July 2017

The Relationship Between Maternal Parenting Knowledge and Infant Development Outcomes: Evidence from Rural China

Ai Yue, Mengying Wu, Yaojiang Shi, Renfu Luo, Baozhu Wang, Kaleigh Kenny, & Scott Rozelle

Abstract

The importance of this first years of life for long-term developmental outcomes has prompted researchers to search for specific factors that may be related to early childhood development. One of the factors that may influence the outcomes of children is parenting knowledge. Parenting knowledge is thought to be associated with the cognitive and social-emotional development of children, as it allows caregivers to better understand and interact with their children in an appropriate and enriching manner. This study uses data from a sample of 648 rural Chinese infants aged 6-24 months to examine the relationship between the parenting knowledge of caregivers and early childhood developmental outcomes. Both our unadjusted and adjusted models show that caregiver knowledge of infant development is positively and significantly related to the social-emotional and language development of infants. However, the relationship between knowledge of infant development and neither cognitive nor motor development were significant. Overall, our findings suggest that the low levels of caregiver knowledge on infant development are correlated with poor developmental outcomes among infants in rural China.

Keywords: cognition; infant development; parenting knowledge; rural China; social-emotion

Working Paper 317

July 2017

reap.fsi.stanford.edu

REAP Rural Education Action Program

1. Introduction

The first years of life comprise a critical period of development which has implications for lifelong outcomes (Almond & Currie, 2011). The importance of this early stage has prompted researchers to search for specific factors that may be related to early childhood development. One factor that is related to infant development is maternal parenting knowledge (Damast, Tamis-LeMonda, & Bornstein, 1996; Fewell & Wheeden, 1998; Parks & Smeriglio, 1986; MacPhee, 1981; Miller, 1988; Sigel & McGillicuddy-De Lisi, 2002). Parenting knowledge can be defined as the "understanding of development norms and milestones, the process of child development, and familiarity with caregiving skills" (Benasich & Brooks-Gunn, 1996).

Parenting knowledge is thought to be associated with the cognitive and social-emotional development of children, as it allows caregivers to better understand and interact with their children in an appropriate and enriching manner (Goodnow, 1988; Sigel, 1992; Smith, 2002; Stevens, 1984; Damast, Tamis-LeMonda, & Bornstein, 1996). When caregivers interact with their child in such a way, they provide high-quality stimulation that contributes to the development of the child's cognitive and motor capabilities (Gertler et al., 2014; Heckman, 2013). For example, it has been shown that mothers with better knowledge of child development are more likely to create an appropriate home environment that aids their child at every stage of their cognitive development (Parks & Smeriglio, 1986).

However, the opposite is also true and caregivers with poor parenting knowledge may interact with their children in ways that do not aid, or possibly stifle, their child's development (Belsky, 1980; Dukewich, Borkowski, & Weitman, 1996). It has been found that a lack of accurate knowledge about child development may be related to higher rates of child abuse and maltreatment (Dukewich, Borkowski, & Whitman, 1996). Mothers with lower levels of

parenting knowledge have also been found to be more likely to use severe or inappropriate discipline strategies that could harm their child's development (Smith, 2002). In addition to negative parenting behaviors, it has been shown that merely a lack of stimulation can leave a child vulnerable to developmental delays, which can harm their future academic and labor-market outcomes, among others (Gertler et al., 2014; Heckman, 2013)

While most of research had been done in developed countries, considerably less has examined whether maternal parenting knowledge affects child development in developing countries. Research conducted in Qatar suggests that parenting knowledge is likely lower in developing than developed countries (Al-Maadadi & Ikhlef, 2015). Several studies have shown that interventions to improve parental monetary and time investments can aid the cognitive and social-emotional development of children in developing countries (Attanasio et al., 2015; Grantham-McGregor et al., 2014), suggesting that other interventions focused on improving parenting may be able to provide the same benefit. In fact, evidence from Bangladesh suggests that an intervention aimed at improving parenting knowledge did increase scores on a scale of knowledge of child development, however this did not translate to better parenting practices or improvements in the cognitive development of children (Aboud, 2007).

Examining the state of parental knowledge may be especially important in countries with high levels of inequality, such as China. Numerous studies have found low levels of cognitive development among rural children as compared to urban children in China (Yang et al., 2008; Bao et al., 2011; Wei et al., 2015; Luo et al., 2015; Chen, Li, & Liu, 2012). However, little research examines the underlying factors behind this developmental gap. This gap may arise, in part, due to education disparities among parents. Some researchers have found that maternal education level is significantly related to knowledge of early childhood development and

appropriate parenting behaviors (Li et al., 2000; Al-Maadadi & Ikhlef, 2015). This is concerning, as 95% of mothers in rural China have only completed middle school or dropped out before completing middle school (ISSS, 2010).

