Children and Youth Services Review 121 (2021) 105855

Contents lists available at ScienceDirect

Children and Youth Services Review

journal homepage: www.elsevier.com/locate/childyouth

Interrelationships of caregiver mental health, parenting practices, and child development in rural China

Jingdong Zhong [a], Tianyi Wang [b], Yang He [b], Jingjing Gao [b], Chengfang Liu [b], Fang Lai [b], Liuxiu Zhang [c], Renfu Luo [b,*]

[a] School of Economics, Peking University, Beijing 100871, China
[b] China Center for Agricultural Policy, School of Advanced Agricultural Sciences, Peking University, Beijing 100871, China
[c] Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China

ARTICLE INFO

Keywords:
Early child development
Mental health
Parental investments
Parenting skills
Rural China

ABSTRACT

Background: Parenting practices are associated with early childhood development (ECD), and some evidences suggest that mental health might affect parenting practices. However, the interrelationships of mental health, parenting practices, and ECD outcomes have not yet been well documented in developing contexts like rural China.

Objective: This paper aims to investigate the interrelationships between the caregiver's mental health, parenting practices, and the child's ECD outcomes in rural China.

Methods: A total of 1787 sample households in an undeveloped rural area of western China are enrolled in the study. A socioeconomic questionnaire, the Depression, Anxiety and Stress Scale, the Family Care Indicators, the Parent and Family Adjustment Scales, and the Bayley Scales of Infant Development version III were used to measure the socioeconomic characteristics of sample households, the caregiver's mental health, parental investments and parenting skills, and the child's development outcomes, respectively. Mediation model was then applied to estimate the interrelationships.

Results: The results showed that parental practices significantly mediated between the caregiver's mental health and the child's cognition, language, motor, and social–emotion development. Through parental investments, one standard deviation increases in the caregiver's mental health test score was associated with the decline in the child's four development scores by 0.6% standard deviation, respectively. Through parenting skills, one standard deviation increases in the caregiver's mental health test score was associated with the decline in the child's language and social-emotional score by 2% and 5% standard deviation, respectively. Different dimensions of caregiver mental health, parental investments and skills played heterogeneous roles in the interrelationships.

Conclusions: Early interventions aimed at improving the caregiver's mental health, parental investments and skills are important and might be effective to improve early childhood development in rural China.

1. Introduction

China faces drastic early development delays among children in rural areas. A new estimate showed that, in four major subpopulations of rural China, 85% of the children aged 0–3 years old were delayed in at least one kind of early childhood development (ECD) outcome (Wang et al., 2019). Especially, 49% of the children exhibited cognitive delays; 52% were delayed in language development; 30% were delayed in motor development; and 53% delayed in social-emotional development (Wang et al., 2019).

Early development delays would do great harm to the children's lifetime well-being. An emerging body of pieces of evidence revealed that poor ECD outcomes would lead to lower earnings in the labor market (e.g., Gertler et al., 2014), worse health outcomes (e.g., Heckman, 2007; Campbell et al., 2014), and other welfare loss in adulthood (e.g., Heckman, 2006).

* Corresponding author.
E-mail addresses: jdzhong@pku.edu.cn (J. Zhong), tianyi_ccap@pku.edu.cn (T. Wang), heyang.ivy@pku.edu.cn (Y. He), gaojj@pku.edu.cn (J. Gao), cfliu.ccap@pku.edu.cn (C. Liu), lxzhang.ccap@igsnrr.ac.cn (L. Zhang), luorf.ccap@pku.edu.cn (R. Luo).

https://doi.org/10.1016/j.childyouth.2020.105855
Received 11 October 2020; Received in revised form 9 December 2020; Accepted 9 December 2020
Available online 15 December 2020

Besides poor ECD outcomes, parenting practices are also far from desirable among caregivers in rural China, which further includes fewer parental investments and lower parenting skills. On the one hand, parental investments are caregiver's parental expenditures that benefit offspring (Clutton-Brock, 1991). Rural families, however, possess fewer toys in both quantity and variety for their children (Wang & Yue, 2019; Wang & Zheng, 2019). On the other hand, parenting skills refer to the parenting styles or attitudes that the caregiver uses for promoting a child's positive outcomes (Sanders, Morawska, Haslam, Filus, & Fletcher, 2014). Few rural caregivers, however, actively engage with children in positive ways that encourage early development, such as telling stories, singing songs, or playing with their children (Luo et al., 2017; Yue et al., 2017, 2019). All these studies documented that poor parenting practices are significant risk factors of ECD outcomes in rural families (Luo et al., 2017; Wang & Yue, 2019; Wang & Zheng, 2019; Yue et al., 2017, 2019).

