberg, 1993). However, cultural values and beliefs influence parental goals and attitudes toward their child's behavior and development (M. H. Bornstein, 2015). For example, one contrast in parental goals is between societies that emphasize individual achievement, independence, and self-reliance among children, and those that more highly value cooperation and interdependence (Oyserman, Coon, & Kemmelmeier, 2002). This has led to a debates in the literature about how these typologies apply to other cultural-ethnic groups in terms of effects on parenting practices and childhood development.

Differing cultural and ethnic values and beliefs may lead to different ways of conceptualizing parenting style (Baumrind, 1996; Rothbaum, Rosen, Ujiie, & Uchida, 2002). For example, some studies of Chinese and Chinese-American youth have questioned the applicability of Baumrind's typology of parenting style (Lim & Lim, 2004), and examined an alternative parenting style, "training", as more culturally relevant (Chao, 1994, 2000). The "training" or *chia shun* parenting style is similar to the authoritarian style in its expectation of a "standard of conduct" of the child, but differs from the authoritarian hostility toward "domination" of the child (Chao, 1994). Research has shown substantial variability across 13 cultural groups in associations between caregiver warmth and control (Deater-Deckard et al., 2011). For example, the study populations of 120 Thai and 242 Chinese parents exhibited low mean parent and child ratings of both warmth and control, while parent and child ratings of warmth and control were both high in a sample of 200 U.S. African and Latin American parents, and warmth was high, and control was low for a sample of 108 Colombian parents (Deater-Deckard et al., 2011).

Associations between parenting and child development

Research on parenting and child development has primarily found authoritative parenting styles to promote optimal child socio-emotional development or school performance (Amato & Fowler, 2002; Crockenberg & Litman, 1990; Pratt, Green, MacVicar, & Bountrogianni, 1992). Stimulating parenting practices (those which have been most consistently associated with optimal child development) include reading books, telling stories, engaging in active play, and avoiding harsh punishment (Bradley & Corwyn, 2002; Bradley et al., 2001; McCartney, Dearing, Taylor, & Bub, 2007). However, while some studies of parenting styles and practices are ethnically diverse, the majority of studies are set in a Caucasian or Western context (Brooks-Gunn & Markman, 2005; Carlson, Uppal, & Prosser, 2000; Pettit, Bates, & Dodge, 1997). Cross-cultural research in child development across socioeconomic, race, and ethnic contexts demonstrates that authoritative parenting style is not consistently associated with better child outcomes (L. Bornstein & Bornstein, 2007; Chao, 2001; Leung, Lau, & Lam, 1998; Quoss & Zhao, 1995; Steinberg, Lamborn, Dornbusch, & Darling, 1992). However the literature on cross-cultural parenting and child development has primarily focused on child socio-emotional and academic achievement outcomes (Spera, 2005), and evidence for cognitive outcomes among young children is lacking (Sorkhabi, 2005). Ideal parenting styles and practices to promote child development are arguably contextually and culturally dependent (Keshavarz & Baharudin, 2009; Kotchick & Forehand, 2002). Therefore, it is important to examine the cultural, socioeconomic and ethnic contexts in which parenting and child development are occurring, because the relation may be not be consistent (M. H. Bornstein, 2012; de Minzi, 2010; Quintana et al., 2006).

There have been mixed results on the effect of parenting practices in LMIC, with some studies demonstrating a positive association between parents who display more stimulating behaviors and child development (e.g. in Bangladesh and Ecuador) (Hamadani et al., 2010; Paxson & Schady, 2007), while other studies (e.g. in Paraguay and Costa Rica) have not (Austin et al., 2006; Lozoff, Park, Radan, & Wolf, 1995). The reasons for this discrepancy may be related to differences in study design and how parenting practices were measured. Studies with statistically significant findings had large sample sizes (over 3,000 in Ecuador and 800 in Bangladesh) and in addition to using the HOME Inventory, also asked targeted questions about

reading and other specific play activities. Both studies found larger effect sizes for parents reading to their children and engaging in other play activities, compared to other aspects of the home environment. In contrast, the studies in Paraguay and Costa Rica were comparatively small (30 in Paraguay and 183 in Costa Rica) and examined the total HOME environment score, which is a composite score of several aspects of the physical and social environment of the home, not all of which may have an effect on developmental outcomes. Associations between parenting and child development in the negative studies may also have been diluted by other factors including poor nutrition, infection, and iron deficiency anemia in children. In addition to these methodological concerns, existing studies in LMIC have not yet distinguished among ethnic or indigenous groups, to examine if the relation between parenting styles and practices and child development may be different among minority ethnic groups.

Parenting styles and practices in Mexico

Parenting in Mexico occurs within a range of socioeconomic, cultural, and ethnic contexts, and there is little agreement within contemporary evidence about the association between parenting styles and practices, and child outcomes among the diverse populations in Mexico. For example, ethnographic research has described differences in parenting styles in Mexico between a "traditional", more authoritarian, style described by Alarcon as, "conservatism and attachment to the legacy of living according to ancient premises" and a more authoritative, "counter-culture" style introduced by Diaz-Guerrero in the 1980's, and described as "the openness to change, modernization, and scientific, technological and social revolutions which are, certainly, the antithesis to traditionalism" (Alarcón, 2010; Solís-Cámara, Fung, & Fox, 2014). Other research has been conflicted as to whether urban Mexican parent's beliefs about family have evolved away from an emphasis on absence and authority of the father and presence and submissiveness of the mother (Díaz-Guerrero, 2000, 2003), or if traditional Mexican values of authority, self-sacrifice, and submission still permeate urban Mexican parenting styles and practices (Díaz-Loving, Aragón, Orozco, & Martínez, 2011). In addition to differences found between traditional and counter-culture parenting styles associated with rural and urban areas respectively, Solís-Cámara and Diaz (2007) also found differences between mothers and fathers regarding parental discipline practices and expectations. Mexican maternal parenting styles were characterized by increased frequency of nurturing practices, while paternal parenting approaches focused more heavily on discipline and control, in a study of 202 mothers and 73 fathers with young children in Aguascalientes, a metropolitan city in Northern-Central Mexico (Solís-Cámara Reséndiz & Romero, 2007). These findings were consistent with studies by Solís-Cámara and Fox which found similarities in beliefs about the disciplinary role of the father and parenting practices between Mexican-American families in the US and families in Mexico (Fox & Solís-Cámara, 1997; Solís-Cámara & Fox, 1995, 1996). The evolving evidence on parenting in Mexico highlights that in addition to SES and education, ethnicity and rurality may also influence parenting practices in Mexico (Solís-Cámara et al., 2014). Previous studies have largely treated parents in Mexico as a single ethnic group, and the majority of studies have taken place in urban areas (Solís-Cámara & Fox, 1995, 1996), while the demographics of Mexico include diverse ethnic groups (indigenous and nonindigenous) and both urban and rural populations.

Diverse populations of Mexico

Mexico has the largest Spanish-speaking population and the largest number and most diverse indigenous population in Latin America (Hall & Patrinos, 2006; Solís-Cámara et al., 2014). There are 62 recognized indigenous languages spoken by nearly 13 million people, with 13% of the total Mexican population classified as indigenous based on speaking an indigenous language (Minority Rights Group International, 2008). However, some have argued that this definition largely undercounts the indigenous population as indigenous languages become less commonly spoken (Hall & Patrinos, 2006). Since 2000, the national census (in years 2000, 2005 and 2010) has included a question on self-identification. In 2010, 15% of the population over age three years self-identified as indigenous (Instituto National de Estatistica y Geographia, 2014). Nearly 80% of indigenous people live in the southern region of Mexico and primarily live in rural communities with less than 15,000 inhabitants (Hall & Patrinos, 2006). States with the most prominent indigenous language-speaking population are Oaxaca (34%), Yucatan (30%) and Chiapas (29%). Puebla is 7th, with 11.6% of its population being indigenous (Instituto National de Estatistica y Geographia, 2014).

Studying indigenous populations is important because indigenous populations have poorer social and health outcomes than non-indigenous populations (Anderson et al., 2016), rooted in poverty and social inequities (King, Smith, & Gracey, 2009), and downstream effects on malnutrition, overcrowding, and infection (Gracey & King, 2009). Indigenous peoples in Mexico experience social inequities in: ownership and access to land and natural resources; the judicial system; access to bilingual and culturally appropriate services, such as education and health; migration and internal displacement; and constitutional reforms that recognize indigenous peoples and their concerns (Minority Rights Group International, 2008). For example, the prevalence of adult illiteracy is nearly three times greater among indigenous people in Mexico compared to the national rate (6.3%), and as high as 50% in some areas such as Guerrero and Chihuahua (Navarrete Linares, 2008). Indigenous people in Mexico, and globally, have less access to health care (Montenegro & Stephens, 2006) and are in poorer health than non-indigenous populations, marked by lower life expectancy at birth, higher infant mortality, malnutrition and stunting among children, and high rates of maternal depressive symptoms in rural areas (Anderson et al., 2016; Fleischer, Fernald, & Hubbard, 2007; Hall & Patrinos, 2006; Navarrete Linares, 2008). Much of the literature on indigenous populations focuses on the poverty and marginalization experienced by members of these populations, but it is unclear how these factors may affect parenting practices, or whether there are aspects of parenting in indigenous cultures that may be protective. It is also unclear how indigenous ethnicity may affect parenting practices, and how these practices in turn may relate to child development. Belonging to a minority ethnic group may have a stronger association with parenting style and practice than national origin. For example, Varela et al (2004) found authoritarian parenting style to be associated with ethnic minority status (Mexican immigrants and Mexican-Americans in the United States), more so than affiliation with Mexican heritage, as parents in Mexico displayed more authoritative style similar to Caucasian non-Hispanic parents in the US (Varela et al., 2004).

Despite the prominence of the indigenous population, studies on parenting in Mexico have not examined contemporary ethnic differences between indigenous and non-indigenous populations, but rather have focused on temporal cultural evolution from "traditional" values

and practices, or comparisons with Mexican American and Caucasian American populations. While some studies have not found a difference in parenting between parents of Mexican decent and Mexican American parents (Solís-Cámara & Fox, 1995), there is some evidence that indigenous parenting styles may differ from those of a US population. For example, in a small study of young indigenous (Mayan) children from Guatemala, there was evidence that children under 5 years were given a greater degree of freedom to act in their self-interest rather than aligning with the larger collaborative cultural context, because their behaviors were attributed to their cognitive and socio-emotional immaturity (Mosier & Rogoff, 2003). Mosier and Rogoff concluded that in the Guatemalan Mayan model of parenting, individualism and collectivism coexist, with the expectation that children will eventually make behavioral choices that align with cooperative cultural beliefs in contrast to the expectations of US parents that children will display cooperative behaviors from an early age.

Current study

This study is a secondary analysis of data collected for a cluster-randomized effectiveness trial to examine associations between characteristics of children (age, sex, cognitive and socio-emotional development), households (indigenous ethnicity, poverty, and parental education), and communities (marginalization) and the frequency of stimulating parenting practices in poor, rural communities in Mexico. We also explored whether the association between parenting and concurrent child development differed by household indigenous designation. There are three main objectives. The first is to examine differences in parenting practices between indigenous and non-indigenous communities in rural Mexico, accounting for differences in community marginalization and individual SES. We hypothesize that there will be an association between indigenous community designation and parenting practices beyond that accounted for by measures of socioeconomic status. The second objective is to explore demographic characteristics associated with parenting practices in indigenous and non-indigenous communities, and how demographic and SES factors may modify the relation between indigenous community and parenting practices. We hypothesize that parenting practices in non-indigenous communities are more sensitive to household SES, defined by household wealth or parent education, than in indigenous communities. Because indigenous communities are more marginalized than non-indigenous communities and have less access to services and resources (such as children's books in indigenous languages) SES may be less strongly associated with parenting practices than in non-indigenous communities where greater SES may mean greater access to resources within the community. In addition, we examine if self-identification as indigenous has a different association with parenting practices in indigenous as compared to non-indigenous communities. Heads of households that self-identify as indigenous may display less stimulating parenting practices, reflecting differential access to resources, and perhaps differences in parenting beliefs, and that the effect of self-identifying as indigenous may be greater in non-indigenous communities than in indigenous communities. We hypothesize this because there could be relatively greater stigma or marginalization associated with self-identifying as indigenous in non-indigenous communities than in indigenous communities, where one would identify with the majority population. Finally, the third objective is to understand the association between parenting and current

measures of child development in these communities. We hypothesize that more stimulating parenting practices will be positively associated with current child development.

Methods
Study design
     This analysis uses baseline data from a randomized controlled effectiveness evaluation of a parenting education program, *Educación Inicial,* operating in collaboration with a national conditional cash transfer program (*Prospera*) in rural communities in three states (Puebla, Oaxaca, and Chiapas) in Mexico. Details of the RCT and parenting program can be found here (Fernald et al., 2016) and here (Knauer et al., 2016).

Sampling
     A sample of 102 indigenous and 102 non-indigenous communities were selected for randomization according to study eligibility criteria: (1) rural location (population <2500) in the Mexican states of Chiapas, Puebla or Oaxaca; (2) at least 15 families with children ages 0-2 years; (3) at least 70% of families in the community eligible to receive *Prospera*; and (4) no current or prior operation (within the past 5 years) of *Educación Inicial*.

Data collection
     All *Prospera* beneficiary families in the eligible indigenous and non-indigenous communities were invited to participate in the study. Baseline data were collected on 2472 children ages 4-18 months in 2008, and 1929 children (78%) were eligible for a developmental assessment. Of the eligible children, one was lost due to missing the HOME inventory, five were lost due to missing the Extended Ages and Stages Cognitive Questionnaire, and 34 were missing the ASQ Socio-Emotional Questionnaire, resulting in an analysis sample of 1893 children.

Measurement of parental engagement and home environment
     The availability and quality of resources in the home for child stimulation was measured using The Home Observation for Measurement of the Environment (HOME) Inventory (Caldwell & Bradley, 1984). The Infant/Toddler version of the HOME (IT-HOME) is applied to children ages 0 to 3 years and is composed of 45 items scored as yes or no. A higher score on the HOME indicates a more enriching home environment, although the instrument does not set any screening cutoff points. The IT-HOME has six subscales designed to measure different dimensions of the physical home environment and parenting through an in home observation and interview of the parent. They are: 1) parent responsiveness to child's behavior (Responsivity subscale); 2) parent avoidance of inappropriate restriction and punishment (Acceptance subscale); 3) family routines and safety and predictability of the home's physical environment (Organization subscale); 4) play and learning materials in the home for development (Learning Materials subscale); 5) parent active engagement in the child's development (Involvement subscale); and 6) parent involvement of a variety of people and experiences in the child's daily life (Variety subscale) (Caldwell & Bradley, 2003; Totsika & Sylva, 2004). The items that comprise the instrument were selected based on empirical evidence, and then validated through testing (Totsika & Sylva, 2004). The instrument has been well validated in the U.S. and used worldwide, including several Latin American countries (Bradley et al., 1989;

Bradley & Corwyn, 2005). Conservative imputation of zero was applied to retain a score for the total HOME for children missing 1 to 3 questions (74 missing 1 item, 8 missing 2 items, 6 missing 3 items). Less than 5% of the analysis sample (n=88) was missing between 1 and 3 questions on the HOME, and only 1 child was missing more than three questions on the HOME, and thus excluded from analysis. The internal consistency of the scale was satisfactory (Cronbach α= 0.8227).