Fortunately, it has also been found that increased maternal knowledge of proper parenting practices can improve children's outcomes, even if mothers have relatively low educational attainment (Block, 2007). Within the context of the United States, parenting knowledge has been found to be more highly correlated with infant developmental outcomes in low income groups than in the rest of the population (Parks & Smeriglio, 1986). Similar findings have been reached using a sample of individuals from a developing context. Specifically, a study conducted in Lesotho found that the effect of maternal education on children's nutritional outcomes was mediated by maternal nutritional knowledge, given that the household can afford a minimum level of resources (Ruel et al., 1992).

Although parenting knowledge is not perfectly correlated with educational attainment, there is still concern that positive parenting behaviors are largely absent in rural China. A study using a sample of infants aged 6 to 24 months found that caregivers in rural China rarely read or sing to their child at this age, under the assumption that they are too young to understand (Yue et al., 2016a). However, verbal interaction has been shown to be significantly related to the language acquisition and vocabulary development (Huttenlocher et al., 1991), which allow children to learn about the world and express themselves. It may be that low levels of parenting knowledge impede the cognitive and social-emotional development of infants and young children in rural China.

The primary goal of this study is to examine the relationship between the parenting knowledge of caregivers and early childhood developmental outcomes in rural China. To achieve

this goal, we have several specific objectives. First, we seek to understand the current situation of parenting knowledge among caregivers of infants in rural China. Next, we identify the association between parenting knowledge of infant development and the practice of specific parenting behaviors. Last, we attempt to identify the correlation between parenting knowledge and the motor, cognitive, language, and social-emotional development of infants.

The rest of the paper is structured as follows. The second section describes our methodology, including our sample selection and data collection efforts. The third section presents and discusses our results. The fourth section concludes.

2. Methods

2.1 Sample selection

Our study was conducted in 7 nationally designated poverty counties located in Shaanxi Province beginning in November 2015. From each of these 7 counties, all townships (the middle level of administration between county and village) were selected to participate in the study. To ensure that we selected a large, rural sample, there were two exceptions to this rule: we excluded the township in each county that housed the county seat, and we excluded townships that did not have any villages with a population of 800 or more. After imposing these criteria, 44 townships were included in the study.

To collect the data this study, our surveying was conducted in two waves: one in November 2015, and another in April 2016. To meet the power requirements of a large, interventional study (not reported in this paper), we needed a minimum of five children in each township. With this requirement in mind, we first randomly selected one village from each township to participate. All children in our desired age range of 6–24 months were enrolled in the study. If a village had fewer than five children in our desired age range, we randomly

selected an additional village in the same township for inclusion in the study, and continued to randomly select additional villages until five children per township had been found. Overall, our study included 648 infants in 55 villages across 44 townships in rural Shaanxi province.

2.2 Data collection

Teams of trained enumerators collected socioeconomic information from all households participating in the study. Each child's primary caregiver was identified and administered a detailed survey on parental and household characteristics, including each child's gender, birth order, maternal age and education, and whether the family received Minimum Living Standard Guarantee Payments (a poverty indicator). The exact age of each child was obtained from his/her birth certificate. The primary caregiver (typically either the child's mother or grandmother) was identified in each family as the individual who is most responsible for the child's care. Our caregiver survey also included the three following questions to gather information on parenting behaviors: Did the caregiver (or any other family member) read books to the child yesterday? Did the caregiver (or any other family member) sing songs to the child yesterday? Did the caregiver (or any other family member) use toys to play with the child yesterday?

To measure each primary caregiver's knowledge of infant development, we used the Knowledge of Infant Development Inventory-P (KIDI-P). KIDI-P is a subsection of the Knowledge of Infant Development Inventory (KIDI), which was designed by David MacPhee in 1981. KIDI has been used widely in the international literature on child development and parenting knowledge (Al-Maadadi & Ikhlef, 2015; Dichtelmiller et al., 1992; Garrett-Peters et al., 2008; Huang et al., 2005; Zolotor et al., 2008). The inventory has an alpha coefficient of 0.82, representing a high level of internal consistency. Test-retest reliability is also high, at 0.92 for the total score, meaning that scores are highly consistent over time.

The KIDI-P includes two parts: the first part consists of 39 items that evaluate caregiver knowledge of child behavior and appropriate caregiver responses on a three-point Likert scale (indicating whether the caregiver agrees, disagrees, or is unsure about the statement). Specifically, these test items concern the normative behavior of infants and caregiver responses regarding crying, feeding, and diapering. In the second part of the instrument, caregivers are asked questions about whether they believe infants will reach a certain milestone at a particular age. If caregivers do not think that a child will reach the milestone at the given age, they then must say if a child should be expected to reach this milestone at a younger or older age. Because KIDI-P is a knowledge test, it has definite answers and, therefore, caregiver responses are marked as either correct (and receive 1 point) or incorrect (and lose 1 point). If the caregiver responds that they are unsure about a question, then they receive no points for that item. KIDI-P scores are reported as a percentage of correctly answered questions, where a higher percentage indicates better knowledge of child development. In our study, only the responses of caregivers to the first part of KIDI-P were evaluated.