Poor parenting practices could be accompanied by poor mental health outcomes of caregivers. Mental health is a noteworthy issue in China, and at least 100 million Chinese adults live in the shadow of mental disorders (Fan, Pei, & Hou, 2013). Prevalence of mental disease, such as depression, is higher among female and rural residents than male and urban residents in China (Qin, Wang, & Hsieh, 2018). A recent estimate showed that, in four major subpopulations of rural China, 39% of caregivers suffered from at least one kind of mental health problem (Zhang et al., 2018). Specifically, 25% of rural caregivers had symptoms of depression; 29% had symptoms of anxiety; and 16% had symptoms of stress (Zhang et al., 2018). Mental health problems could increase medical expenditures (Hsieh & Qin, 2018), which might influence the caregiver's parental investments in the child. Also, mental health problems could decline social trust and life satisfaction (Hsieh, Liu, & Qin, 2019), which might affect the caregiver's parenting skills in interacting with the child. These shreds of evidence indicated that parenting practices (in terms of parental investments and parenting skills) might mediate in the links between the caregiver's mental health and the child's ECD outcomes. As far as we know, however, the interrelationship chains between them have not yet been well understood.

The overall goal of this study is to identify the interrelationships between the caregiver's mental health, parenting practices, and early child development in rural China. This study has three specific objectives as follows: (1) examining whether the caregiver's parental investments and parenting skills mediate between the caregiver's mental health and the child's ECD outcomes; (2) estimating the indirect effects of different dimensions of mental health on early child development through parental investments and parenting skills; (3) estimating the mediation effects of different components of parental investments and parenting skills in the interrelationships.

To achieve the objectives, the following three study hypotheses were proposed: (1) parental investments and parenting skills work as mediators between caregiver mental health and early child development; (2) different dimensions of mental health have heterogeneous indirect effects on child development through parental investments and parenting skills; (3) the mediation effects of different components of parental investments and parenting skills vary across ECD outcomes.

2. Literature review

There are a large number of existing works on the links between parents' socio-economic status (SES) and child development. In the developed countries, income-related achievement gaps across children from different socio-economic backgrounds begin to emerge as early as their preschool age (Almond & Currie, 2011; Crook & Evans, 2014; Cunha, Heckman, Lochner, & Masterov, 2006; Heckman, 2006; Larson, Russ, Nelson, Olson, & Halfon, 2015). In the developing countries, similar relationships have also been observed. For example, in Ecuador, both parents' education and family wealth were strongly and positively associated with children's cognitive development (Paxson & Schady, 2007). Children from high socio-economic backgrounds have also been found to do better in cognitive development, in Columbia (Rubio-Codina, Attanasio, Meghir, Varela, & Grantham-McGregor, 2015), Bangladesh (Hamadani et al., 2014), Madagascar (Fernald, Weber, Galasso, & Ratsifandrihamanana, 2011), India, Indonesia, Peru, and Senegal (Fernald, Kariger, Hidrobo, & Gertler, 2012).

In addition to SES backgrounds, caregiver's mental health is another important parental characteristic for child development (Stein et al., 2014). However, different from the fact that the relationships between SES backgrounds and child development have been well studied, while the idea that caregiver's mental health could influence child development seems widespread, it is more than difficult to examine the relationship between them, because the measure of mental health is usually not available in most health datasets (Almond, Currie, & Duque, 2018). In the absence of direct measures, most studies examined whether an exogenous stressful event during pregnancy that is likely to lead to maternal stress has negative impacts on child outcomes (Almond et al., 2018). Such exogenous events in the literature included terrorist attacks (Camacho, 2008; Eskenazi, Marks, Catalano, Bruckner, & Toniolo, 2007), earthquake (Torche, 2011), hurricane (Currie & Rossin-Slater, 2013), and relative's death (Persson & Rossin-Slater, 2018). These studies showed that the stressful event during pregnancy had significantly negative effects on children's birth outcomes. However, due to the limitation of data, these researches could not identify whether early child development during age 0–3 is affected by mental health of the caregivers, especially when the caregiver is grandmother instead of mother of the child.

Furthermore, the mechanisms underlying the relationships between caregiver's mental health and child development are also complex (Stein et al., 2014). Specifically, potential mechanisms include a range of different pathways, such as genetic factors (Jonas et al., 2013; Rice et al., 2010), other biological factors (Davis & Sandman, 2012; Glover, O'connor, & O'Donnell, 2010), and environmental factors (Pawlby, Hay, Sharp, Waters, & Pariante, 2011; Pearson et al., 2012).