Measurement of child development

Child's baseline cognitive development was assessed using the Extended Ages and Stages Questionnaire (EASQ), a developmental screening tool that has been used in several countries. The EASQ was adapted for use in Mexico by researchers at the Instituto Nacional de Perinatología in Mexico City, led by a co-author of this study [LS], and administered to parents as an interview. The EASQ is designed for children 4 to 60 months old and measures three developmental domains: gross motor function, personal-social ability, and communication; individual domain scores were summed to produce a global score (Squires, Potter, & Bricker, 1999). The ASQ Socio-Emotional Questionnaire (ASQ:SE) is an additional screener for children at risk of emotional or social problems (Squires, Bricker, & Twombly, 2003). Missing scores were imputed using the mean of the child's domain score for any child missing fewer than 3 questions in a given domain. EASQ and ASQ:SE scores were converted to standard scores using two-month age intervals with a mean of 100 and standard deviation of 15.

Household, parent and child characteristics

Data were collected on child age (in months) and sex (boy, girl), parent education (kindergarten or less, completed primary school, completed secondary school, completed high school or higher), whether the father was present in the household, head of household self-identification as indigenous, household crowding (number of people in the house / number of rooms), state of residence (Chiapas, Oaxaca or Puebla), and household wealth. Household wealth was measured using an inventory of household assets (21 items: e.g., refrigerator, TV, iron), with an average of about 4 items for the sample. A principal components analysis was used to consolidate this index. We retained the first component, rotated using the varimax rotation and logged to account for rightward skew (Vyas & Kumaranayake, 2006). The asset index was included in the model as a categorical variable, divided into quartiles, to identify differences between income groups. In addition to the above, household composition (number of adults and children in the house), the availability of electricity and piped water in the home, were used to assess baseline differences between indigenous and non-indigenous communities. Fewer than 1% of follow-up observations were missing data for mother's education, while 4.8% of observations were missing data for father's education, and 5.2% for father's presence. No data were missing for child age or sex, household wealth or crowding, head of household self-identification as indigenous, or state of residence. Where demographic data were missing, values were imputed using the community mean.

Community characteristics

The prominence of the indigenous population in the community was used to determine community indigenous designation, given to communities where at least 70% of the population

speaks an indigenous language, according to the National Institute of Statistics and Geography (INEGI) census classifications. The community marginalization index, developed by the National Population Council, was used as a measure of community level SES to account for differing SES levels among indigenous and non-indigenous communities. It is a composite measure of a set of 8 indicator questions (e.g. percent of the population ≤ 15 that is illiterate or has not completed primary school, average number of occupants per room in households, the percent of households with dirt floors, and percent of households without; a toilet, electricity, piped water) consolidated using a principal components analysis (Consejo Nacional de Poblacion, 2005).

Statistical analysis

For our first objective, we tested differences in the HOME subscale and total HOME scores between indigenous and non-indigenous communities using three techniques determined by type of outcome variable: ordinary least squares regression for the total HOME score, poisson regressions for the Acceptance, Organization, Involvement and Variety scales, and negative binomial regressions for the Responsivity and Learning scales. We examined unadjusted means and then adjusted for child age and sex, parent education, father present in the household, head of household self-identification as indigenous, household crowding and wealth, and community marginalization. We used Bonferroni corrections to account for multiple tests (FER: 0.05/7= p<0.007).

To address our second objective, we stratified analyses of predictive characteristics of total HOME score by community indigenous designation. We first examined the unadjusted associations between each of the characteristics and total HOME score, and then analyzed two adjusted models. We built our model to first include demographic characteristics (head of household self-identification as indigenous, child age and sex, parent's education, father's presence, household wealth and crowding, and community marginalization). We then examined interactions between self-identification as indigenous, parents' education, and household wealth, and indigenous community designation in separate interaction models, to further understand how these factors may moderate the relation between indigenous community designation and total HOME score. The interaction models were adjusted for demographic characteristics.

Finally, for our third objective, we included child global EASQ and socio-emotional ASQ scores to the adjusted demographic models to examine the association between current child development and total HOME score. Finally, in all of our analyses we included indicator variables for state of residence (Chiapas, Oaxaca, and Puebla) and clustered standard errors at the community level. We conducted our statistical analyses using STATA 14 (STATA Corporation, College Station, TX, USA).

Results
Descriptive statistics

Baseline characteristics of indigenous and non-indigenous communities are presented in **Table 1**. Children in indigenous communities had significantly lower developmental scores, and were younger than children in non-indigenous communities. Mothers in indigenous communities had lower completed educational levels than mothers in non-indigenous

communities, but fathers in indigenous and non-indigenous communities had similar educational levels. Fathers were more likely to be present in households in indigenous communities than non-indigenous. Households in indigenous communities had substantially lower levels of wealth and a greater number of household members with more crowding. While both indigenous and non-indigenous communities were rural, had small populations (<2500), and high percentage of Prospera beneficiaries (>70%), indigenous communities were significantly more marginalized than non-indigenous communities. However, there was no significant difference in the availability of piped water or electricity between indigenous and non-indigenous communities.

Community indigenous designation was based on the proportion (≥70%) of indigenous language speaking households in the community. Thus, not surprisingly, 99.81% (n=1051) of households in indigenous communities spoke an indigenous language, and 0.19% (n=2) did not, while in non-indigenous communities, 11.79% (n=99) did and 88.21% (n=741) did not. When indigenous was measured by self-identification rather that language, a greater number of households in non-indigenous as well as indigenous communities identified as non-indigenous (9.64% or n=81 in non-indigenous communities, and 3.52% or n=37 in indigenous communities) (**Table 1**). Self-identification may be biased by social desirability to be considered part of the majority population, but may also demographic trends of intermarriage or that non-indigenous households may speak an indigenous language if they live in a majority indigenous community, as indigenous communities can have a large non-indigenous population (up to 30%). **Table 2** gives the overall distribution of HOME Inventory scores in the population. Mean score for the sample was 25.32, with a standard deviation of 6.08.

Differences in total HOME scores between indigenous and non-indigenous communities

Table 3 shows unadjusted and adjusted differences in total HOME score, and subscale scores between indigenous and non-indigenous communities. Scores were adjusted for child age and sex, mother and father education, father's presence, household wealth and crowding, head of household self-identification as indigenous, and community marginalization. The unadjusted Responsivity, Organization, Learning, Involvement, and total scores were significantly different between indigenous and non-indigenous communities, including after accounting for Bonferroni correction for multiple testing, but the Acceptance subscale was not. The differences between indigenous and non-indigenous communities for the Acceptance subscale became significant after adjusting for demographic characteristics, but only the Organization, Learning, and Involvement subscales and total HOME score remained significant after demographic adjustment and multiple outcomes corrections were taken into account.

Characteristics associated with variability in total HOME score

Stratified analyses of characteristics associated with variability in total HOME score, shown in **Tables 4 and 5**, demonstrate how characteristics associated with total HOME score differ between families in indigenous and non-indigenous communities. Examining the unadjusted association of each demographic factor with total HOME score in indigenous communities (**Table 4**), child age, parent's education, and household wealth and crowding were significantly associated with total HOME score. In the model adjusted for demographic characteristics (Model 1), child age, mother's education, and household wealth remained

significantly associated with total HOME score. Households with mothers with primary school education had total HOME scores nearly 1.5 points higher (β= 1.46 SE= 0.36 p<0.001) than households in which mothers' education level was kindergarten or less. Total HOME scores were almost 3 points higher (β= 2.73 SE= 0.68 p<0.001) in households with mothers with secondary school education or higher compared with mothers with only kindergarten or less formal education. Households with wealth scores above the 25th percentile had significantly higher HOME scores than households in the bottom quartile. Father's education, and household crowding were not associated with total HOME score after adjustment. Child sex, father's presence in the household, and community marginalization were not associated with total HOME score in either unadjusted or adjusted regressions.

In non-indigenous communities, total HOME score was significantly associated with the following variables in unadjusted models: self-identification as indigenous, child age, mother's completed secondary school or greater, household wealth above the median, household crowding, and community marginalization (**Table 5**). In the model adjusted for demographic characteristics (Model 1), child age, household wealth above the median and crowding were significantly associated with total HOME score. Child age was similarly associated with total HOME scores in both indigenous (I) communities as non-indigenous (NI) communities (I: β=0.28 SE=0.04, and NI: β=0.21 SE=0.04, p<0.001 for both). Wealth had a stronger association with total HOME score in non-indigenous communities among the top two quartiles (3rd: β=3.04 SE=0.96 p=0.002, 4th: β=4.14 SE=0.93 p<0.001) than indigenous communities (3rd: β=1.99 SE=0.48 p<0.001, 4th: β=1.64 SE=0.65 p=0.014), but total HOME scores in the second quartile were not consistently significantly higher than those in the bottom quartile across the three models. Greater household crowding had an inverse association with HOME scores (β=-0.38, SE 0.12 p=0.002) in non-indigenous communities, but not in indigenous communities. Father's education demonstrated an inconsistent association with total HOME scores in non-indigenous communities. A Wald F-test of joint significance indicated that father's education was significantly associated with total HOME score in non-indigenous communities (p=0.041), but the direction of the association was negative, and only significant for fathers with primary school education, and it was not associated with total HOME score after the inclusion of child development scores in Model 2. Mother's education, indigenous self-identification, and community marginalization were not significant after adjusting for demographic characteristics in Model 1, and household crowding was not significantly associated with total HOME score after adjusting for child development scores in Model 2 in non-indigenous communities. Child sex and father's presence were not significantly associated with total HOME score in any of the analyses among non-indigenous communities.

Effect modifiers of the association between indigenous community and total HOME score

Table 6 displays interactions between indigenous community and indigenous self-identification, mother and father's education, and household wealth. All interaction models were adjusted for demographic characteristics. In the stratified analyses, head of household self-identification as indigenous was significantly negatively associated with total HOME score in unadjusted regression in non-indigenous communities, but was not significant when other demographic characteristics were accounted for (**Table 5**). Self-identification as indigenous was marginally positively associated with HOME scores in the unadjusted regression in indigenous

communities (**Table 4**). When the interaction of indigenous community and self-identification as indigenous was examined, indigenous community and indigenous self-identification were independently associated with lower total HOME score (β= -4.25 SE= 0.98 p<0.001; β= -1.58 SE= 0.83 p= 0.060 respectively), however, individuals identifying as indigenous in indigenous communities had statistically significant higher HOME scores as compared to those who did not identify as indigenous in indigenous communities (β= 2.96 SE= 1.25 p= 0.019) (**Table 6**). The interaction between parent's education and indigenous community was significant for both mother (β= 1.54 SE= 0.065 p=0.018) and father's primary school completion (β= 1.99 SE= 0.72 p= 0.006) in indigenous communities compared to those who had not completed primary school, but not for completion of secondary school or higher. However, father's completion of primary school was negatively associated with total HOME score (β= -1.65 SE= 0.61 p= 0.007). Household median wealth or higher was also independently associated with higher HOME scores, but only the interaction between the highest quartile (greater than 75th percentile) had a significant interaction with indigenous community, and the direction of the effect was negative (β= -3.14 SE= 1.17 p= 0.008). When the wealth-indigenous interaction was included in the model, indigenous community designation was no longer independently associated with total HOME score (**Table 6**).

Association between total HOME score and concurrent child development

When concurrent child development scores (global EASQ score and ASQ:SE score) were added in Model 2 (**Tables 4 and 5**), they substantially increased the percent of variability of HOME scores explained by the model in both indigenous (22%) and non-indigenous (31%) communities. Child EASQ global score was strongly and significantly associated with HOME scores in both indigenous and non-indigenous communities (I: β= 1.70 SE= 0.17, NI: β= 1.89 SE= 0.20; p<0.001 for both), as well as the socio-emotional scores (I: β= 0.40 SE= 0.20 p= 0.045, NI: β=1.07 SE= 0.22 p<0.001).

Discussion

This study examined socioeconomic and other demographic characteristics associated with parenting practices in indigenous and non-indigenous communities in rural Mexico. Key findings of the study were that after controlling for community marginalization, household poverty, and other demographic characteristics, living in an indigenous community was still negatively associated with stimulating parenting practices and the home learning environment as measured by the HOME Inventory, confirming the hypothesis for the first objective. Stimulating parenting practices were also associated with global and socio-emotional child development in both indigenous and non-indigenous communities, although the association between socio-emotional development was less strong in indigenous communities. Adjusted scores of stimulating parenting practices were lower in indigenous communities for all subscales (Responsivity, Acceptance, Organization, Learning Materials, Involvement, and Variety, however after Bonferroni correction, Responsivity, Acceptance and Variety subscales were not significant), indicating that there were factors beyond parental education and poverty that differentially influenced parenting, in which ethnicity may play a role. Illustrating this finding, self-identification as indigenous modified the association between indigenous community and stimulating parenting practices.

Self-identification as indigenous was negatively associated with stimulating parenting practices in non-indigenous communities, but positively associated with stimulating parenting practices in indigenous communities, suggesting that for marginalized, ethnic minority communities, being part of a majority population may be protective for parenting. The finding partially supported the hypothesis that indigenous households would have lower levels of stimulating parenting than non-indigenous households. However, this was only true in non-indigenous communities, and the hypothesis was not supported in indigenous communities. Indigenous parents in non-indigenous communities may face difficulty in accessing resources, such as reading materials in their mother language, that may be available to indigenous parents in indigenous communities. We were able to conduct this analysis because indigenous community was defined based on the proportion of the population that spoke or understood an indigenous language, and all eligible communities were stratified by indigenous designation prior to study assignment. In contrast, community marginalization (controlled for community indigenous status) was not associated with less stimulating parenting practices, suggesting that community level poverty was not a good indicator of individual level outcomes, and variation in stimulating parenting practices was determined to a greater extent by individual and household characteristics.

Demographic characteristics associated with stimulating parenting practices were similar in indigenous communities to those observed in other studies in LMIC, such as household wealth, and maternal education (Bradley & Corwyn, 2005). Wealth was a strong predictor of stimulating parenting practices in both indigenous and non-indigenous communities, particularly in households with wealth greater than the median, and was also more strongly associated with stimulating parenting practices in non-indigenous communities among households above the 75th percentile than in indigenous communities. These findings support the second study hypothesis, that parenting practices in non-indigenous communities are more sensitive to household SES, if defined as household wealth, than in indigenous communities. The difference in the relation between household wealth and stimulating parenting practices may lie in the fact that indigenous households had nearly half as much wealth (mean=0.59 vs 0.96 index scores) as non-indigenous households. The economic difference between wealth quartiles may also be greater in non-indigenous communities than indigenous communities, explained by the differences in community marginalization between indigenous and non-indigenous communities. Household wealth was more strongly associated with community marginalization in non-indigenous communities (r=-0.5124) than in indigenous communities (r=-0.1412). However, if household SES is defined as parent education, the association is less consistent. For example, maternal education was not significantly associated with stimulating parenting in non-indigenous communities. The findings in the non-indigenous communities were consistent with a gradient effect of wealth on parenting. The findings in indigenous communities did not display a clear gradient, but nevertheless supported the findings of previous literature linking stimulating parenting practices to SES in Mexico (Solís-Cámara & Fox, 1996). This study adds nuance to the prior literature, that household SES has a greater effect on stimulating parenting practices in non-indigenous communities than in indigenous communities.