In this study, our measure of early childhood development is the Bayley Scales of Infant Development-Third Edition (BSID-III). This test is well recognized in the psychological literature (Jaffe et al., 2001; Luo et al., 2015) and is listed by the American Psychiatric Association as a way to diagnose certain developmental disorders (American Psychiatric Association, 2000). The test was formally adapted to the Chinese language and environment in 1992 (Yi et al., 1993). The BSID-III takes into consideration each infant's age in days, as well as whether he or she was a premature birth. These two factors, combined with the infant's performance on a series of tasks using the standardized toy kit, broadly assess the quality of a child's development.

Specifically, the BSID-III is designed to assess the development of infants and young children aged 1 to 42 months in five domains: cognitive, language, motor, social-emotional, and adaptive behavior.[1] The cognitive, motor, and language scales were developed for the BSID-III, while Greenspan's Social Emotional Growth Chart (GSEGC) was included to evaluate social-emotional development (Albers & Grieve, 2007). The cognitive measure assesses sensorimotor development, exploration and manipulation of objects, object relations, concept formation, and memory of children; the motor measure analyzes gross and fine motor control; and the language measure evaluates both receptive and expressive communication. These three measures were evaluated based on an infant's performance on tasks using a standardized toy kit. The GSEGC uses caregiver survey responses to examine the functional emotional skills of children, including self-regulation and interest in the world; ability to communicate needs, engage others, and establish relationships; use of emotions in a purposeful manner; and use of emotional signals to solve problems (Albers & Grieve, 2007). For our research, all scores are normalized to a mean of 100 and a standard deviation of 15.

Evaluations of the reliability and consistency for items in the BSID-III suggest that the scale is an accurate measure of infant development in the domains tested. For the cognition, language, and motor scales, composite average reliability coefficients ranged from 0.91 (cognitive) to 0.93 (language), whereas subtest average reliability coefficients ranged from 0.86 (fine motor subtest) to 0.91 (gross motor subtests). In all, these reliability coefficients demonstrate that the BSID-III is capable of accurately measuring infant development in these areas. For the social-emotional portion of the scale (which employs the Greenspan Social-

[1] Although the BSID-III evaluates five components in total, we only focus on the cognitive, motor, language, and social-emotional outcomes in this study.

Emotional Growth Chart), alpha coefficients for social emotional items ranged from 0.83 to 0.94, and ranged from 0.76 to 0.91 for sensory processing items, demonstrating internal consistency.

All enumerators attended a week-long training course on how to administer the KIDI-P and BSID-III, including a 2.5-day experiential learning program in the field. The scales were administered one-on-one in the household using questionnaires, a set of standardized toys, and detailed scoring sheets. This study represents one of the largest administrations of the KIDI-P and BSID-III ever conducted in China, and is one of the only administrations of these scales ever conducted in rural communities in China's nationally-designated poverty counties. Throughout our paper, we will refer to the results of children on these measures as their KIDI and BSID scores for the sake of simplicity.

2.3 Statistical analysis

To identify the correlation between parenting knowledge and child development outcomes, we used both unadjusted and adjusted ordinary least squares (OLS) regression models. First, to identify whether there is a relationship between parenting knowledge and infant development, we regressed the BSID scores of children on the KIDI scores of their caregivers as follows:

$$Outcome_{ic} = \alpha + \beta \cdot Score_{ic} + \lambda \cdot s_c + \varepsilon_{ic}$$

Where the dependent variable, $Outcome_{ic}$ indicates development outcomes as measured by scores on the cognitive, language, motor, and social-emotional portions of the BSID-III of infant *i* in village *c*. $Score_{ic}$ is z-score of the total KIDI score of the caregiver of infant *i.* Other non-time varying village effects are captured by λ. ε_i is random error term. We account for the clustered design by constructing Huber-White standard errors clustered at the village level.

To improve the efficiency of our estimations, we also used an adjusted model by controlling for a set of individual and household-level covariates collected at the time of the baseline survey. The model used is as follows:

$$Outcome_{ic} = \alpha + \beta \cdot Score_{ic} + \gamma \cdot X_{ic} + \lambda \cdot s_c + \varepsilon_{ic}$$

Where X_{ic} is a vector of covariates that are included to capture and control for the characteristics of infants and their households. These covariates include child *gender, age, birth order, whether the child was born prematurely, whether the child's mother was identified as the primary caregiver, maternal educational level, maternal age,* and *whether the child's family received minimum living standard guarantee payments*.

Statistical analyses were performed using STATA 13.0 and p-values below 0.05 were considered statistically significant. Linear regression was used for multivariate analyses as appropriate. In our sample, most caregivers are mothers and all others are grandmothers. The education levels and ages of grandmothers are similar to those of the mothers in our sample and should not be considered potential confounders. All multiple linear regressions adjust for village fixed effects.

3. Results

The basic characteristics of our sample are displayed in Table 1. As can be seen in the table, our sample is evenly split between male and female children (50% male and 50% female). Only a small portion of infants in our sample were born prematurely (4%). Slightly more than half of sample infants were the first born in their family (51%), rather than at least the second child in their family (49%). The mother was the primary caregiver for 68% of the infants in the sample, and 32% of sample infants were taken care of by their grandparents. Almost 80% of mothers have completed less than 9 years of schooling and 65% were over 25 years of age.