Based on evidences in the existing literature, the key pathways to explain the influence of caregiver's mental health on child development are the parenting practices (Stein et al., 2014). On the one hand, mental disorders not only increase medical expenditures (Hsieh & Qin, 2018), but also decrease income (Schofield et al., 2011). As a result, caregivers with mental disorders face tight budget constraint, and thus reduce parental investments in their children. Reduced parental investments, in turn, might restrain child development (Carneiro & Heckman, 2002; Dahl & Lochner, 2012). On the other hand, mental disorders might decline the caregivers' social trust and life satisfaction (Hsieh et al., 2019), and affect their parenting skills, such as reducing maternal responsiveness towards their children (Pearson et al., 2012; Stein et al., 2012), decreasing mother–child interactions (Frank & Meara, 2009; Stanley, Murray, & Stein, 2004), and increasing intrusive parenting behaviors (Feldman et al., 2009; Field, 2010; Jones, Chandra, Dazzan, & Howard, 2014). Poor parenting skills are negatively associated with child development in cognition, language, and social-emotion (Field, 2010; Murray, Cooper, Creswell, Schofield, & Sack, 2007; Tronick & Reck, 2009).

To summarize, caregiver's mental disorders might hinder child development through disrupting parenting practices. However, different disorders might be associated with specific disruption to different dimensions of parenting practices, that in turn, could affect different development outcomes of the children (Stein et al., 2014). As far as we know, the interrelationship chains have not yet been well documented, especially in the developing contexts like rural China.

3. Methods

3.1. Sample selection

This study was conducted in 22 nationally designated poverty

counties located in a relatively undeveloped province in northwestern China. This province ranked in the bottom half among all provinces in 2016, in terms of per capita income.

A three-step protocol was followed to choose the study sample. First, there are 245 towns in the sample counties. Based on the sample size calculated for a large-scale randomized controlled trial, 118 towns were randomly chosen from the sample counties by a random number generator. Second, from each sample town, one village was randomly chosen to participate in the study. Third, in each sample village, a list of all registered births was obtained from the local official. Based on the list, all children aged 6–24 months old, and their caregivers were sampled in the study.

In total, 1788 households were invited to participate in the study, and they all agreed to do so. However, one sample household did not finish the interview, so a total of 1787 sample households were included in the study.

All subjects gave their informed consent for inclusion that was in accordance with the Declaration of Helsinki, before participating in the study. The Ethics Committee of Stanford University, Stanford, CA, USA (No. 35921) and the Peking University Institutional Review Board, Beijing, China (No. 17056) approved the study.

3.2. Data collection

In the survey, five types of information were collected from each sample household: (1) socioeconomic characteristics; (2) caregiver's mental health; (3) parental investments; (4) parenting skills; and (5) child's early development outcomes.

The following survey instruments were used to collect the data:

(1) Socioeconomic questionnaire. For each sampled child, the individual who takes the most responsibility for child daily care was identified as the primary caregiver. The socioeconomic questionnaire was then administered to each primary caregiver. The questionnaire includes the child's gender, the child's age, whether the child is born with low weight (the child's birth weight < 2500 g), the caregiver's age, the caregiver's education, and whether the mother is the primary caregiver. The child's age and birth weight were directly taken from his or her birth certificate.

(2) Depression, Anxiety and Stress Scale − 21 Items (DASS-21). As a shortened version of the DASS-42, the DASS-21 is a well-established instrument to assess the degree of mental disorders associated with depression, anxiety, and stress for adults, yielding both validity and reliability in clinical samples (Antony, Bieling, Cox, Enns, & Swinson, 1998) and non-clinical samples (Henry & Crawford, 2005). Its validity has also been verified in China by Wang et al. (2016). The inventory includes three subscales (depression, anxiety and stress), and each subscale contains 7 items. It was administered to the primary caregiver of each sampled child. They were asked to use the four-point rating scale (0 = "did not apply to me at all", 1 = "applied to me to some degree or some of the time", 2 = "applied to me to a considerable degree or a good part of the time", 3 = "applied to me very much or most of the time") to score the items. As presented in Table A1 of Appendix A, the Cronbach's alpha coefficient of the inventory is 0.91, which indicates that its internal consistency is adequate in the sample (Nunnally, 1978). The total scores are calculated by summing up the scores of the relevant items. A higher total score of DASS-21 is corresponding to the worse mental health of the caregiver.