This study found stimulating parenting practices to be strongly and significantly associated with concurrent child development, supporting our final study hypothesis and

consistent with studies in other LMIC examining the association between parenting and current child development, although the association was stronger in non-indigenous communities, particularly for the socio-emotional domain, than in indigenous communities. These findings are similar to US studies on racial minorities by Bradley and others (1989) that found stronger associations between stimulating parenting practices and child development in European Americans than in Mexican Americans. Prior studies in Latin American countries have generally supported use of the HOME inventory, but provided mixed results on the strength of its relation to child development outcomes in Latin America. (Austin et al., 2006; Gardner, Grantham-McGregor, & Baddeley, 1996; Grantham-McGregor, Powell, Walker, & Himes, 1991; Rink et al., 2014). Despite this, the HOME inventory is a common tool used in impact evaluations of early childhood interventions (Engle et al., 2011; Grantham-McGregor, Fernald, Kagawa, & Walker, 2013), and early childhood interventions have been found to have a positive effect on stimulating parenting practices (Aboud & Akhter, 2011; Knauer et al., 2016; Rosero & Oosterbeek, 2011). To further understand the relation between stimulating parenting practices and child development outcomes, future studies should examine longitudinal associations between stimulating parenting practices and child development outcomes.

The mean total HOME score for this population (mean 25.3, SD=6.1) was lower than the original HOME sample from Arkansas in 1979 (60% black, 40% white) with a mean of 30.9 and SD of 7.6 (Bradley & Caldwell, 1979), as well as a mixed sample from multiple US sites (54% white, 18% black, 28% Mexican-American) with a mean of 32.7 and SD of 7.1, (Bradley et al., 1989) but was similar to those found in other Central and South American countries, with similar income levels at their respective time of study (Bank, 2016). The mean total score was similar to that of some lower income countries, such as Paraguay (mean of 23.8 and SD of 6) (Austin et al., 2006), and some upper middle-income countries, such as Argentina, Brazil and Uruguay (Bradley & Corwyn, 2005; Lima et al., 2004; Rink et al., 2014). However, the mean score for this Mexican sample was lower than a sample in Costa Rica, a lower income country (at the time of study) that had a mean of 29.8 and SD of 6.7 (Lozoff et al., 1995), and a sample in Chile, another upper middle-income country (Bustos Correa, Herrera, & Mathiesen, 2001). The differences may be due to the particular population studied within Mexico- rural, poor and marginalized indigenous and non-indigenous communities. Mean scores in non-indigenous communities were closer to U.S., Costa Rican, and Chilean samples, while mean scores in indigenous communities were more similar to those found in Paraguay, Argentina, Brazil and Uruguay. National recognition, indigenous rights and protections, and government commitments to indigenous peoples may be a greater indicator for the impact of indigenous marginalization on parenting practices and home environments that support child development, than country GDP or the percent or size of the indigenous population in a given country (Minority Rights Group International, 2008).

Our results support the literature on indigenous marginalization, and demonstrate that there are concerns in indigenous communities beyond material wealth and education. Future studies should measure and evaluate differential access and use of social programs that may support families and child development, stressors associated with indigenous ethnicity, and cultural aspects not measured in this study that may influence differences in stimulating parenting practices between indigenous and non-indigenous communities. Unexpectedly, indigenous families living in indigenous communities had more stimulating parenting practices

than non-indigenous families living in indigenous communities, indicating that there may be a protective aspect of living in an indigenous community for indigenous families. However, both indigenous and non-indigenous families living in indigenous communities had lower parenting scores than indigenous families living in non-indigenous communities, suggesting that the effect of living in an indigenous community has a greater negative effect on parenting than being minority ethnicity in a non-indigenous community. These associations speak to complex relations between ethnicity and place that warrant further investigation and understanding.

While the scores for all but one of the subscales was lower in indigenous communities, the Acceptance score was higher than in non-indigenous communities. The Acceptance subscale of the HOME is a set of questions around parents' tolerance of non-optimal behaviors from their child, and their avoidance of harsh punishment or excessive restriction of their child (Caldwell & Bradley, 1984). An example is parent's avoidance of expressing overt annoyance with or hostility toward the child. Greater parental acceptance in indigenous communities may reflect the findings of Mosier and Rogoff (2003), in how Mayan parents perceive and tolerate the behaviors of their children under the age of six years. Lower scores in the other subscales may be reflective of cultural differences in parenting and the parent-child relationship that warrant further qualitative investigation, and may reflect other effects of marginalization, such as access to stores to purchase books or toys, particularly in the child's first language, or opportunities for exposing children to a variety of experiences.

There are several limitations to this study. This is a cross-sectional study, so it cannot determine causality, only the association between the characteristics examined and stimulating parenting practices. The direction of causality for some characteristics, particularly for early child development, may work in either direction. Future studies should examine longitudinal associations between stimulating parenting practices and childhood development outcomes. In addition, the HOME Inventory was not designed to capture every aspect of parenting that could potentially influence child development (Bradley & Corwyn, 2005). It was intended to capture key elements of parenting and the home learning environment, that are associated with child development, namely warmth and responsiveness, discipline and control, and stimulation, and that are distinguishable between cultures and ethnicities (Whiting, Edwards, & Edwards, 1992). However, these associations with child development have not been well established in Mexico or other Latin American countries or in indigenous populations. While there is the potential for measurement bias of the HOME in indigenous communities, or that the HOME may favor a majority culture or ethnicity, there was considerable variability in scores, and indigenous families in indigenous communities had higher HOME scores compared to indigenous families in non-indigenous communities. Presumably, indigenous families living in indigenous communities would be less acculturated to the majority culture or ethnicity, countering the notion of measurement bias of the instrument. However, there may be selection factors present in the study that are not accounted for. Indigenous families that remain in indigenous communities rather than migrating might be those with stronger economic and social supports, while those families that migrated may have been those more likely to have less stimulating parenting for reasons not captured in this study. Or, the experience of being indigenous and living in a non-indigenous community may reflect the differences in stimulating parenting behaviros. However, this study was not able to assess racism or social perceptions of marginalization of the families.

This study is among the first that examines stimulating parenting practices and their relation to demographic characteristics and concurrent child development comparing indigenous and non-indigenous communities in Latin America. Examination of stimulating parenting practices in minority populations, that are often the target of early childhood interventions, is important for targeting and curriculum development of social programs aiming to improve parenting practices and the home learning environment, as well as understanding program effects on parenting and how parenting may mediate program effects on early childhood development. This study identifies the varied risks to parenting practices of indigenous and non-indigenous families living in indigenous or non-indigenous communities, and highlights the need for programming to identify and address different difficulties that families may face. Further investigation is needed to understand the sequelae of poverty in indigenous communities and how it differs from non-indigenous communities, to appropriately target these populations.

Table 1. Characteristics of sample. (n=1893)

	Non-indigenous[1] n=840		Indigenous[1] n=1053		
	n(%) or mean (sd)		n(%) or mean (sd)		p
Child					
EASQ scores[2]					
Communication	0.18	0.93	-0.13	1.03	<0.001
Motor	0.11	0.98	-0.08	1.01	0.001
Perceptual	0.18	0.90	-0.13	1.04	<0.001
Global Score	0.20	0.94	-0.15	1.01	<0.001
ASQ Socio-emotional[2]	0.17	0.97	-0.13	1.00	<0.001
Child sex (girl)	412	49%	518	49%	0.928
Child age					0.001
4 to 8 months	266	32%	411	39%	
9 to 13 months	325	39%	386	37%	
14 to 18 months	249	30%	256	24%	
Parent					
Mother education[3]					<0.001
Kindergarten or less	109	13%	288	27%	
Primary	597	71%	688	65%	
Secondary and above	134	16%	77	7%	
Father education[3]					0.105
Kindergarten or less	103	12%	170	16%	
Primary	581	69%	717	68%	
Secondary and above	156	19%	166	16%	
Father present	715	85%	967	92%	<0.001
Household					
Speaks indigenous language	99	12%	1051	>99%	<0.001
Indigenous self-identification	81	10%	1016	96%	<0.001
Piped water	604	72%	703	67%	0.472
Electricity	796	95%	979	93%	0.585
Household size	6.45	2.31	6.9	2.23	0.008
Crowding[4]	2.95	1.73	3.41	1.85	<0.001
Kids	3.95	1.86	4.52	1.95	<0.001
Adults	2.49	1.09	2.33	0.87	0.007
Asset index[5] (log)	0.96	0.39	0.58	0.33	<0.001
Community					
Marginalization index[6]	0.03	0.53	0.54	0.47	<0.001

Note. Data are n(%) or mean (SD) and are stratified by inclusion in the final sample. P-values are generated from t-tests (for continuous variables) and chi-squared tests (for dichotomous variables) and adjusted for state of residence and clustering at the community level. [1]Indigenous community is defined as those in which more than 70% of the community population speaks an indigenous language. [2]Child development was measured using the Extended Ages and Stages Questionnaire (EASQ) and the Ages and Stages Questionnaire: Socio-emotional (ASQ:SE). [3]Education denotes the highest level completed. [4]Crowding is number of people in the household divided by the number of rooms (including kitchen but not bathroom). [5]Asset index is a log of a PCA of a standard summary index of household possessions. [6]Community marginalization index is a composite of community indicators.

Table 2. HOME[1] Inventory scores. (n=1893)

Scale	Mean	SD	Max possible score
Responsivity	7.52	2.69	11
Acceptance	5.81	1.52	8
Organization	4.06	1.25	6
Learning	2.46	2.05	9
Involvement	2.89	1.46	6
Variety	2.59	0.98	5
Total Score	25.32	6.08	45

Note. [1]HOME is the Home Observation for the Measurement of the Environment Inventory.

Table 3. Unadjusted and adjusted differences in HOME[1] Inventory scores between indigenous and non-indigenous communities. (n=1893)

	Unadjusted					Adjusted[2]				
	Non-indigenous (n=840)		Indigenous[2] (n=1053)			Non-indigenous (n=840)		Indigenous[2] (n=1053)		
Scale	Mean	SE	Mean	SE	P-value	Mean	SE	Mean	SE	P-value
Responsivity	8.30	0.13	6.89	0.09	**<0.001**	7.95	0.23	7.14	0.17	**0.029**
Acceptance	5.77	0.11	5.84	0.07	0.555	5.43	0.17	6.15	0.13	**0.012**
Organization	4.47	0.06	3.73	0.06	**<0.001**	4.32	0.08	3.84	0.08	**0.001**
Learning	3.13	0.10	1.92	0.10	**<0.001**	2.83	0.11	2.10	0.11	**<0.001**
Involvement	3.41	0.09	2.47	0.05	**<0.001**	3.31	0.11	2.53	0.07	**<0.001**
Variety	2.65	0.04	2.54	0.04	0.087	2.72	0.06	2.49	0.05	**0.020**
Total Score	**27.73**	**0.33**	**23.40**	**0.23**	**<0.001**	**26.56**	**0.47**	**24.34**	**0.35**	**0.003**

Note. [1] HOME is the Home Observation for the Measurement of the Environment Inventory. [2]Adjusted for child age and sex, mother and father education, father's presence, household assets and crowding, head of household self-identification as indigenous and community marginalization. [2] Indigenous community is defined as those in which more than 70% of the community population speaks an indigenous language. P-values are adjusted for state of residence and clustering at the community level.

Table 4. Stratified analysis of characteristics associated with variability in total HOME[1] Inventory score in indigenous[2] communities. (n=1053)

	Unadjusted			Adjusted					
				Model 1			Model 2		
	β	SE	P-value	β	SE	P-value	β	SE	P-value
Indigenous self-identification[3]	1.70	0.91	0.065	1.59	0.89	0.078	1.04	0.85	0.226
Child age (months)	0.29	0.04	<0.001	0.28	0.04	<0.001	0.26	0.03	<0.001
Child sex (girl)	0.33	0.35	0.345	0.12	0.31	0.697	0.03	0.30	0.933
Mother education[4]									
Kindergarten or less	reference								
Primary	1.71	0.33	<0.001	1.46	0.36	<0.001	1.12	0.34	0.001
Secondary and above	3.18	0.65	<0.001	2.73	0.68	<0.001	2.60	0.60	<0.001
Father education[4]									
Kindergarten or less	reference								
Primary	1.09	0.43	0.012	0.32	0.40	0.417	0.20	0.39	0.599
Secondary and above	2.19	0.61	0.001	0.88	0.57	0.127	0.50	0.53	0.352
Father present	0.11	0.59	0.859	0.52	0.55	0.347	0.62	0.56	0.271
Asset index[5]									
<25%	reference								
25 to 51%	0.97	0.44	0.030	0.90	0.43	0.039	1.05	0.40	0.009
50 to 74%	2.26	0.49	<0.001	1.99	0.48	<0.001	1.92	0.45	<0.001
≥75%	1.84	0.67	0.007	1.64	0.65	0.014	1.41	0.53	0.010
Household crowding[6]	-0.31	0.10	0.003	-0.11	0.11	0.321	-0.11	0.09	0.264
Community marginalization index[7]	-0.29	0.50	0.567	0.56	0.50	0.354	0.77	0.43	0.076
EASQ Global score[8]	1.85	0.17	<0.001				1.70	0.17	<0.001
ASQ Socio-emotional score[8]	0.77	0.23	0.001				0.40	0.20	0.045
R^2	0.099			0.099			0.225		

Note. [1] HOME is the Home Observation for the Measurement of the Environment Inventory. [2] Indigenous community is defined as those in which more than 70% of the community population speaks an indigenous language. [3] Indigenous self-identification is by the head of household. [4] Education denotes the highest level completed. [5] Asset index is a log of a PCA of a standard summary index of household possessions. [6] Crowding is number of people in the household divided by the number of rooms. (including kitchen but not bathroom). [7] Community marginalization index is a composite of community indicators. [8] Child development was measured using the Extended Ages and Stages Questionnaire (EASQ) and the Ages and Stages Questionnaire: Socio-emotional (ASQ:SE). P-values are adjusted for state of residence and clustering at the community level.

Table 5. Stratified analysis of characteristics associated with variability in total HOME[1] Inventory score in non-indigenous[2] communities. (n=840)

	Unadjusted			Adjusted Model 1			Adjusted Model 2		
	β	SE	P-value	β	SE	P-value	β	SE	P-value
Indigenous self-identification[3]	-1.87	0.85	0.029	-092	0.74	0.218	-0.78	0.69	0.263
Child age (months)	0.22	0.05	<0.001	0.21	0.04	<0.001	0.26	0.04	<0.001
Child sex (girl)	-0.48	0.37	0.190	-0.45	0.35	0.208	0.02	0.31	0.942
Mother education[4]									
Kindergarten or less	reference								
Primary	0.21	0.57	0.709	0.06	0.56	0.912	-0.15	0.47	0.752
Secondary and above	2.24	0.67	0.001	0.87	0.70	0.215	0.56	0.63	0.377
Father education[4]									
Kindergarten or less	reference								
Primary	-0.89	0.65	0.171	-1.46	0.58	0.013	-0.97	0.54	0.073
Secondary and above	0.51	0.73	0.487	-1.00	0.68	0.145	-0.89	0.62	0.155
Father present	0.62	0.64	0.331	0.88	0.55	0.115	0.57	0.57	0.320
Asset index[5]									
<25%	reference								
25 to 49%	1.66	1.02	0.105	1.73	0.92	0.061	1.55	0.85	0.073
50 to 74%	3.60	1.12	0.002	3.04	0.96	0.002	2.2	0.97	0.025
≥75%	5.30	1.11	<0.001	4.14	0.93	<0.001	3.14	0.92	0.001
Household crowding[6]	-0.62	0.12	<0.001	-0.38	0.12	0.002	-0.34	0.11	0.003
Community marginalization index[7]	-2.56	0.67	<0.001	-0.96	0.63	0.132	-0.55	0.60	0.360
EASQ Global score[8]	2.25	0.22	<0.001				1.89	0.20	<0.001
ASQ Socio-emotional score[8]	1.60	0.25	<0.001				1.07	0.22	<0.001
R²	0.192						0.315		

Note. [1] HOME is the Home Observation for the Measurement of the Environment Inventory. [2] Non-indigenous community is defined as those in which less than 70% of the community population speaks an indigenous language. [3] Indigenous self-identification is by the head of household. [4] Education denotes the highest level completed. [5] Asset index is a log of a PCA of a standard summary index of household possessions. [6] Crowding is number of people in the household divided by the number of rooms. (including kitchen but not bathroom). [7] Community marginalization index is a composite of community indicators. [8] Child development was measured using the Extended Ages and Stages Questionnaire (EASQ) and the Ages and Stages Questionnaire: Socio-emotional (ASQ:SE). P-values are adjusted for state of residence and clustering at the community level.