About 12% of the households in our sample reported receiving minimum living standard guarantee payments, a form of government welfare for the lowest income households in China.

3.1 Situation of parenting knowledge in rural Shaanxi province

As shown in table 2, the average KIDI score of caregivers in our sample is 0.54. When we examine average scores for different types of caregivers, we see that mothers in our sample received an average KIDI score of 0.55, while grandparents had an average score of 0.51 (Table 2). Although this is only a 0.04 difference, it is significant at the 1% level, demonstrating that the parenting knowledge of mothers is generally better than that of grandparents in our sample.

From the comparisons presented in Table 3, we find that levels of knowledge on infant development differ between subgroups of caregivers. Specifically, we find that caregivers whose child was born prematurely are 0.43 SD less likely to have high KIDI scores than caregivers of children who were not born prematurely (significant at the 5% level). In addition, mothers that serve as their child's primary caregiver and that have at least a high school education received average KIDI scores 0.11 SD and 0.34 SD higher than that of other caregivers, respectively (both significant at the 1% level). Household socioeconomic status also appears to be associated with knowledge of infant development, as we find that caregivers in households receiving minimum living standard guarantee payments are 0.27 SD less likely to have higher KIDI scores (significant at the 5% level). However, we find no significant differences in knowledge of infant development between mothers above and below 25 years of age, or mothers whose infant is or is not their first child.

3.2 Relationship of parenting knowledge and behavior

Figure 1 depicts the relationship between parenting behaviors and KIDI scores. From this analysis, we find that there are significant differences in KIDI scores between caregivers who do

and do not practice positive parenting behaviors. For example, we find that the difference in standardized KIDI scores of caregivers who did and did not play with their child yesterday is 0.25 SD and is significant at the 1% level. We also find a significant difference (at the 1% level) of 0.24 SD in the KIDI scores of caregivers who did and did not sing to their child yesterday. However, even though there is an estimated correlation of 0.14 SD, there appears to be no significant difference in the KIDI scores of caregivers who did and did not tell stories to their child yesterday. It may be important to note that very few caregivers in our sample had read to their child the previous day (71 caregivers or only 11% of our sample).

3.3 Relationship between parenting knowledge and infant development

Results from our multivariate analysis presented in Table 4 show that better caregiver knowledge of infant development is positively and significantly related to the language and social emotional development of infants after adjusting for village fixed effects. Specifically, in our adjusted models, we find that a one standard deviation increase in the KIDI score of caregivers is associated with a 1.97-point increase in language scores and a 1.85-point increase in the social emotional scores of children (both significant at the 1% level – Table 4, Columns 6 and 8). We also find that a one standard deviation increase in the KIDI score of caregivers is associated with a 0.94-point increase in the BSID cognitive scores of infants, but this result is not statistically significant at the 5% level (Table 4, Column 4). We also find no significant relationship between the KIDI scores of caregivers and the motor development of infants represented by the BSID motor score in either our unadjusted or adjusted models (Columns 1 and 2).

4. Discussion

Our research reveals relatively low levels of knowledge on infant development in rural China. The average KIDI score among caregivers in our sample is 0.54, which is considerably lower than the average score found among the sample of mothers used to standardize the KIDI instrument (0.72 – MacPhee, 1981). In addition, this score is lower than those reported in other studies that used an abbreviated form of the KIDI instrument. For example, Huang et al. (2005) found an average KIDI score of 0.56 among a sample of 378 mother-infant pairs in the United States. Additionally, a study conducted in three low-income counties in the United States found an average KIDI scores among sample mothers of 0.81 (Garrett-Peters et al., 2008). These comparisons suggest that knowledge of infant development is indeed low in rural China, and warrants attention.

From comparisons between different subgroups, we find that there are certain types of caregivers who are at a higher risk for having low KIDI scores than others. For example, we found that the average KIDI score of mothers is higher than that of grandparents. We also find that mothers who have lower levels of educational attainment (namely, a junior high school diploma or below) are more likely have lower KIDI scores. Poverty also appears to be linked to parenting knowledge, as caregivers of children in households that receive minimum living standard guarantee payments are more likely to have lower KIDI scores than other caregivers.

Perhaps it is not surprising that these types of caregivers are more likely to have low KIDI scores, given that they may have less access and be less receptive to new information on parenting and child development. Although some research has shown that there is a general lack of information on elements of child development in rural China (Yue et al., 2016b), it may the case that younger caregivers and caregivers with more resources available to them are willing to seek out information on child development and apply it to their parenting practices. This idea is

supported by the finding that greater access to information can improve certain measures of parenting knowledge, regardless of the educational background of caregivers (Block, 2007).

We also found that caregiver knowledge of infant development is significantly related to certain parenting behaviors. For example, our results indicate that caregivers with higher levels of knowledge on infant development are more likely to have used toys to play with their child and to have sung to their child the previous day. However, we found that there was no significant relationship between caregiver KIDI scores and telling stories to children. This finding stands in contrast to previous research that found reading to children is positively and significantly related to their cognitive development (Yue et al., 2016c). However, the reason we find no significant correlation between reading and KIDI score may be because very few sample caregivers read to their children the previous day (71 of 648 caregivers or 11% of the sample).

Although we cannot say for certain why so few caregivers tell stories to their children, we believe that it is likely due to convenience. For example, 81% of caregivers in our sample reported that they believe that reading books to their child is important. However, 58% of sample households do not have any children's books and 51% of sample caregivers reported that they do not know how to read books to their infant in an appropriate and effective manner. This evidence is in line with other research that has found that children's reading materials are scarce in rural China (Qian, 2009), suggesting that caregivers likely do not have a method of finding stories that are appropriate and engaging for their children. From these findings, it appears that when a task that caregivers know is beneficial for their children is difficult to perform, they are not likely to engage in that activity. For this reason, interventions aimed at improving early childhood development outcomes should not only educate caregivers, but also teach them how to apply this knowledge in their parenting practices.

Then, we examine the relationship between caregiver knowledge of development and early childhood development within the context of rural China. From our results, we can see that caregiver knowledge of infant development is positively and significantly related to the social emotional and language development of infants, as represented by their BSID scores. However, the relationship between knowledge of infant development and neither cognitive nor motor development were significant at the 5% level. Our results both support and contrast those found in the literature base. For example, other research has found significant associations between the social emotional development of infants and caregiver knowledge of infant development (Dukewich, Borkowski, & Weitman, 1996; Smith, 2002). However, previous research has also found that caregiver knowledge of infant development is, indeed, related to the cognitive development of infants (Parks & Smeriglio, 1986; Stevens, 1984). Additional research on this topic is warranted to resolve these apparent discrepancies.

We believe our research represents a contribution to the literature on relationship between knowledge of infant development and motor, cognitive, language and social emotional development of infant in rural China due to its large sample size and standardized measures of infant development and knowledge of infant development. We find that even if caregivers have very low educational level, higher knowledge can improve language and social emotional development of infant in rural China. Further research is needed to explore the most effective way to improve caregiver knowledge of infant development in rural China.

5. Conclusion

Overall, our findings suggest that the low levels of caregiver knowledge on infant development are correlated with poor developmental outcomes among infants in rural China. We find that caregivers with low levels of educational attainment or income are more likely to have

low levels of knowledge on infant development. We also find that the KIDI scores of caregivers are related to whether they practice certain positive parenting behaviors. Specifically, we found that knowledgeable caregivers are more likely to use toys to play with their child and to sing to their infants.

To avoid the long-term, negative consequences that poor early childhood outcomes have on human capital development, China's government should take steps to improve the state of parenting knowledge in rural areas of the country. Given the significant relationship between caregiver knowledge and infant development, we suggest that government administrative bodies implement programming that can disseminate information on parenting knowledge. One government agency that could run such a program is the Population and Family Planning Commission (PFPC), which has relatively easy access to every village in China. Following the end of China's one-child policy, the PFPC is looking for a new institutional mission, and it has turned its attention to early childhood development (Greubel & Van der Gaag, 2012). Given that the PFPC already has the institutional reach and experience conducting village outreach and running informational campaigns, it is well positioned to distribute information on infant development.

Another possible policy solution is establishing early childhood parenting centers in rural areas. Each parenting center could provide lessons that teach caregivers how to interact with their child in an enriching manner. Caregivers often recognize the importance of positive parenting behaviors, such as telling stories to their infant, but they may not know how to effectively engage with their child. Parenting centers can be established with a set curriculum and with guidance provided by trained teachers. These teachers could be a nurse or a doctor at the local township hospital, or it could again be possible to leverage the network of PFPC

workers to train teachers who are familiar with the local environment. By implementing interventions of this nature, rural caregivers can acquire the knowledge and practical skills to help their child, and their country, develop to its full potential.

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.

Albers, C. A., & Grieve, A. J. (2007). Test review: Bayley, N. (2006). Bayley scales of infant and toddler development–third edition. San Antonio, TX: Harcourt assessment. *Journal of Psychoeducational Assessment*, *25*(2), 180-190.

Al-Maadadi, F., & Ikhlef, A. (2015). What mothers know about child development and parenting in Qatar: Parenting cognitions and practices. *The Family Journal*, *23*(1), 65-73.

Almond, D., & Currie, J. (2011). Killing me softly: The fetal origins hypothesis. *The Journal of Economic Perspectives*, *25*(3), 153-172.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders*, fourth edition, text revision. Washington D.C.: American Psychiatric Association.

Attanasio, O., Cattan, S., Fitzsimons, E., Meghir, C., & Rubio-Codina, M. (2015). *Estimating the production function for human capital: Results from a randomized control trial in Colombia* (No. w20965). Cambridge, MA: National Bureau of Economic Research.

Bao, X., Zheng, Y., Sun, S., Wang, H., Wang, D., Li, Y., & Xiao, N. (2011). Effect of early intervention on healthy personality development in 0-3 year-old infants [in Chinese]. *Chinese Journal of Child Health Care*, 19(7), 606-609.