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Table 6. Effect modifiers of the relation between indigenous community[1] and total HOME[2] Inventory score. (n=1893)

	β	SE	p
Indigenous community	-4.25	0.98	<0.001
Indigenous self-identification[3]	-1.58	0.83	0.060
Indigenous X self-identification	2.96	1.25	0.019
Indigenous community	-3.95	0.62	<0.001
Mother's education[4]			
Kindergarten or less	Reference		
Primary	-0.10	0.55	0.861
Secondary	1.12	0.66	0.093
Indigenous X primary	1.54	0.65	0.018
Indigenous X secondary	1.45	0.89	0.102
Indigenous community	-4.36	0.68	<0.001
Father's education[4]			
Kindergarten or less	Reference		
Primary	-1.65	0.61	0.007
Secondary	-0.95	0.68	0.165
Indigenous X primary	1.99	0.72	0.006
Indigenous X secondary	1.67	0.88	0.058
Indigenous community	-1.31	1.04	0.207
Asset index[5]			
<25%	Reference		
25 to 49%	1.72	0.98	0.080
50 to 74%	3.30	1.05	0.002
≥75%	4.60	1.00	<0.001
Indigenous x 25 to 49%	-0.87	1.07	0.416
Indigenous x 50 to 74%	-1.36	1.14	0.235
Indigenous x ≥75%	-3.14	1.17	0.008

Note. Interactions between community indigenous designation and head of household self-identification as indigenous, mother and father's education, and household assets were run as separate interaction models. The interaction models were adjusted for demographic characteristics (child age and sex, mother and father education, father's presence, household assets and crowding, head of household self-identification as indigenous and community marginalization). [1] Indigenous community is defined as those in which more than 70% of the community population speaks an indigenous language. [2]HOME is the Home Observation for the Measurement of the Environment Inventory. [3] Indigenous self-identification is by the head of household. [4]Education denotes the highest level completed. [5]Asset index is a log of a PCA of a standard summary index of household possessions. P-values are adjusted for state of residence and clustering at the community level.

References

Aboud, F. E., & Akhter, S. (2011). A cluster-randomized evaluation of a responsive stimulation and feeding intervention in Bangladesh. *Pediatrics, 127*(5), e1191-e1197.

Alarcón, R. (2010). O legado psicológico de Rogelio Díaz-Guerrero. *Estudos e Pesquisas em Psicologia, 10*(2), 553-571.

Amato, P. R., & Fowler, F. (2002). Parenting practices, child adjustment, and family diversity. *Journal of Marriage and Family, 64*(3), 703-716.

Anderson, I., Robson, B., Connolly, M., Al-Yaman, F., Bjertness, E., King, A., . . . Coimbra, C. E. (2016). Indigenous and tribal peoples' health (The Lancet–Lowitja Institute Global Collaboration): a population study. *The Lancet, 388*(10040), 131-157.

Austin, A. M. B., Blevins-Knabe, B., de Aquino, C. N., de Burró, E. U., Park, K. E., Bayley, B., . . . Taylor, D. (2006). Parent socialization, family economic well-being, and toddlers' cognitive development in rural Paraguay. *Journal of Research in Childhood Education, 20*(4), 255-274.

Baker-Henningham, H., Powell, C., Walker, S., & Grantham-McGregor, S. (2003). Mothers of undernourished Jamaican children have poorer psychosocial functioning and this is associated with stimulation provided in the home. *European Journal of Clinical Nutrition, 57*(6), 786-792.

Bank, T. W. (2016). *World Development Indicators*. Retrieved from: http://data.worldbank.org/data-catalog/world-development-indicators

Baumrind, D. (1966). Effects of authoritative parental control on child behavior. *Child development, 37*(4), 887-907.

Baumrind, D. (1996). The discipline controversy revisited. *Family relations, 45*(4), 405-414.

Bornstein, L., & Bornstein, M. H. (2007). Parenting styles and child social development. *Encyclopedia on early childhood development*, 1-4.

Bornstein, M. H. (2012). Cultural approaches to parenting. *Parenting, 12*(2-3), 212-221.

Bornstein, M. H. (2015). Children's parents. *Handbook of child psychology and developmental science, 4*(3), 1-78.

Bornstein, M. H., & Putnick, D. L. (2012). Cognitive and Socioemotional Caregiving in Developing Countries. *Child development, 83*(1), 46-61.

Bradley, R. H., & Caldwell, B. M. (1979). Home observation for measurement of the environment: a revision of the preschool scale. *American Journal of Mental Deficiency, 84*(3), 235-244.

Bradley, R. H., Caldwell, B. M., Rock, S. L., Ramey, C. T., Barnard, K. E., Gray, C., . . . Siegel, L. (1989). HOME environment and cognitive development in the first 3 years of life: a collaborative study involving six sites and three ethnic groups in North America. *Developmental psychology, 25*(2), 217-235.

Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual review of psychology, 53*(1), 371-399.

Bradley, R. H., & Corwyn, R. F. (2005). Caring for children around the world: A view from HOME. *International Journal of Behavioral Development, 29*(6), 468-478.

Bradley, R. H., Corwyn, R. F., Burchinal, M., McAdoo, H. P., & García Coll, C. (2001). The home environments of children in the United States Part II: Relations with behavioral development through age thirteen. *Child development, 72*(6), 1868-1886.

Brooks-Gunn, J., & Markman, L. B. (2005). The contribution of parenting to ethnic and racial gaps in school readiness. *The future of children, 15*(1), 139-168.

Bustos Correa, C., Herrera, M. O., & Mathiesen, M. E. (2001). Calidad del ambiente del hogar: inventario HOME como un instrumento de medición. *Estudios pedagógicos (Valdivia)*(27), 7-22.

Caldwell, B. M., & Bradley, R. H. (1984). *Home observation for measurement of the environment*: University of Arkansas at Little Rock

Caldwell, B. M., & Bradley, R. H. (2003). Home Observation for Measurement of the Environment: Administration Manual. Tempe, AZ: Family & Human Dynamics Research Institute, Arizona State University.

Carlson, C., Uppal, S., & Prosser, E. C. (2000). Ethnic differences in processes contributing to the self-esteem of early adolescent girls. *The Journal of Early Adolescence, 20*(1), 44-67.

Chao, R. K. (1994). Beyond parental control and authoritarian parenting style: Understanding Chinese parenting through the cultural notion of training. *Child development, 65*(4), 1111-1119.

Chao, R. K. (2000). The parenting of immigrant Chinese and European American mothers: Relations between parenting styles, socialization goals, and parental practices. *Journal of Applied Developmental Psychology, 21*(2), 233-248.

Chao, R. K. (2001). Extending research on the consequences of parenting style for Chinese Americans and European Americans. *Child development, 72*(6), 1832-1843.

Consejo Nacional de Poblacion. (2005). *Indice de Marginacion por Localidad*. Retrieved from http://www.conapo.gob.mx/en/CONAPO/Indices_de_Marginacion.

Crockenberg, S., & Litman, C. (1990). Autonomy as competence in 2-year-olds: Maternal correlates of child defiance, compliance, and self-assertion. *Developmental psychology, 26*(6), 961-971.

Darling, N., & Steinberg, L. (1993). Parenting style as context: An integrative model. *Psychological bulletin, 113*(3), 487-496.

de Minzi, M. C. R. (2010). Gender and cultural patterns of mothers' and fathers' attachment and links with children's self-competence, depression and loneliness in middle and late childhood. *Early Child Development and Care, 180*(1-2), 193-209.

Deater-Deckard, K., Lansford, J. E., Malone, P. S., Alampay, L. P., Sorbring, E., Bacchini, D., . . . Di Giunta, L. (2011). The association between parental warmth and control in thirteen cultural groups. *Journal of Family Psychology, 25*(5), 790-794.

Díaz-Guerrero, R. (2000). Evolución de la obediencia afiliativa. *Revista Latinoamericana de Psicología, 32*(3), 467-484.

Díaz-Guerrero, R. (2003). Ethnopsychology and culture conflict. *Cross-Cultural Psychology Bulletin, 37*(3), 27-32.

Díaz-Loving, R., Aragón, S. R., Orozco, G. B. T. V., & Martínez, L. M. C. (2011). Las premisas histórico-socioculturales de la familia mexicana: su exploración desde las creencias y las normas. *Revista Mexicana de Investigación en Psicología, 3*(2), 128-142.

Engle, P., Fernald, L. C., Alderman, H., Behrman, J., O'Gara, C., Yousafzai, A., . . . Ertem, I. (2011). Strategies for reducing inequalities and improving developmental outcomes for young children in low-income and middle-income countries. *The Lancet, 378*(9799), 1339-1353.

Fernald, L. C. H., Gertler, P., & Hidrobo, M. (2012). Conditional cash transfer programs: effects on growth, health, and development in young children. *The Oxford handbook of poverty and child development. Oxford University Press, New York*.

Fernald, L. C. H., Kagawa, R., Knauer, H., García Guerra, A., Schnaas, M. d. L., & Neufeld, L. M. (2016). Promoting Child Development through Group-Based Parent Support within a Cash Transfer Program: Experimental Effects on Children's Outcomes. *Developmental psychology*, Advance online publication.

Fleischer, N. L., Fernald, L. C., & Hubbard, A. E. (2007). Depressive symptoms in low-income women in rural Mexico. *Epidemiology, 18*(6), 678-685.

Fox, R. A., & Solís-Cámara, P. (1997). Parenting of young children by fathers in Mexico and the United States. *The Journal of social psychology, 137*(4), 489-495.

Gardner, J. M., Grantham-McGregor, S., & Baddeley, A. (1996). Trichuris trichiura infection and cognitive function in Jamaican school children. *Annals of tropical medicine and parasitology, 90*(1), 55-63.

Gracey, M., & King, M. (2009). Indigenous health part 1: determinants and disease patterns. *The Lancet, 374*(9683), 65-75.

Grantham-McGregor, S. M., Fernald, L. C. H., Kagawa, R., & Walker, S. (2013). Effects of integrated child development and nutrition interventions on child development and nutritional status. *Annals of the New York Academy of Sciences, 1308*(1), 11-32.

Grantham-McGregor, S. M., Powell, C. A., Walker, S. P., & Himes, J. H. (1991). Nutritional supplementation, psychosocial stimulation, and mental development of stunted children: the Jamaican Study. *The Lancet, 338*(8758), 1-5.

Hall, G., & Patrinos, H. A. (2006). *Indigenous peoples, poverty, and human development in Latin America*: Palgrave Macmillan New York.

Hamadani, J. D., Tofail, F., Hilaly, A., Huda, S. N., Engle, P., & Grantham-McGregor, S. M. (2010). Use of family care indicators and their relationship with child development in Bangladesh. *Journal of Health, Population, & Nutrition, 28*(1), 23-33.

Instituto National de Estatistica y Geographia. (2014). *Mexico en cifras: Informacion national, por entidad federativa y municipios [Mexico in figures: National information, by state and municipalities]*.

Keshavarz, S., & Baharudin, R. (2009). Parenting style in a collectivist culture of Malaysia. *European Journal of Social Sciences, 10*(1), 66-73.

King, M., Smith, A., & Gracey, M. (2009). Indigenous health part 2: the underlying causes of the health gap. *The Lancet, 374*(9683), 76-85.

Knauer, H. A., Kagawa, R. M. C., García-Guerra, A., Schnaas, L., Neufeld, L. M., & Fernald, L. C. H. (2016). Pathways to improved development for children living in poverty A randomized effectiveness trial in rural Mexico. *International Journal of Behavioral Development, 40*(6), 492-499.

Kotchick, B. A., & Forehand, R. (2002). Putting parenting in perspective: A discussion of the contextual factors that shape parenting practices. *Journal of Child and Family Studies, 11*(3), 255-269.

Leung, K., Lau, S., & Lam, W. L. (1998). Parenting styles and academic achievement: A cross-cultural study. *Merrill-Palmer Quarterly, 44*(2), 157-172.

Lim, S. L., & Lim, B. K. (2004). Parenting style and child outcomes in Chinese and immigrant Chinese families-current findings and cross-cultural considerations in conceptualization and research. *Marriage & Family Review, 35*(3-4), 21-43.

Lima, M., Eickmann, S., Lima, A., Guerra, M., Lira, P., Huttly, S., & Ashworth, A. (2004). Determinants of mental and motor development at 12 months in a low income population: a cohort study in northeast Brazil. *Acta Paediatrica, 93*(7), 969-975.

Lozoff, B., Park, A. M., Radan, A. E., & Wolf, A. W. (1995). Using the HOME inventory with infants in Costa Rica. *International Journal of Behavioral Development, 18*(2), 277-295.

McCartney, K., Dearing, E., Taylor, B. A., & Bub, K. L. (2007). Quality child care supports the achievement of low-income children: Direct and indirect pathways through caregiving and the home environment. *Journal of Applied Developmental Psychology, 28*(5), 411-426.

Minority Rights Group International. (2008). World Directory of Minorities and Indigenous Peoples- Mexico: Indigenous peoples. Retrieved from http://www.refworld.org/docid/49749ce423.html

Montenegro, R. A., & Stephens, C. (2006). Indigenous health in Latin America and the Caribbean. *The Lancet, 367*(9525), 1859-1869.

Mosier, C. E., & Rogoff, B. (2003). Privileged treatment of toddlers: cultural aspects of individual choice and responsibility. *Developmental psychology, 39*(6), 1047-1060.

Navarrete Linares, F. (2008). *Los pueblos indígenas de México: pueblos indígenas del México contemporáneo*. Comisión Nacional Para el Desarrollo de los Pueblos Indígenas.

Oyserman, D., Coon, H. M., & Kemmelmeier, M. (2002). Rethinking individualism and collectivism: evaluation of theoretical assumptions and meta-analyses. *Psychological bulletin, 128*(1), 3-72.

Paxson, C., & Schady, N. (2007). Cognitive development among young children in Ecuador the roles of wealth, health, and parenting. *Journal of Human Resources, 42*(1), 49-84.

Pettit, G. S., Bates, J. E., & Dodge, K. A. (1997). Supportive parenting, Ecological Context, and Children's Adjustment: A Seven-Year Longitudinal Study. *Child development, 68*(5), 908-923.

Pratt, M. W., Green, D., MacVicar, J., & Bountrogianni, M. (1992). The mathematical parent: Parental scaffolding, parenting style, and learning outcomes in long-division mathematics homework. *Journal of Applied Developmental Psychology, 13*(1), 17-34.

Quintana, S. M., Aboud, F. E., Chao, R. K., Contreras-Grau, J., Cross, W. E., Hudley, C., . . . Vietze, D. L. (2006). Race, ethnicity, and culture in child development: Contemporary research and future directions. *Child development, 77*(5), 1129-1141.

Quoss, B., & Zhao, W. (1995). Parenting styles and children's satisfaction with parenting in China and the United States. *Journal of Comparative Family Studies, 26*(2), 265-280.

Rink, S. M., Ardoino, G., Queirolo, E. I., Cicariello, D., Mañay, N., & Kordas, K. (2014). Associations between hair manganese levels and cognitive, language, and motor development in preschool children from Montevideo, Uruguay. *Archives of environmental & occupational health, 69*(1), 46-54.

Rosero, J., & Oosterbeek, H. (2011). Trade-offs between different early childhood interventions: Evidence from Ecuador. *Tinbergen Institute Discussion Paper 11-102/3*.

Rothbaum, F., Rosen, K., Ujiie, T., & Uchida, N. (2002). Family systems theory, attachment theory, and culture. *Family process, 41*(3), 328-350.

Solís-Cámara, P., & Fox, R. A. (1995). Parenting among mothers with young children in Mexico and the United States. *The Journal of social psychology, 135*(5), 591-599.

Solís-Cámara, P., & Fox, R. A. (1996). Parenting practices and expectations among Mexican mothers with young children. *The Journal of genetic psychology, 157*(4), 465-476.

Solís-Cámara, P., Fung, M. P., & Fox, R. A. (2014). Parenting in Mexico: Relationships based on love and obedience *Parenting Across Cultures* (pp. 349-366): Springer.

Solís-Cámara Reséndiz, P., & Romero, M. D. (2007). Relaciones entre creencias y prácticas de crianza de padres con niños pequeños. *Anales de psicología, 23*(2), 177-184.

Sorkhabi, N. (2005). Applicability of Baumrind's parent typology to collective cultures: Analysis of cultural explanations of parent socialization effects. *International Journal of Behavioral Development, 29*(6), 552-563.

Spera, C. (2005). A review of the relationship among parenting practices, parenting styles, and adolescent school achievement. *Educational Psychology Review, 17*(2), 125-146.

Squires, J., Bricker, D., & Twombly, E. (2003). Ages and stages questionnaires: Social-emotional. *Baltimore: Brookes*.

Squires, J., Potter, L., & Bricker, D. (1999). Ages and Stages Questionnaire user's guide. *Baltimore, MD: Brookes*.

Steinberg, L., Lamborn, S. D., Dornbusch, S. M., & Darling, N. (1992). Impact of parenting practices on adolescent achievement: Authoritative parenting, school involvement, and encouragement to succeed. *Child development, 63*(5), 1266-1281.

Totsika, V., & Sylva, K. (2004). The home observation for measurement of the environment revisited. *Child and Adolescent Mental Health, 9*(1), 25-35.

Varela, R. E., Vernberg, E. M., Sanchez-Sosa, J. J., Riveros, A., Mitchell, M., & Mashunkashey, J. (2004). Parenting style of Mexican, Mexican American, and Caucasian-non-Hispanic families: social context and cultural influences. *Journal of Family Psychology, 18*(4), 651-657.

Vyas, S., & Kumaranayake, L. (2006). Constructing socio-economic status indices: how to use principal components analysis. *Health policy and planning, 21*(6), 459-468.

Whiting, B. B., Edwards, C. P., & Edwards, C. P. (1992). *Children of different worlds: The formation of social behavior*: Harvard University Press.

Quality of parenting in early childhood: a longitudinal study

Abstract

Parental warmth, responsiveness, and stimulation are associated with positive child development, but it is unclear how parenting quality in early versus later developmental periods contributes to disparities in child cognitive and socioemotional development in low- and middle-income countries (LMIC). This longitudinal study examines the association between early childhood development and parenting quality (low, moderate, high) during infancy and prekindergarten developmental periods. Parenting quality was defined using scales for "warmth and responsivity", quantity of "stimulating parenting practices", and "variety of learning materials" in the home environment, measured using the HOME Inventory in infancy and the Family Care Indicators (FCI) in the prekindergarten period. Child development was assessed in infancy using the Extended Ages and Stages Questionnaire (EASQ) and ASQ Socioemotional scale, and during prekindergarten with the McCarthy Scales of Children's Abilities. The study sample included 603 children from poor, rural communities in Mexico who were assessed at 4 to 18 months of age and again at 3 to 5 years of age. The association between parenting quality and child development was examined for differences between indigenous and non-indigenous communities and controlled for child and family demographic characteristics (child age and sex, parent's educational attainment, and household wealth and crowding). Parenting quality during infancy and prekindergarten were both independently and significantly associated with later child development. However, parenting quality in infancy was no longer significantly associated with later child development after controlling for the effects of child development in infancy. Parental warmth and responsiveness and the availability of learning materials in the home in infancy were significant predictors of child development at 3 to 5 years of age, but parental stimulating practices were not. Conversely, during the prekindergarten period, parental stimulating practices were significant predictors of child development, while the variety of learning materials in the home was not. There were no differences in the association between parenting and child development between indigenous and non-indigenous communities. This study advances the understanding of parenting quality in the early childhood period in LMIC, and among indigenous populations in Mexico.

Introduction

Parental warmth, responsiveness, and stimulation are the behaviors most consistently associated with positive child development (Britto et al., 2016). Parenting quality is defined as the composite of these behaviors, along with the variety of materials in the home, and the consistency of parenting quality (high or low quality) during the early childhood period drives disparities in child cognitive and socioemotional development by age 5 years (Landry, Smith, Swank, Assel, & Vellet, 2001). High quality parenting is a reflection of the stimulating home learning environment and practices parents engage in with their children, such as reading, singing, storytelling, active play, and exposing young children to a diverse experiences (Black et al., 2016), and there is a dynamic and bi-directional association between parenting behaviors and child development in the first years of life (Landry, Smith, Swank, & Guttentag, 2008).

Children's risk of poor developmental outcomes from lack of stimulating parenting in LMIC is evident from UNICEF Multiple Indicator Cluster Survey (MICS) data in which a study of parenting behaviors in 38 low- and middle- income countries (LMIC) demonstrated that only 9% of parents read books to their children, although 70% reported that they played with their child within the prior three days (United Nations Children's Fund, 2016). However, studies of concurrent parenting and child development in LMICs have found mixed associations between parenting behaviors and child development outcomes. For example, A study in Bangladesh found aspects of the home learning environment (variety of play materials and play activities) to independently predict child development scores among 801 18-month-olds (Hamadani et al., 2010). In contrast, a study in Paraguay did not find a significant association between quality of the home learning environment and child cognitive development among a sample of 30 children between 12 and 24 months old (Austin et al., 2006). These studies examined cross-sectional associations between parenting measures and child outcomes, leaving the directionality of the association unclear. A study of 183 infants in Costa Rica found that the quality of the home learning environment was not associated with child development outcomes in infancy, but was moderately associated with child development at age 5 years (Lozoff, Park, Radan, & Wolf, 1995). In contrast, a longitudinal home-visiting study in Jamaica found an association between parenting behaviors, and both current and future child development (Baker-Henningham, Powell, Walker, & Grantham-McGregor, 2003). This study, however, did not adjust for parenting practices at follow-up to differentiate between the effects of early parenting from later parenting on child outcomes.

There may be sensitive periods in early childhood (0 to 5 years) in which the quality of parenting children receive affects their developmental trajectory more than the effects of parenting during other developmental periods, however the results are similarly mixed between positive and negative studies. For example, Rodriguez (2011) found a standard deviation difference in child development outcomes between children who had consistently low quality parenting during the critical period from infancy to prekindergarten age compared to children who had consistently high quality parenting during this time. There is a similar pattern of findings in Argentina, India, Indonesia, Peru, Senegal and Colombia (Fernald, Kariger, Hidrobo, & Gertler, 2012; Lipina, Martelli, & Colombo, 2005; Rubio-Codina, Attanasio, Meghir, Varela, & Grantham-McGregor, 2015). In contrast, research by Landry (2001) demonstrated that parenting quality during infancy was not predictive of developmental outcomes in prekindergarten above parenting quality during the prekindergarten age.

In general, research linking parenting and home learning environments to early childhood outcomes has primarily been conducted in the US and Western Europe, and studies in LMIC and amongst different ethnic and cultural groups are sparse and lack longitudinal associations (Lansford et al., 2016). There may be variations in parenting behaviors associated with different cultural or ethnic groups (Bornstein & Putnick, 2012; Bornstein, Putnick, Lansford, Deater-Deckard, & Bradley, 2015), and how these variations may differ in their association with early child development requires further investigation. Bornstein and others (2012) found that parents in a diverse group of LMIC were more likely to provide warm and responsive caregiving rather than stimulating caregiving, but whether warm and responsive parenting buffered potential consequences of a lack of stimulating parenting was not examined. Knauer and others (2016), found that living in an indigenous community independently predicted the amount of stimulating parenting behaviors above and beyond the effects of household SES and community marginalization, and that the interaction of self-identifying as indigenous and living in an indigenous community was protective for parenting.

Existing literature has shown that poverty has a gradient effect on childhood cognitive and socioemotional development (Fernald et al., 2012; Rubio-Codina et al., 2015; Schady et al., 2015), and the cumulative effects of sustained poverty can lead to increasing developmental deficits throughout the early childhood period(Aboud & Yousafzai, 2015; Boo, 2016). In addition to sustained poverty, changes in poverty level in the early childhood period can also affect child development outcomes (Hackman, Gallop, Evans, & Farah, 2015). As a result, the downward effects of poverty may compromise the development of 250 million children under age 5 years in LMIC globally, and nearly 10 million (18%) children in Latin America (Black et al., 2016).

One of the pathways through which poverty affects childhood development is through deficits in material resources and parental education that limit the ability of parents to provide supportive home environments and nurturing care to their children (Bradley & Putnick, 2012; Shonkoff et al., 2012). Nurturing care, as described by Britto and others, is the ability of parents to meet their child's health, nutritional and developmental needs through a warm, responsive and stimulating parenting behaviors and home learning environment. The negative effects of socioeconomic status on the quality of parenting and the home learning environment have been consistently demonstrated in studies around the world (Britto, Engle, & Super, 2013).

While poverty affects parenting through the capacity to provide nurturing care and can have lasting effects on children's developmental trajectory, stimulating parenting behaviors and the quality of the home environment can mediate the effects of socioeconomic status on early childhood outcomes (Duncan, Brooks-Gunn, & Klebanov, 1994; Hackman et al., 2015; Luby et al., 2013; Lugo-Gil & Tamis-LeMonda, 2008; Shonkoff et al., 2012). In addition, research has parenting behaviors and the quality of the home learning environment are malleable to intervention (Knauer, Kagawa, et al., 2016; Landry et al., 2008). However, without intervention, the trajectory of households in which the quality of the learning environment begins as low tends to remain low throughout early childhood (Rodriguez & Tamis-LeMonda, 2011).

In order to address the risks of poverty on parenting and child development, there has been a proliferation of home visiting and group parenting programs, for example, in Jamaica (Walker, Chang, Powell, & Grantham-McGregor, 2005), Colombia (Attanasio et al., 2014), Bangladesh (Aboud & Akhter, 2011), Brazil (Eickmann et al., 2003), Paraguay (Peairson, Austin, de Aquino, & de Burró, 2008), South Africa (Cooper et al., 2009), and Pakistan (Obradović,

Yousafzai, Finch, & Rasheed, 2016; Yousafzai, Rasheed, Rizvi, Armstrong, & Bhutta, 2015) that have shown consistent positive effects on parenting (when measured) and early child development outcomes (Aboud & Yousafzai, 2015; Engle et al., 2011). In recent studies by Singla and others (2015) and Knauer and others (2016), group parenting programs in Uganda and Mexico had positive effects on parenting behaviors and early childhood development, and parenting quality was found to partially mediate program effects on childhood development outcomes. The goals of parenting programs are to address parent's knowledge, attitudes, and responsive behaviors to promote children's health, hygiene, nutrition, safety, and cognitive stimulation (Britto et al., 2013). However, the timing of a parenting intervention in conjunction with the curriculum delivered can have different effects on different types of parenting behaviors. For example, a study by Landry and colleagues (2008) found that intervention during infancy had positive effects on maternal warmth, while intervention targeting parents of preschoolers had positive effects on mothers' stimulating behaviors. A better understanding of the association between child development and parenting in infancy and early childhood in LMIC and indigenous populations could inform future curriculum and program targeting.

This study seeks to augment the limited literature on the association between parenting practices, home environment, and child development in LMICs. Specifically, this study aims to evaluate parenting quality during infancy and early childhood in poor, rural communities in Mexico (including indigenous and nonindigenous communities), and assess whether there is an association between early childhood development and parenting quality in these populations, including longitudinal effects of parenting quality. In this study we conduct a secondary data analysis of a cluster-randomized controlled trial to examine the relation between the quality of parenting and the home learning environment during infancy and prekindergarten and early childhood development at 3 to 5 years of age in poor, rural communities in Mexico.
There are three objectives of this study. The primary objective is to examine parenting during infancy and early childhood and their independent associations with child development outcomes at age 3 to 5 years in our study population. We hypothesize that parenting quality during each of the periods will be predictive of child development in prekindergarten, and that there will be a gradient effect between parenting quality and child development outcomes. Our second objective is to examine the association between parenting subscales (such as responsiveness, acceptance, learning materials) and child development to gain a greater understanding of whether there are specific aspects of parenting and the home learning environment that are more predictive of child development. We hypothesize that specific measures of parental warmth, responsiveness, and engagement in stimulating activities with children will have greater association with child development compared to measures of the quantity or variety of materials available in the home. Finally, as our previous work found an association between living in an indigenous community and higher parenting quality, we aim to extend analyses of the relation between ethnicity, parenting, and child development, to examine whether the association between parenting quality and child development is different in indigenous and non-indigenous communities. However, given that our previous studies did not find differences in program effects or between parenting and concurrent development in indigenous and non-indigenous communities, we expect that the relation between parenting quality in infancy and prekindergarten and child development will be similar in indigenous and non-indigenous communities.

Methods

Study design

      Data for this analysis is from a randomized controlled effectiveness evaluation (RCT) of a parenting education program (*Educación Inicial*) in rural communities in three states (Puebla, Oaxaca, and Chiapas) in Mexico implemented within a national conditional cash transfer (CCT) program. Communities were randomized to three treatment arms; the first (T_0) arm received CCT benefits only, the second (T_1) received CCT benefits and the *Educación Inicial* parenting program, and the third (T_2) received CCT benefits and *Educación Inicial*, with the addition of program promotion and support by the CCT program. The *Educación Inicial* targeted pregnant women and parents of children up to age 4 years. Further details of the RCT and parenting program can be found in the following studies (Fernald et al., 2016) and (Knauer, Kagawa, et al., 2016).

Sampling

      A sample of 102 indigenous and 102 non-indigenous eligible communities were selected and randomized to one of the three treatment arms described above. Eligibility criteria for inclusion of communities in the study were: (1) rural location (population <2500) in the Mexican states of Chiapas, Puebla or Oaxaca; (2) having 15 or more families with children 0-2 years of age; (3) having a high density of CCT beneficiaries (at least 70% of families in the community receiving benefits); and (4) no operation of *Educación Inicial* within the past 5 years.

Data collection

      All CCT beneficiary families in eligible study communities were invited to participate. Data were collected in 957 children (T_0=444, T_1=513) 0-18 months of age in 2008, and in 2012 when children were 3 to 5 years old. Of n=741 (T_0=333, T_1=408) children ages 4-18 months old who were eligible for developmental assessment at baseline, 136 children (T_0=56, T_1=80) were missing data (11 were missing development scores at 4 to 18 months, 124 were missing development scores, and 3 were missing parenting data at age 3 to 5 years). This resulted in an analysis size of n=603 (T_0=275 and T_1=328), or 81.5% of the eligible sample.