Benasich, A. A., & Brooks-Gunn, J. (1996). Maternal attitudes and knowledge of child‐rearing: Associations with family and child outcomes. *Child Development*, *67*(3), 1186-1205.

Belsky, J. (1980). Child maltreatment: an ecological integration. *American Psychologist*, *35*(4), 320-335.

Block, S. A. (2007). Maternal nutrition knowledge versus schooling as determinants of child micronutrient status. *Oxford Economic Papers*, *59*(2), 330-353.

Chen, Y., Li, J., & Liu, H. (2012). Analysis of 229 cases with ages & stages questionnaires and developmental screening test [article in Chinese]. *Chinese Journal of Child Health Care*, 1, 78–79.

Damast, A. M., Tamis‐LeMonda, C. S., & Bornstein, M. H. (1996). Mother‐child play: Sequential interactions and the relation between maternal beliefs and behaviors. *Child Development*, *67*(4), 1752-1766.

Dichtelmiller, M., Meisels, S. J., Plunkett, J. W., Bozytnski, M. E. A., Claflin, C., & Mangelsdorf, S. C. (1992). The relationship of parental knowledge to the development of extremely low birth weight infants. *Journal of Early Intervention*, *16*(3), 210-220.

Dukewich, T. L., Borkowski, J. G., & Whitman, T. L. (1996). Adolescent mothers and child abuse potential: An evaluation of risk factors. *Child Abuse & Neglect*, *20*(11), 1031-1047.

Fewell, R. R., & Wheeden, C. A. (1998). A Pilot Study of Intervention with Adolescent Mothers and their Children: A Preliminary Examination of Child Outcomes. *Topics in Early Childhood Special Education*, *18*(1), 18-25.

Garrett-Peters, P., Mills-Koonce, R., Adkins, D., Vernon-Feagans, L., Cox, M., & Family Life Project Key Investigators. (2008). Early environmental correlates of maternal emotion talk.

Parenting: Science and Practice, *8*(2), 117-152.
Gertler, P., Heckman, J., Pinto, R., Zanolini, A., Vermeersch, C., Walker, S., … Grantham-McGregor, S. (2014). Labor market returns to an early childhood stimulation intervention in Jamaica. *Science*, *344*(6187), 998–1001.
Goodnow, J. J. (1988). Parents' ideas, actions, and feelings: Models and methods from developmental and social psychology. *Child Development*, 59(2), 286-320.
Grantham-McGregor, S. M., Fernald, L. C., Kagawa, R., & Walker, S. (2014). 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.
Greubel, L., & Van der Gaag, J. (2012, June 29). Early Childhood Development: A Chinese National Priority and Global Concern for 2015. Retrieved from https://www.brookings.edu/blog/up-front/2012/06/29/early-childhood-development-a-chinese-national-priority-and-global-concern-for-2015/.
Heckman, J. (2013). *Giving Kids a Fair Chance*. Boston: The MIT Press. Retrieved from https://mitpress.mit.edu/books/giving-kids-fair-chance
Huang, K. Y., Caughy, M. O. B., Genevro, J. L., & Miller, T. L. (2005). Maternal knowledge of child development and quality of parenting among White, African-American and Hispanic mothers. *Journal of Applied Developmental Psychology*, *26*(2), 149-170.
Huttenlocher, J., Haight, W., Bryk, A., Seltzer, M., & Lyons, T. (1991). Early vocabulary growth: Relation to language input and gender. *Developmental Psychology*, *27*(2), 236-248.
Institute of Social Science Survey (ISSS). (2010). *China Family Panel Studies (CFPS)* [data file]. Retrieved from http://www.isss.edu.cn/cfps/EN/.
Jaffe, J., Beebe, B., Feldstein, S., Crown, C. L., Jasnow, M. D., Rochat, P., & Stern, D. N. (2001). Rhythms of dialogue in infancy: Coordinated timing in development. *Monographs of the Society for Research in Child Development*, i-149.
Li, Y., Liu, J., Liu, F., Guo, G., Anme, T., & Ushijima, H. (2000). Maternal child-rearing behaviors and correlates in rural minority areas of Yunnan, China. *Journal of Developmental & Behavioral Pediatrics*, *21*(2), 114-122.
Luo, R., Shi, Y., Zhou, H., Yue, A., Zhang, L., Sylvia, S., ... & Rozelle, S. (2015). Micronutrient deficiencies and developmental delays among infants: evidence from a cross-sectional survey in rural China. *BMJ Open*, *5*(10), e008400.
MacPhee, D. (1981). Manual: Knowledge of infant development inventory. Princeton, NJ: Educational Testing Service.
Miller, S. A. (1988). Parents' beliefs about children's cognitive development. *Child Development*, 59(2), 259-285.
Parks, P. L., & Smeriglio, V. L. (1986). Relationships among parenting knowledge, quality of stimulation in the home and infant development. *Family Relations*, 35(3) 411-416.
Ruel, M. T., Habicht, J. P., Pinstrup-Andersen, P., & Gröhn, Y. (1992). The mediating effect of maternal nutrition knowledge on the association between maternal schooling and child nutritional status in Lesotho. *American Journal of Epidemiology*, *135*(8), 904-914.
Qian, J. H. (2009). A Preliminary Study of Early Childhood Reading in Rural China [in Chinese].