Measurement of parenting quality

      Parenting quality was measured during infancy using the infant/toddler version of The Home Observation for Measurement of the Environment (HOME) Inventory, designed to be applied to children up to 3 years old (Caldwell & Bradley, 1984). The IT-HOME is a home observation and parent interview composed of 45 items scored as yes or no, with higher scores indicating a more enriching home environment and parenting practices. The IT-HOME has six subscales 1) parental responsivity; 2) acceptance of the child (avoidance of restriction and punishment), 3) organization of the environment; 4) learning materials; 5) parental involvement; and 6) variety in experience (Caldwell & Bradley, 2003). The items that comprise the instrument were selected based on empirical evidence, and then validated through testing (Totsika & Sylva, 2004). The instrument has been well validated in the US and used in over 100 studies worldwide, including few other Latin American countries (Bradley et al., 1989; Bradley & Corwyn, 2005). Less than 7% of the analysis sample (n=42) was missing between 1 and 3

questions on the HOME. Conservative imputation of zero was applied to retain a score for the total HOME (35 missing 1 item, 5 missing 2 items, 2 missing 3 items). The internal consistency of the scale was satisfactory (Cronbach α= 0.8227).

During the prekindergarten period, parenting quality was measured using the Family Care Indicators (FCI), a set of indicators derived from the Home Observation for Measurement of the Environment (HOME) Inventory and used worldwide in the UNICEF Multiple Indicator Cluster Survey (Kariger et al., 2012). The FCI consists of several sets of yes/no questions, including the variety of play materials in the home (items to make/play music, to draw and/or write, to stack/construct/build, for moving around, for learning shapes and colors, and for pretend play, as well as picture books), and parent-child play activities in the previous three-days (reading/looking at picture books; telling stories; singing songs; taking child outside the home; playing with toys; and spending time naming things, drawing and counting). Approximately 1% of the follow-up analysis sample was missing data on the FCI subscales. For children missing only one subscale component (n=5 for play activities and n=7 for play materials), a conservative imputation of zero was applied to retain a score for the total subscale. Subscale scores missing more than one indicator measure were excluded (n=2).

Total HOME and FCI scores were divided into quartiles (0 to 24%, 25 to 49%, 50 to 74% and 75 to 100%), and then assigned quality ratings after which the two middle quartiles were grouped, so that low parenting quality was defined as 0 to 24%, moderate parenting quality was defined as 25% to 74%, and high parenting quality was defined as 75 to 100%. This allowed for a potential gradient effect of increasing parenting quality and child development scores to be examined.

Measurement of child development

Child development at follow-up was measured using the McCarthy Scales of Children's Abilities (MSCA), a psychological test administered to children 2 to 8 years old to assess abilities. Four scales, verbal ability, perceptual- performance (non-verbal reasoning), quantitative, and memory were applied in this study (McCarthy, 1972). The General Cognitive Index (GCI) is a sum of the verbal, perceptual, and quantitative scale scores. The MSCA was translated and adapted for use in Mexico by researchers at the Instituto Nacional de Perinatología in Mexico City. Test scores were converted to age-adjusted standard scores using two-month age intervals with a mean of 100 and standard deviation of 15.

Household, parent, and child characteristics

Data were collected on household socio-economic status (parent highest level of education completed, household assets), the availability of electricity and piped water in the home, demographic structure (father's presence, number of adults and children) and crowding (number of people in the house/ number of rooms), head of household self-identification as indigenous, whether the head of household speaks or understands an indigenous language, child age (in months) and sex, and state of residence (Chiapas, Oaxaca or Puebla). At least 70% of residents in the study communities were recipients of *Prospera*, a welfare program, and thus designated as poor. Parent education was measured as kindergarten or less, completed primary school, completed secondary school, or higher. Household wealth was measured using an inventory of household assets (21 items: e.g., refrigerator, TV, iron), with an average of 4 assets

owned. A principal components analysis was used to consolidate this index, and we retained the first component (Falkingham & Namazie, 2002; Jolliffe, 2002), rotated using the varimax rotation and logged to account for rightward skew (Vyas & Kumaranayake, 2006). The asset index was included in the model as quintiles. One child was missing data on mother and father's education, and fewer than 1% of observations were missing data for mother's education, while fewer than 5% were missing data for father's presence or education. No data were missing for household wealth, child age or sex. Where demographic data were missing, values were imputed using the community mean.

Community characteristics

Communities were designated as "indigenous" or "non-indigenous" based on the prominence of the indigenous population in the community (at least 80% speaks an indigenous language) according to the National Institute of Statistics and Geography (INEGI) census classifications. Community marginalization was measured as a composite index of a set of 8 indicators (the percent of the population 15 years or older that is illiterate or has not completed primary school, the average number of occupants per room in households, the percent of households with dirt floors, and percent of households without; a toilet, electricity, piped water), consolidated using a principal components analysis (Consejo Nacional de Poblacion, 2005).

Statistical analysis

The first objective of the analysis was to examine the relation between parenting at two different ages (4 to 18 months, and 3 to 5 years) and child development at 3 to 5 years. To address the objective, we first examined the unadjusted associations of measures of parenting (HOME, FCI), demographic factors and child development at baseline (EASQ, ASQ:SE) and McCarthy GCI. We then constructed three models, with McCarthy GCI at 3 to 5 years as the outcome variable, and HOME inventory in infancy (0 to 18 months) and FCI at prekindergarten (3 to 5 years) as the primary independent variables of interest.

The first model is a multiple regression of the HOME on McCarthy GCI adjusting for child (age and sex), household (parents completed education level, wealth index in quartiles and crowding), and community (indigenous designation) level confounders at baseline. Community indigenous designation was highly predictive of community marginalization, so we chose to use indigenous designation in the analysis. We considered the potential effect of an improving or deteriorating socio-economic position on parenting and child development between baseline and follow-up that may adversely affect the relation between parenting at baseline and child development at follow up. Household socioeconomic measures at baseline and follow-up were highly correlated for parental educational level (mother $r= 0.79$, father $r= 0.76$), moderately correlated for household wealth and crowding (asset index $r= 0.62$, crowding $r= 0.33$), and the group means were not statistically significantly different between baseline and follow-up. Therefore, follow-up measures were not included in the analysis, but as a robustness check, we included change in parental education, household wealth, and crowding in the model. None of the coefficients for change were significant. Therefore, we included only baseline SES measures in successive models. In the second model, we added parenting quality in prekindergarten, total FCI score, to examine the independent effects of parenting in infancy from those in early

childhood on McCarthy scores. In the third model, we included child development scores in infancy to control the potential effects of early child development on later parenting and child development outcomes (Lugo-Gil & Tamis-LeMonda, 2008).

Our second objective was to examine which aspects of parenting and the home learning environment were critical to parenting quality. Thus, we disaggregated the HOME Inventory and FCI into subscales. To improve the comparability of the HOME to the FCI, we consolidated several of the subscales of the HOME and standardized the scores of the FCI and HOME. The HOME Responsivity and Acceptance subscales were summed to create a composite "warmth and responsiveness" subscale, and the Organization, Involvement and Variety subscales were summed to create a composite subscale of "stimulating experiences" that incorporate items similar to the play-activities of the FCI, and finally, the learning materials subscale was a comparison to the FCI variety of learning materials subscale. We then converted each of the new subscale scores to z-scores, and conducted a multiple regression that was adjusted for demographic characteristics and child development in infancy.

Finally, to determine whether there was a different association between parenting quality and child development outcomes in indigenous and non-indigenous communities, we conducted two regressions to examine the interaction between community indigenous designation and HOME quality groups, and community indigenous designation and FCI quality groups separately, on McCarthy General Cognitive Index (GCI).

The analyses for this study were conducted on children in the T_0 and T_1 groups of the original RCT, because there was no effect of the *Educación Inicial* on parenting or child development in the T_1 group (Fernald et al., 2016; Knauer, Kagawa, et al., 2016). As a sensitivity test, we repeated all analyses with the only the control group (T_0), to ensure that there were not subtle program effects, that while non-significant, may influence the associations in this analysis. We used adjusted Wald tests to test for differences between the coefficients for the T_0 group and the $T_0 + T_1$ group. All summary statistics and analyses in this study included indicator variables for state of residence (Chiapas, Oaxaca, and Puebla) and standard errors clustered at the community level. We conducted our analyses using STATA 14 (STATA Corporation, College Station, TX, USA).

Results

Descriptive statistics

Table 1 displays baseline characteristics of the sample. Children's sex and age were well distributed among the sample. The majority of mothers (70%) and fathers (68%) had completed primary school and fathers were present in 90% of households. Ninety-four percent of households had electricity, 74% had piped water, and the average household size was nearly 7 members (about 3 persons per room). The average number of household assets was 4 (index mean= 0.83).

Indigenous classification by language, self-identification, and community designation were highly correlated (r= 0.90 - 0.92); only 9% (n= 26) of persons in non-indigenous communities spoke or understood an indigenous language and 5% (n= 16) self-identified as indigenous, while only 1 head of household in an indigenous community did not speak or understand an indigenous language and 4% (n= 13) did not self-identify as indigenous (data not

shown). Community marginalization was significantly greater in indigenous (mean= 0.59, SD= 0.43) communities compared to non-indigenous (mean= -0.04, SD= 0.46) communities (p<0.001), and was moderately correlated with individual wealth (r= -0.489) (data not shown).

Table 2 displays the summary statistics on the parenting and child development measures of interest in this analysis during infancy and prekindergarten. In infancy, parents scored higher on responsivity and acceptance subscales of the HOME inventory (which measure parental warmth and feedback toward and tolerance of their child) and lower on organization, variety, and involvement (which measure parental engagement in active stimulation through play, instruction, and exposing children to a variety of people and experiences). Parents had on average fewer than 3 toys (out of 9 possible), indicating children did not have large quantity or variety of play toys or materials that support learning in the home. At prekindergarten age, households had a similarly low variety of play and learning materials (mean 3.06 out of 7 possible), and parents engaged in on average 3 play-activities with their child regularly. The average total HOME score was 26.10 out of 45 possible (SD= 6.03). When total parenting scores were divided into quartiles (Supplementary Table 1), score ranges were notably more broad in the lowest and highest quartiles compared to the middle two quartiles, reflected in smaller standard deviations for the middle two quartiles.

Association between parenting in infancy (4 to 18 months) and prekindergarten (3 to 5 years) and child development at 3 to 5 years old

Table 3 displays the unadjusted and adjusted associations between HOME and FCI score quality ratings, and McCarthy General Cognitive Index z-scores at 3 to 5 years. Parenting quality in infancy, as measured by the HOME score, was significantly associated with child development outcomes. In unadjusted analyses, children whose parents had moderate parenting quality ratings in infancy had 0.39 standard deviation (SD) higher McCarthy scores than children whose parents had low parenting quality in infancy (SE=0.10 p<0.001). When parenting quality rating was high in infancy, child development scores were 0.63 SD higher than when parenting quality was low (SE=0.11 p<0.001). These associations remained significant, although the magnitude of the association decreased, after adjusting for demographic characteristics (Model 1, Moderate: β =0.28 SE=0.10 p=0.005, High: β =0.33 SE=0.12 p=0.008), and after adjusting or parenting quality in prekindergarten as measured by the FCI (Model 2, Moderate: β =0.26 SE=0.10 p=0.011, High: β =0.29 SE=0.13 p=0.025). However, once infant child development measures (EASQ and ASQ:SE) were added to Model 3, parenting quality in infancy was no longer significantly associated with child development in prekindergarten.

Parenting quality during prekindergarten as measured by the FCI was significantly associated with concurrent child development outcomes in all models, and the magnitude of the coefficients were similar between parenting quality in infancy and parenting quality in prekindergarten. In the unadjusted analysis, moderate parenting quality in prekindergarten was associated with 0.35 SD higher child development scores (SE=0.10 p<0.001) compared to low parenting quality, and high parenting quality was associated with 0.64 SD higher child development scores (SE=0.11 p<0.001) than low parenting quality. After controlling for child development during infancy and demographic characteristics (Model 2), moderate parenting quality was associated with 0.19 SD higher child development scores (SE=0.09 p=0.038) than low parenting quality, and high parenting quality was associated with 0.29 SD higher child

development scores (SE=0.11 p=0.012) than low parenting quality. Finally, after adding child development scores in infancy in Model 3, parenting quality in prekindergarten remained significantly associated with concurrent child development. Children whose parents had moderate parenting quality had 0.18 SD (SE=0.09 p=0.046) higher developmental scores than children whose parents had a low parenting quality rating in prekindergarten. High quality parenting was associated with 0.27 SD higher child development scores (SE=0.11 p=0.018) than low parenting quality.

While child development scores were higher across all models when parenting quality was high compared to moderate, due to the width of the standard errors, there did not appear to be a clear gradient effect of parenting quality on child development outcomes. However, there was a threshold effect of parenting quality above the 25th percentile compared to parenting below the 25th percentile.

In addition to the association between higher parenting quality and child development outcomes in prekindergarten, children in households with wealth in the top quartile during infancy also had significantly higher McCarthy Scores (β =0.37 SE=0.16 p=0.022 Model 3) than children in households with wealth below the 75th percentile. Children living in indigenous communities had significantly lower child development scores (β = -0.35 SE=0.10 p=0.001 Model 3) than children living in non-indigenous communities. Children whose fathers completed primary school (but not secondary school or higher) during infancy also had significantly higher child development scores in prekindergarten (β = 0.27 SE=0.11 p=0.012 Model 3). Finally, global child development z-scores in infancy (β =0.10 SE=0.03 p=0.002 Model 3), but not socio-emotional scores, were also predictive of child development scores at 3 to 5 years.

Associations between parenting subscales and child development at 3 to 5 years old

In **Table 4** the HOME Inventory and Family Care Indicators were broken out by subscale to examine the adjusted association between subscales of the HOME and FCI and child development measured by McCarthy General Cognitive Index z-score at 3 to 5 years old. After creating composite subscales of the HOME inventory, each subscale (HOME: warmth and responsiveness, variety of learning materials, stimulating experiences; FCI: variety of learning materials, stimulating play-activities) was standardized (z-scores) and included in the regression. The multiple regression was adjusted for demographic characteristics and child development in infancy. In infancy, parent warmth and responsiveness (β=0.09 SE=0.03 p=0.008), and greater variety of learning materials in the home (β=0.10 SE=0.05 p=0.031) were associated with higher McCarthy developmental scores in prekindergarten, while parents engaging in or providing a greater variety of stimulating experiences for their infants was not. In contrast, the variety of learning materials in prekindergarten was not significantly associated with McCarthy developmental scores, while parents engaging in stimulating play-activities with their child was strongly predictive of child development scores (β=0.16 SE=0.04 p<0.001).

Effect modification of Indigenous community designation on the association of parenting and child development

For our final objective, we examined interactions between living in an indigenous community and parenting quality in infancy and prekindergarten in separate regressions for

each interaction, on child development scores in prekindergarten. Living in an indigenous community did not have an interactive effect with either parenting at infancy or prekindergarten on child development outcomes at age 3 to 5 years old (**Supplementary Table 2**). These regressions were adjusted for parenting quality during the non-interacted age range, demographic characteristics, and child development in infancy.

Sensitivity analyses

Our results of the sensitivity analysis found that the coefficients for the total HOME and HOME subscales in the combined sample ($T_0 + T_1$) were not statistically significantly different than those of the T_0 group for any of the analyses conducted, including the interaction, the four models, and the subscale regressions (data not shown). Our results were also not sensitive to whether measures of parenting quality (HOME and FCI) were examined as continuous variables, quartiles, or quality ratings group. Thus, we chose to present our results as quality ratings groups for simplicity of interpretation and policy orientation.

Discussion

This study examined the relation between parenting in infancy (4 to 18 months) and prekindergarten (3 to 5 years) and childhood development at 3 to 5 years old. There were several key findings. First, parenting quality in prekindergarten was a significant independent predictor of child development at 3 to 5 years. Parenting quality in infancy was also associated with child development at 3 to 5 years, but the association was not significant after controlling for child development in infancy. There was not a distinct gradient effect of increasing quality parenting at either time point on child development. Rather, child development scores were significantly higher for children of parents whose parenting quality was at least moderate in infancy or prekindergarten. Child development scores in prekindergarten were primarily driven by parental warmth and responsiveness and the variety of learning materials that parents provided in infancy, and the amount of stimulating play-activities parents engaged in with their children in prekindergarten. These relations between parenting and child development were the same for both indigenous and non-indigenous communities. This study adds to previous analyses by Knauer and colleagues (2016), which found parenting quality in infancy to be associated with concurrent child development in this population.

There were several limitations of the current study. The first limitation is that while the FCI is derived from the HOME Inventory, the questions are different and rely on parent self-report of engaging in stimulating parenting behaviors. Therefore, it is possible that parenting scores in prekindergarten were less accurate than the HOME collected by observation and interview in the home in infancy (Dodici, Draper, & Peterson, 2003). Another limitation is that the child development tool in infancy (EASQ and ASQ:SE) was also based on parent self-report of children's development. In infancy, parent warmth and responsiveness and greater variety of learning materials in the home were associated with higher McCarthy developmental scores in prekindergarten, while parents engaging in or providing a greater variety of stimulating experiences for their infants was not. This could be due to the fact that parents had uniformly low scores (mean= 9.66, SD=2.80, max=21) for this domain compared to warmth and responsiveness (mean= 13.74, SD=2.89, max=19) during infancy. Finally, this analysis is not able to assess the potential reciprocal influences of parenting and child development. It is possible

that the association between parenting in infancy and child development in prekindergarten operates through its effects on the trajectory of child development, although parenting in infancy may also be responsive to the child's developmental status (Landry et al., 2008). Despite these limitations, this analysis does improve on the studies of parenting and child development in LMIC that primarily examine cross-sectional associations between parenting and child development, or the effect of a parenting program on parenting and child development outcomes.

This study supported previous findings in the literature on parenting quality, that there is not a unique role for early parenting (Landry et al., 2001), and found that low parenting quality at any point in early childhood can have substantial negative effects on early childhood development. Parents engaged in very few stimulating behaviors in infancy, and parents engaging in stimulating practices and experiences in infancy was not associated with child development at age 3 to 5, while there was a relation between child development and parenting practices during prekindergarden. These findings seemingly contradicted Dallaire's (2005) findings that stimulating parenting behaviors are stable throughout early childhood. However, in general parents engaged in relatively few stimulating activities with their children in prekindergarten, on average only 3 out of 6 possible. In addition, responsiveness in infancy was associated with child development outcomes, which in a very resource constrained setting could provide a buffer for less stimulating experiences in infancy. Our findings on parent warmth and responsiveness, variety of materials in infancy, and stimulating parenting practices in prekindergarten supported previous literature on the parenting behaviors most consistently associated with child development (Britto et al., 2016).. Finally, our findings were consistent with previous literature in that SES is an independent predictor of child development outcomes (Bradley & Putnick, 2012). Living in an indigenous community and household SES (notably, household assets above the 75th percentile) were significant predictors of child development in prekindergarten, after accounting for the effects of parenting and child development in infancy.

This study informs the pathways through which a parenting program may have positive effects on parenting quality and child development. Previous studies of *Educación Inicial* found that the parenting program had a positive effect on child development (*Cohen's d*= 0.25) (Fernald et al., 2016), parent's reading books and singing to their children (*Cohen's d*= 0.29), and among parents who already read to their children, significantly increased the odds of reading to their children daily (Knauer, Kagawa, et al., 2016). The quality of parenting and the home learning environment was also positively associated with concurrent infant developmental outcomes in this population (Knauer, Ozer, et al., 2016). *Educación Inicial* operated through its effects on parenting quality and directly to improve developmental outcomes among the most vulnerable children, those living in indigenous communities and with developmental scores in the bottom 20% at baseline. The program did not have an effect on increasing the variety of learning materials in the home, while this study found mixed evidence of the importance of these materials for children's development. The present study found that parental warmth and responsiveness in infancy was more predictive of child development, while parental engagement in stimulating activities in prekindergarten was strongly associated with child development, indicating that parenting programs could most effectively tailor curriculum to address different aspects of parenting during different developmental periods.

A previous examination of the association between indigenous ethnicity, family resources, and parenting behaviors in infancy in this population revealed that family resources, living in an indigenous community and self-identification of the head of household as indigenous, all independently predicted parenting quality in infancy (Knauer, Ozer, et al., 2016). The present study supported these previous findings, in that living in an indigenous community was also independent predictor of child development in prekindergarten. However, this study clarified that the relation between parenting quality and child development was not different between indigenous and non-indigenous communities. Building on previous findings that living in an indigenous community was protective of parenting quality for indigenous families (Knauer, Ozer, et al., 2016), these findings indicate that the primary driver of low parenting quality and poor child outcomes in indigenous communities is a result of marginalization and not reflective of ethnic differences.

This study addresses an important gap in the research on the relation between the quality parenting in infancy and prekindergarten and early childhood development in LMIC, particularly among indigenous populations. As early interventions targeting parenting quality increase in LMIC, there is a demand for researchers to replicate and advance studies traditionally conducted in the US and Western Europe that inform the relation between parenting and child development in other countries, including in indigenous populations (2008). Our findings support the implementation of parenting programs for parents of children throughout early childhood, and targeting children and parents whose parenting quality rating falls in the lowest quartile. This study did not find a difference in the relation between parenting practices and child development in indigenous and non-indigenous communities, but reinforced previous findings that children living in poor, rural indigenous communities are a vulnerable group at greater risk for developmental delay.

Table 1. Characteristics of Sample in Infancy (n=603)

	n(%) or mean (SD)	
Child		
Child Sex (Girl)	285	47%
Child Age		
4- 8 months	206	34%
9- 13 months	171	28%
14- 18 months	226	37%
Parent		
Mother Education[1]		
Kindergarten or less	102	17%
Primary	425	70%
Secondary and above	76	13%
Father Education[1]		
Kindergarten or less	94	16%
Primary	410	68%
Secondary and above	99	16%
Father present	542	90%
Household		
Speaks indigenous language	324	54%
Self-identification as indigenous	302	50%
Piped water	445	74%
Electricity	565	94%
Household Size	6.70	2.26
Crowding[2]	3.11	1.73
Kids	4.29	1.93
Adults	2.40	0.95
Asset Index (log)[3]	0.83	0.42
Community		
Indigenous[4]	299	50%
Marginalization Index[5]	0.27	0.55

Note. Data are n (%) or mean (SD) and standard deviations account for clustering at the community level. [1] Education denotes the highest level completed. [2] Crowding is number of people in the household divided by the number of rooms (including kitchen but not bathroom). [3] Asset index is a log of a PCA of a standard summary index of household possessions. [4] Indigenous community is defined as those in which more than 70% of the community population speaks an indigenous language. [5] Community marginalization index is a composite of community indicators.

Table 2. Parenting quality and child development measures (n=603)

	Mean	SD
Infancy (4 to 18 months)[1]		
HOME Inventory Scores		
Responsivity (0-11)	7.75	2.53
Acceptance (0-8)	5.99	1.18
Organization (0-6)	4.13	1.27
Learning Materials (0-9)	2.70	2.18
Involvement (0-6)	2.92	1.47
Variety (0-5)	2.62	0.95
Total Score (0-45)	26.10	6.03
EASQ Scores		
Communication	0.08	0.96
Motor	0.06	0.96
Perceptual	0.06	0.97
Global Score[3]	0.08	0.97
ASQ Socio-emotional	0.01	0.96
Prekindergarten (3 to 5 years)[2]		
Family Care Indicators		
Variety of play materials (0-7)	3.06	1.68
Play-activities in the past 3 days (0-6)	3.05	1.72
Total Score (0-13)	6.11	2.72
McCarthy Scores		
Verbal	-0.03	0.97
Perceptual	0.01	0.99
Quantitative	-0.005	0.99
Memory	-0.03	0.97
General Cognitive Index[4]	-0.01	0.99

Note. Data are mean (SD), and standard deviations account for clustering at the community level. [1]In infancy parenting quality was measured with the Home Observation for Measurement of the Environment (HOME) and child development was measured using the Extended Ages and Stages Questionnaire (EASQ) and the Ages and Stages Questionnaire: Socio-emotional (ASQ:SE). [2]In prekindergarten, parenting quality was measured with the Family Care Indicators (FCI) and child development was measured using the McCarthy Scales of Child Abilities. Child development scores are age adjusted z-scores.

Table 3. Associations between parenting quality in infancy (4 to 18 months) and prekindergarten (3 to 5 years) and child development[1] at 3 to 5 years. n=603

	Unadjusted			Adjusted Model 1			Model 2			Model 3		
	β	SE	p-value	β	SE	p-value	β	SE	p-value	β	SE	p-value
Parenting Quality												
During infancy[2]												
Low (0 to 24%)	Reference											
Moderate (25 to 74%)	0.39	0.10	<0.001	0.28	0.10	0.005	0.26	0.10	0.011	0.20	0.10	0.051
High (75 to 100%)	0.63	0.11	<0.001	0.33	0.12	0.008	0.29	0.13	0.025	0.18	0.13	0.161
During prekindergarten[3]												
Low (0 to 24%)	Reference											
Moderate (25 to 74%)	0.35	0.10	<0.001				0.19	0.09	0.038	0.18	0.09	0.046
High (75 to 100%)	0.64	0.11	<0.001				0.29	0.11	0.012	0.27	0.11	0.018
Demographic Factors[4]												
Child Age (months)	0.005	0.01	0.605	-0.01	0.01	0.255	-0.01	0.01	0.230	-0.01	0.01	0.261
Child Sex (Girl)	-0.09	0.09	0.347	-0.08	0.08	0.304	-0.07	0.08	0.387	-0.06	0.08	0.474
Mother Education[5]												
Kindergarten or less	Reference											
Primary	0.10	0.11	0.373	-0.08	0.11	0.470	-0.07	0.11	0.511	-0.01	0.11	0.455
Secondary and above	0.49	0.16	0.004	-0.01	0.14	0.939	0.03	0.14	0.817	0.03	0.14	0.814
Father Education[5]												
Kindergarten or less	Reference											
Primary	0.34	0.10	0.001	0.29	0.10	0.006	0.28	0.10	0.008	0.27	0.11	0.012
Secondary and above	0.42	0.15	0.006	0.28	0.13	0.039	0.25	0.13	0.067	0.23	0.13	0.080
Asset index[6]												
≤24%	Reference											
25 to 49%	0.14	0.12	0.236	0.08	0.12	0.507	0.08	0.12	0.520	0.08	0.12	0.487

50 to 74%	0.40	0.15	0.009	0.18	0.15	0.226	0.17	0.15	0.250	0.17	0.15	0.252
≥75%	0.82	0.16	<0.001	0.41	0.16	0.011	0.38	0.16	0.017	0.37	0.16	0.022
Household crowding[7]	-0.06	0.03	0.070	-0.04	0.03	0.124	-0.04	0.03	0.153	-0.04	0.03	0.154
Indigenous community[8]	-0.60	0.10	<0.001	-0.40	0.10	<0.001	-0.38	0.11	<0.001	-0.35	0.10	0.001
Child Development in infancy[10]												
EASQ Global Score	0.20	0.04	<0.001							0.10	0.03	0.002
ASQ:SE Score	0.16	0.05	0.001							0.05	0.04	0.170
R^2	0.1982			0.206			0.217					

Note. [1]Child Development in prekindergarten (3 to 5 years) is age-adjusted z-scores of the McCarthy Scales for Children's Abilities General Cognitive Index. [2]Parenting quality during infancy (4 to 18 months old) was measured with the Home Observation for Measurement of the Environment (HOME). [3]Parenting quality during prekindergarten was measured with the Family Care Indicators (FCI) at 3 to 5 years of age. [4]Demographic factors were collected in infancy. [5]Education denotes the highest level completed. [6]Asset index is a log of a PCA of a standard summary index of household possessions. [7]Crowding is number of people in the household divided by the number of rooms (including kitchen but not bathroom). [8]Indigenous community is defined as those in which more than 70% of the community population speaks an indigenous language. [9]Community marginalization index is a composite of community indicators. [10]Child development in infancy age-adjusted z-scores of the Extended Ages and Stages Questionnaire (EASQ) global score and the Ages and Stages Questionnaire: Socio-emotional (ASQ:SE). P-values for unadjusted and adjusted analyses are adjusted for state of residence and clustering at the community level.

Table 4. The association between parenting quality[1] subscale z-scores and child development[2] at 3 to 5 years. n=603

	McCarthy General Cognitive Index		
	β	SE	p-value
Parenting during Infancy (HOME)[3]			
Warmth and Responsiveness[4]	0.09	0.03	0.008
Variety of Learning Materials	0.10	0.05	0.031
Stimulating Experiences[5]	-0.04	0.05	0.469
Parenting during Prekindergarten (FCI)[6]			
Variety of Learning Materials	-0.04	0.04	0.320
Stimulating Play-Activities	0.16	0.04	<0.001
R^2	0.223		

Note. [1]Parenting quality is a categorical variable of parenting scores in the lowest quartile (Low), middle two quartiles (Moderate), and highest quartile (High). [2]Child development in prekindergarten (3 to 5 years) is age-adjusted z-scores of the McCarthy Scales for Children's Abilities General Cognitive Index. [3]The Home Observation for Measurement of the Environment (HOME) was collected in infancy (4-18 months old), and composite subscales were converted to z-scores. [3]The Family Care Indicators (FCI) was collected in prekindergarten, at 3 to 5 years, and subscales were converted to z-scores. [4]Warmth and responsiveness is a composite of the Responsivity and Acceptance HOME subscales. [5]Stimulating experiences is a composite of the HOME Organization, Involvement and Variety subscales. The multiple regression was adjusted for child age, sex and development in infancy, parent's education, household assets and crowding, indigenous community, state fixed effects and clustering at the community level.

Supplementary Table 1. Percentile and quality ratings of parenting scores. n=603

Total HOME Score Percentile[1]	Quality Rating	Mean Total Score	SD	Total Score Range	N (%)
0% to 24%	Low	18.38	2.24	12 to 21	141 (23.4%)
25% to 49%	Moderate	23.52	1.12	22 to 25	145 (24.1%)
50% to 74%	Moderate	27.42	1.11	26 to 29	145 (24.1%)
75% to 100%	High	33.50	3.25	30 to 42	172 (28.5%)
FCI Total Score Percentile[2]					
0% to 24%	Low	2.39	0.82	0 to 3	108 (17.9%)
25% to 49%	Moderate	4.45	0.50	4 to 5	161 (26.7%)
50% to 74%	Moderate	6.51	0.50	6 to 7	146 (24.2%)
75% to 100%	High	9.36	1.36	8 to 13	188 (31.2%)

Note. [1]The Home Observation for Measurement of the Environment (HOME) was collected in infancy (4-18 months old). [2]The Family Care Indicators (FCI) was collected in prekindergarten, at 3 to 5 years. Standard deviations account for clustering at the community level.