Research on Early Childhood Education, (9), 31-31.

Sigel, I. E., & McGillicuddy-De Lisi, A. V. (2002). Parent beliefs are cognitions: The dynamic belief systems model. In Bornstein, M. H. (ed.), *Handbook of parenting: Being and becoming a parent* (pp. 485-508). Mahwah, NJ: Lawrence Erlbaum Associates.

Sigel, I. E . (1992). The belief-behavior connection: A resolvable dilemma. In Sigel, I. E., McGillicuddy-DeLisi, A., & Goodnow, J. (eds.), *Parental belief systems: The psychological consequences for children* (pp. 433-456). Hillsdale, NJ: Lawrence Erlbaum Associates.

Smith, T. K. (2002). The relationship between knowledge, attributions and behavior in adolescent mothers: Implications for child outcomes (Unpublished doctoral dissertation). University of California, Santa Barbara, CA.

Stevens, J. H. (1984). Child development knowledge and parenting skills. *Family Relations*, 33(2), 237-244.

Wei, Q. W., Zhang, J. X., Scherpbier, R. W., Zhao, C. X., Luo, S. S., Wang, X. L., & Guo, S. F. (2015). High prevalence of developmental delay among children under three years of age in poverty-stricken areas of China. *Public Health*, *129*(12), 1610-1617.

Yang H., Liang, A., Qiu L., Meng J., Zhang W., & Wang F. (2008). Relationship between family rearing pattern and the physical development of their infants and toddlers in Beijing [in Chinese]. *Chinese Journal of Child Health Care*, 15(6), 596-598.

Yi, S., Luo, X., Yang, Z., & Wan, G. (1993). The revising of Bayley Scales of Infant Development (BSID) in China [in Chinese]. *Chinese Journal of Clinical Psychology*, 1, 71–75.

Yue, A., Shi, Y., Luo, R., Chen, J., Garth, J., Zhang, J., ... & Rozelle, S. (2016a). *Rural Chinese Caregiver Attitudes, Parenting Behavior, and Developmental Delays in Children Aged 18-30 Months: Findings from Poor Counties* (REAP Working Papers no. 307). Stanford, CA: Rural Education Action Program.

Yue, A., Marsh, L., Zhou, H., Medina, A., Luo, R., Shi, Y., ... & Rozelle, S. (2016b). Nutritional Deficiencies, the Absence of Information and Caregiver Shortcomings: A Qualitative Analysis of Infant Feeding Practices in Rural China. *PloS one*, *11*(4), e0153385.

Yue, A., Shi, Y., Luo, R., Chen, J., Garth, J., Zhang, J., ... & Rozelle, S. (2016c). *Parental Attitudes, Behavior and Developmental Delays in Children Aged 18-30 Months: Evidence from Rural China* (REAP Working Papers no. 308). Stanford, CA: Rural Education Action Program.

Zolotor, A. J., Burchinal, M., Skinner, D., & Rosenthal, M. (2008). Maternal psychological adjustment and knowledge of infant development as predictors of home safety practices in rural low-income communities. *Pediatrics*, *121*(6), e1668-e1675.

Table 1. Summary statistics

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	326	50
Female	322	50
Is the infant premature?		
No	625	96
Yes	23	4
Birth order of infant		
First	331	51
Second or higher	317	49
Mother is primary caregiver		
No	208	32
Yes	440	68
Maternal education level		
High school or above	133	20
Middle school or below	515	80
Maternal age		
Age≤ 25	229	35
Age>25	419	65
Household receives minimum living standard guarantee		
No	572	88
Yes	76	12

Source: Authors' own data.

Table 2. Parenting knowledge of infant development as measured by scores on the KIDI instrument among sample in rural Shaanxi Province.

Characteristics	Observations	Mean score of Total ±SD	Difference	p Value
All caregivers	648	0.54±0.10		
Mother is primary caregiver				
Yes	440	0.55±0.10	0.04	0.00***
No	208	0.51±0.10		

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%.

Source: Authors' own data.

Table 3. Mean KIDI scores of caregivers of sample infants along observable characteristics.

Characteristics	Mean score of KIDI z-score ± SD	Difference	p Value
Is the infant premature?			
Yes	-0.41±1.25	-0.43	0.05**
No	0.02±0.99		
Birth order of infant			
First	0.03±0.93	0.06	0.46
Second or higher	-0.03±1.07		
Mother is primary caregiver			
Yes	0.11±0.98	0.34	0.00***
No	-0.23±1.02		
Maternal education level			
High school or above	0.23±0.87	0.29	0.00***
Middle school or below	-0.06±1.03		
Maternal age			
Age>25	-0.02±1.01	-0.06	0.47
Age≤ 25	0.04±0.98		
Family receives minimum living standard guarantee			
Yes	-0.24±1.12	-0.27	0.03***
No	0.03±0.98		

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%.

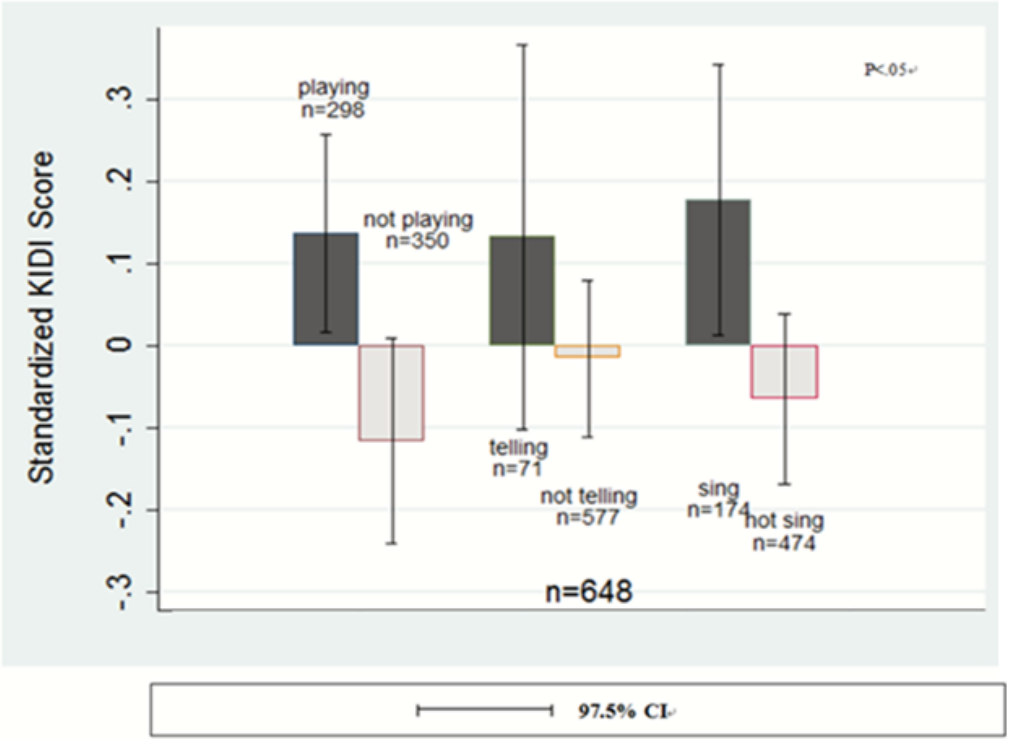
Source: Authors' own data.

Table 4: Multivariate analysis of the relationship between caregiver knowledge of infant development (KIDI score z-scores) and infant developmental outcomes (BSID-III scores)

	(1) Motor	(2) Motor	(3) Cognitive	(4) Cognitive	(5) Language	(6) Language	(7) SE	(8) SE
KIDI z-score	0.37	0.84	0.86*	0.94*	2.11***	1.97***	1.88***	1.85***
	(0.73)	(0.79)	(0.48)	(0.5)	(0.60)	(0.63)	(0.60)	(0.63)
Gender (1=Male)		-1.01		-0.73		-3.42***		-0.5
		(1.27)		(1.15)		(1.06)		(1.61)
Premature (1=premature birth)		3.67		-0.21		-1.66		-4.77
		(5.18)		(2.67)		(3.01)		(4.81)
Birth order (1=First-born)		3.25*		2.44*		4.30***		0.72
		(1.75)		(1.45)		(1.10)		(1.44)
Mother is primary caregiver (1=Yes)		-5.11**		-1.43		1.25		-2.27*
		(1.90)		(1.26)		(1.27)		(1.23)
Maternal education level (1=high school or above)		-0.15		0.32		1.82		2.66
		(1.85)		(1.14)		(1.39)		(1.61)
Maternal age (1=age>25)		4.38**		1.62		3.15**		-0.07
		(1.92)		(1.38)		(1.38)		(1.40)
Receives minimum living standard guarantee (1=Yes)		-0.59		-0.54		1.4		-0.31
		(2.03)		(1.52)		(2.01)		(1.70)
_cons	96.50***	94.91***	94.69***	92.82***	90.22***	84.29***	77.39***	78.18***
	(0.27)	(2.45)	(0.17)	(2.33)	(0.22)	(1.93)	(0.22)	(2.00)
Village dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	648	648	648	648	648	648	648	646
R^2	0.17	0.14	0.12	0.13	0.18	0.22	0.13	0.15

Notes: * significant at 10% level; ** significant at 5% level; *** significant at 1% level. Robust standard errors in parentheses clustered at village level.
Source: Authors' own data.

Figure 1: Correlation between positive parenting behaviors and standardized KIDI scores of caregivers.



Notes: "playing" refers to whether or not the caregiver or another member of the household played with the infant the previous day, "telling" refers to whether the caregiver or another member of the household told a story to the infant the previous day, and "sing" refers to whether or not the caregiver or another household member sang to the child the previous day.

Source: Authors' data.