Supplementary Table 2. Interaction between parenting quality[1] and community indigenous[2] designation on child development[3] at 3 to 5 years. n=603

	β	SE	P-value
Indigenous community	-0.27	0.16	0.078
Total HOME[4] score percentile in infancy			
Low (0 to 24%)	Reference		
Moderate (25 to 74%)	0.18	0.16	0.277
High (75 to 100%)	0.25	0.18	0.156
Indigenous community x HOME score percentile			
Indigenous X Moderate (25 to 74%)	0.04	0.20	0.837
Indigenous X High (75 to 100%)	-0.21	0.24	0.394
Indigenous community	-0.31	0.18	0.092
Total FCI[5] score percentile in prekindergarten			
Low (0 to 24%)	Reference		
Moderate (25 to 74%)	0.14	0.19	0.456
High (75 to 100%)	0.35	0.18	0.051
Indigenous community x FCI score percentile			
Indigenous X Moderate (25 to 74%)	0.09	0.20	0.658
Indigenous X High (75 to 100%)	-0.20	0.25	0.427

Note. [1]Parenting quality is a categorical variable of parenting scores in the lowest quartile (Low), middle two quartiles (Moderate), and highest quartile (High). [2]Indigenous community is defined as those in which more than 70% of the community population speaks an indigenous language. [3]Child Development in prekindergarten (3 to 5 years) is age-adjusted z-scores of the McCarthy Scales for Children's Abilities General Cognitive Index. [4]The Home Observation for Measurement of the Environment (HOME) was collected in infancy (4-18 months old). [5]The Family Care Indicators (FCI) was collected at 3 to 5 years. Two separate regressions were adjusted for parenting quality, child age, sex and developmental score in infancy, parent's education, household assets and crowding, state fixed effects, and clustering at the community level.

References

Aboud, F. E., & Akhter, S. (2011). A cluster-randomized evaluation of a responsive stimulation and feeding intervention in Bangladesh. *Pediatrics, 127*(5), e1191-e1197.

Aboud, F. E., & Yousafzai, A. K. (2015). Global health and development in early childhood. *Annual review of psychology, 66*, 433-457.

Attanasio, O. P., Fernández, C., Fitzsimons, E. O., Grantham-McGregor, S. M., Meghir, C., & Rubio-Codina, M. (2014). Using the infrastructure of a conditional cash transfer program to deliver a scalable integrated early child development program in Colombia: cluster randomized controlled trial. *BMJ, 349*, g5785.

Austin, A. M. B., Blevins-Knabe, B., de Aquino, C. N., de Burró, E. U., Park, K. E., Bayley, B., . . . Taylor, D. (2006). Parent socialization, family economic well-being, and toddlers' cognitive development in rural Paraguay. *Journal of Research in Childhood Education, 20*(4), 255-274.

Baker-Henningham, H., Powell, C., Walker, S., & Grantham-McGregor, S. (2003). Mothers of undernourished Jamaican children have poorer psychosocial functioning and this is associated with stimulation provided in the home. *European Journal of Clinical Nutrition, 57*(6), 786-792.

Black, M. M., Walker, S. P., Fernald, L. C., Andersen, C. T., DiGirolamo, A. M., Lu, C., . . . Shiffman, J. (2016). Early childhood development coming of age: science through the life course. *The Lancet*.

Boo, F. L. (2016). Socio-economic status and early childhood cognitive skills A mediation analysis using the Young Lives panel. *International Journal of Behavioral Development*, 0165025416644689.

Bornstein, M. H., & Putnick, D. L. (2012). Cognitive and Socioemotional Caregiving in Developing Countries. *Child development, 83*(1), 46-61.

Bornstein, M. H., Putnick, D. L., Lansford, J. E., Deater-Deckard, K., & Bradley, R. H. (2015). A Developmental Analysis of Caregiving Modalities Across Infancy in 38 Low-and Middle-Income Countries. *Child development, 86*(5), 1571-1587.

Bradley, R. H., Caldwell, B. M., Rock, S. L., Ramey, C. T., Barnard, K. E., Gray, C., . . . Siegel, L. (1989). HOME environment and cognitive development in the first 3 years of life: a collaborative study involving six sites and three ethnic groups in North America. *Developmental psychology, 25*(2), 217-235.

Bradley, R. H., & Corwyn, R. F. (2005). Caring for children around the world: A view from HOME. *International Journal of Behavioral Development, 29*(6), 468-478.

Bradley, R. H., & Putnick, D. L. (2012). Housing quality and access to material and learning resources within the home environment in developing countries. *Child development, 83*(1), 76-91.

Britto, P. R., Engle, P. L., & Super, C. M. (2013). *Handbook of early childhood development research and its impact on global policy*: Oxford University Press.

Britto, P. R., Lye, S. J., Proulx, K., Yousafzai, A. K., Matthews, S. G., Vaivada, T., . . . Fernald, L. C. (2016). Nurturing care: promoting early childhood development. *The Lancet*.

Caldwell, B. M., & Bradley, R. H. (1984). *Home observation for measurement of the environment*: University of Arkansas at Little Rock

Caldwell, B. M., & Bradley, R. H. (2003). Home Observation for Measurement of the Environment: Administration Manual. Tempe, AZ: Family & Human Dynamics Research Institute, Arizona State University.

Consejo Nacional de Poblacion. (2005). *Indice de Marginacion por Localidad*. Retrieved from http://www.conapo.gob.mx/en/CONAPO/Indices_de_Marginacion.

Cooper, P. J., Tomlinson, M., Swartz, L., Landman, M., Molteno, C., Stein, A., . . . Murray, L. (2009). Improving quality of mother-infant relationship and infant attachment in socioeconomically deprived community in South Africa: randomised controlled trial. *BMJ, 338*, b974.

Dallaire, D. H., & Weinraub, M. (2005). The stability of parenting behaviors over the first 6 years of life. *Early Childhood Research Quarterly, 20*(2), 201-219.

Dodici, B. J., Draper, D. C., & Peterson, C. A. (2003). Early parent—child interactions and early literacy development. *Topics in Early Childhood Special Education, 23*(3), 124-136.

Duncan, G. J., Brooks-Gunn, J., & Klebanov, P. K. (1994). Economic deprivation and early childhood development. *Child development, 65*(2), 296-318.

Eickmann, S. H., Lima, A. C., Guerra, M. Q., Lima, M. C., Lira, P. I., Huttly, S. R., & Ashworth, A. (2003). Improved cognitive and motor development in a community-based intervention of psychosocial stimulation in northeast Brazil. *Developmental Medicine & Child Neurology, 45*(08), 536-541.

Engle, P., Fernald, L. C., Alderman, H., Behrman, J., O'Gara, C., Yousafzai, A., . . . Ertem, I. (2011). Strategies for reducing inequalities and improving developmental outcomes for young children in low-income and middle-income countries. *The Lancet, 378*(9799), 1339-1353.

Falkingham, J., & Namazie, C. (2002). Measuring health and poverty: a review of approaches to identifying the poor. *London: DFID Health Systems Resource Centre*.

Fernald, L. C. H., Kagawa, R., Knauer, H., García Guerra, A., Schnaas, M. d. L., & Neufeld, L. M. (2016). Promoting child development through group-based parent support within a cash transfer program: experimental effects on children's outcomes. *Developmental psychology*, Advance online publication.

Fernald, L. C. H., Kariger, P., Hidrobo, M., & Gertler, P. J. (2012). Socioeconomic gradients in child development in very young children: evidence from India, Indonesia, Peru, and Senegal. *Proceedings of the National Academy of Sciences, 109*(Supplement 2), 17273-17280.

Hackman, D. A., Gallop, R., Evans, G. W., & Farah, M. J. (2015). Socioeconomic status and executive function: developmental trajectories and mediation. *Developmental science, 18*(5), 686-702.

Hamadani, J. D., Tofail, F., Hilaly, A., Huda, S. N., Engle, P., & Grantham-McGregor, S. M. (2010). Use of family care indicators and their relationship with child development in Bangladesh. *Journal of Health, Population, & Nutrition, 28*(1), 23-33.

Jolliffe, I. (2002). *Principal component analysis* (2nd ed.). New York: Springer-Verlag New York, Inc.

Kariger, P., Frongillo, E. A., Engle, P., Britto, P., Sywulka, S. M., & Menon, P. (2012). Indicators of family care for development for use in multicountry surveys. *Journal of health, population, and nutrition, 30*(4), 472-486.

Knauer, H. A., Kagawa, R. M. C., García-Guerra, A., Schnaas, L., Neufeld, L. M., & Fernald, L. C. H. (2016). Pathways to improved development for children living in poverty A randomized effectiveness trial in rural Mexico. *International Journal of Behavioral Development, 40*(6), 492-499.

Knauer, H. A., Ozer, E. J., & Fernald, L. C. (2016). *Parenting practices and concurrent child development in indigenous and non-indigenous communities in rural Mexico*. Unpublished manuscript.

Landry, S. H., Smith, K. E., Swank, P. R., Assel, M. A., & Vellet, S. (2001). Does early responsive parenting have a special importance for children's development or is consistency across early childhood necessary? *Developmental psychology, 37*(3), 387.

Landry, S. H., Smith, K. E., Swank, P. R., & Guttentag, C. (2008). A responsive parenting intervention: the optimal timing across early childhood for impacting maternal behaviors and child outcomes. *Developmental psychology, 44*(5), 1335.

Lansford, J. E., Bornstein, M. H., Deater-Deckard, K., Dodge, K. A., Al-Hassan, S. M., Bacchini, D., . . . Di Giunta, L. (2016). How International Research on Parenting Advances Understanding of Child Development. *Child Development Perspectives, 10*(3), 202-207.

Lipina, S. J., Martelli, M. I., & Colombo, J. (2005). Performance on the A-not-B task of Argentinean infants from unsatisfied and satisfied basic needs homes. *Revista interamericana de psicología= Interamerican journal of psychology, 39*(1), 49-60.

Lozoff, B., Park, A. M., Radan, A. E., & Wolf, A. W. (1995). Using the HOME inventory with infants in Costa Rica. *International Journal of Behavioral Development, 18*(2), 277-295.

Luby, J., Belden, A., Botteron, K., Marrus, N., Harms, M. P., Babb, C., . . . Barch, D. (2013). The effects of poverty on childhood brain development: the mediating effect of caregiving and stressful life events. *JAMA Pediatrics, 167*(12), 1135-1142.

Lugo-Gil, J., & Tamis-LeMonda, C. S. (2008). Family resources and parenting quality: Links to children's cognitive development across the first 3 years. *Child development, 79*(4), 1065-1085.

McCarthy, D. (1972). *McCarthy scales of children's abilities*: Psychological Corporation.

Obradović, J., Yousafzai, A. K., Finch, J. E., & Rasheed, M. A. (2016). Maternal scaffolding and home stimulation: Key mediators of early intervention effects on children's cognitive development. *Developmental psychology, 52*(9), 1409.

Peairson, S., Austin, A. M. B., de Aquino, C. N., & de Burró, E. U. (2008). Cognitive development and home environment of rural Paraguayan infants and toddlers participating in Pastoral del Niño, an early child development program. *Journal of Research in Childhood Education, 22*(4), 343-362.

Rodriguez, E. T., & Tamis-LeMonda, C. S. (2011). Trajectories of the home learning environment across the first 5 years: Associations with children's vocabulary and literacy skills at prekindergarten. *Child development, 82*(4), 1058-1075.

Rubio-Codina, M., Attanasio, O., Meghir, C., Varela, N., & Grantham-McGregor, S. (2015). The socioeconomic gradient of child development: Cross-sectional evidence from children 6–42 months in Bogota. *Journal of Human Resources, 50*(2), 464-483.

Schady, N., Behrman, J., Araujo, M. C., Azuero, R., Bernal, R., Bravo, D., . . . Paxson, C. (2015). Wealth gradients in early childhood cognitive development in five Latin American countries. *Journal of Human Resources, 50*(2), 446-463.

Shonkoff, J. P., Garner, A. S., Siegel, B. S., Dobbins, M. I., Earls, M. F., McGuinn, L., . . . Wood, D. L. (2012). The lifelong effects of early childhood adversity and toxic stress. *Pediatrics, 129*(1), e232-e246.

Singla, D. R., Kumbakumba, E., & Aboud, F. E. (2015). Effects of a parenting intervention to address maternal psychological wellbeing and child development and growth in rural Uganda: a community-based, cluster-randomised trial. *The Lancet Global Health, 3*(8), e458-e469.

Totsika, V., & Sylva, K. (2004). The home observation for measurement of the environment revisited. *Child and Adolescent Mental Health, 9*(1), 25-35.

United Nations Children's Fund. (2016). Multiple indicator cluster survey.   Retrieved from http://mics.unicef.org/

Vyas, S., & Kumaranayake, L. (2006). Constructing socio-economic status indices: how to use principal components analysis. *Health policy and planning, 21*(6), 459-468.

Walker, S. P., Chang, S. M., Powell, C. A., & Grantham-McGregor, S. M. (2005). Effects of early childhood psychosocial stimulation and nutritional supplementation on cognition and education in growth-stunted Jamaican children: prospective cohort study. *The Lancet, 366*(9499), 1804-1807.

Yousafzai, A. K., Rasheed, M. A., Rizvi, A., Armstrong, R., & Bhutta, Z. A. (2015). Parenting skills and emotional availability: an RCT. *Pediatrics*, peds. 2014-2335.

Conclusion

This dissertation on stimulating parenting and child development in rural, indigenous communities in Mexico had several key findings. The first is that the parenting program, *Educación Inicial* had a positive effect on stimulating parenting behaviors, and that the effect on these behaviors mediated program effects on child development outcomes. Program effects did not differ between indigenous and non-indigenous communities. While the program did not induce parents to increase the variety of play and learning materials in the home, it did increase parental engagement in play-activities with their children. *Educación Inicial* only had significant effects on parenting behaviors and child development when it was integrated with the existing social infrastructure, receiving promotional support from the cash transfer program *Prospera*.

An in-depth examination of parenting during infancy revealed that child age, family socioeconomic status, and mother's education were predictive of parental engagement in stimulating behaviors, and the quality of the home environment. Children in indigenous families or living in indigenous communities were the most vulnerable to having less stimulating parenting and home environments, however living in an indigenous community was protective of parenting for indigenous families. Indigenous community designation was highly associated with community marginalization, and could explain children and families increased vulnerability, however the protective effects of living in an indigenous community for indigenous families highlights several potential concerns of social marginalization, additional stress that indigenous families face when not living in an indigenous community, or that families that migrate out of indigenous communities are at greater risk.

Finally, a longitudinal analysis found that parenting quality during infancy and prekindergarten were independently associated with later child development. However, while parenting quality in infancy was associated with concurrent child development, it did not remain significantly associated with later child development after controlling for the effects of child development in infancy. Parental warmth and responsiveness and the availability of learning materials in the home in infancy were significant predictors of later child development, but parental stimulating practices were not. Conversely, during prekindergarten, parental stimulating practices were significant predictors of child development, while the variety of learning materials in the home was not. There were no differences in the association between parenting and child development between indigenous and non-indigenous communities.

This dissertation advances the understanding of parenting quality in the early childhood period in LMIC, and among indigenous populations in Mexico, and the protective and predictive factors associated with parenting in these populations. Understanding the pathways of parenting program effects on child development in indigenous and non-indigenous communities, and the underlying relations between indigeneity, poverty, parenting quality and child development can inform policy and practice in Mexico and other resource constrained settings with vulnerable populations. There is a demand for researchers to replicate and advance studies traditionally conducted in the US and Western Europe that inform the relation between parenting and child development in other countries, including in indigenous populations, and future direction for this work is to conduct longitudinal studies with repeated measures throughout the early childhood period, and to model for reciprocal effects of child development on parenting behaviors.