(3) Family Care Indicators (FCI). Designed by the UNICEF experts to assess parental investments (Frongillo, Sywulka, & Kariger, 2003), the FCI was an international widely-used instrument with both reliability and validity (Hamadani et al., 2010). Previous studies have formally translated the inventory into the Chinese language to adapt to the local context in rural areas (Wang & Yue, 2019; Wang & Zheng, 2019). The inventory contains 19 items in five subscales in total. It was administered to each primary caregiver. The items in three subscales ("sources of play materials", "varieties of play materials", and "play activities"), were scored by the 0–1 binary-choice (1 = "yes"; 0 = "no"). The items in the other two subscales ("household books" and "magazines and newspapers"), were scored by the four-point rating scale according to their real quantity (1 = "none"; 2 = "1–2"; 3 = "3–5"; 4 = ">=6"). As presented in Table A2 of Appendix A, the Cronbach's alpha coefficient of the inventory is 0.75, indicating its adequate internal consistency in the sample (Nunnally, 1978). The total score was calculated by summing up the scores of the relevant items. A higher total score of FCI is corresponding to higher parental investments of the caregiver.

(4) Parent and Family Adjustment Scales (PAFAS). Designed by Sanders et al. (2014), the PAFAS is a brief caregiver-report measure to assess parenting skills. Its reliability and validity have been verified in both developed countries, such as Australia (Sanders et al., 2014), and developing countries, such as China (Guo, Morawska, & Filus, 2017) and Indonesia (Sumargi, Filus, Morawska, & Sofronoff, 2018). The inventory contains 30 items in seven subscales in total: parental consistency (5 items), coercive parenting (5 items), positive encouragement (3 items), parent–child relationship (5 items), parental adjustment (5 items), family relationships (4 items), and parental teamwork (3 items). It was administered to each primary caregiver. They were asked to use the four-point rating scale (0 = "not true of me at all"; 1 = "true of me a little or some of the time"; 2 = "true of me quite a lot or a good part of the time"; 3 = "true of me very much or most of the time") to score the items. In the inventory, 18 out of the 30 items are designed as positive scored (higher scores indicating lower dysfunction levels) and the rest 12 items are designed as reverse scored (higher scores indicating higher dysfunction levels). For the 12 reverse-scored items, we used three minus their original scores to keep consistency across all items. As presented in Table A3 of Appendix A, the Cronbach's alpha coefficient of the inventory is 0.77, suggesting that its internal consistency is adequate in the sample (Nunnally, 1978). The total score was calculated by summing up the scores of the relevant items. A higher total score of PAFAS is corresponding to the higher parenting skills of the caregiver.

(5) Bayley Scales of Infant Development version III (BSID-III). Developed by Bayley (2006) to access the child's early development under age three, the BSID-III is a golden-standard instrument that is widely used around the world. Previous studies have formally translated the inventory into the Chinese language to adapt to the local context in rural areas (Wang et al., 2019). The cognitive, language and motor subscale scores are based on the child's successful completion of the tasks, while the social-emotional subscale score is based on the caregiver's responses to questions developed from the Greenspan Social-Emotional Growth Chart (Greenspan, 2004). Before the fieldwork, all enumerators had taken a week-long intensive training course on how to administer the BSID-III, but they were all blind to the study. During the fieldwork, the trained enumerators used a detailed scoring sheet and a standardized set of toys to administer the test for each sampled child, when their caregiver was present, but the caregiver was not allowed to help the child. The subscale reliability coefficients are all above 0.8, indicating their adequate internal consistency in the sample (Nunnally, 1978). Higher subscale scores are corresponding to better development outcomes of the child.

3.3. Statistical analysis

The following mediation model was used to estimate the interrelationships between the caregiver's mental health, parenting practices, and child development:

$$development_i = \alpha + \beta_1 dass_i + \beta_2 pinvest_i + \beta_3 pskill_i + \gamma X_i + u_j + \varepsilon_i \quad (1)$$

$$pinvest_i = \alpha + \beta_4 dass_i + \gamma X_i + u_j + \varepsilon_i \quad (2)$$

$$pskill_i = \alpha + \beta_5 dass_i + \gamma X_i + u_j + \varepsilon_i \quad (3)$$

where the dependent variable $development_i$ include the child's four development scores in BSID-III (*cog*, *lang*, *motor*, *soemo*); the independent variable is the caregiver's total DASS-21 score (*dass*) measuring mental health; the two mediate variables are the caregiver's FCI total score (*pinvest*) measuring parental investments and the caregiver's PAFAS total score (*pskill*) measuring parenting skills; the control variables include the socioeconomic characteristics X_i (the child's gender, the child's age, whether the child is born with low weight, the caregiver's age, the caregiver's education, and whether the mother is the primary caregiver), and the county fixed effects (county FE) u_j that account for the unobserved heterogeneity at the county level; and ε_i is the random error term. The coefficient β_1 captures the direct effect of caregiver mental health on the child development. The product term $\beta_2\beta_4$ captures the indirect effect through the parental investment, and $\beta_3\beta_5$ captures the indirect effect through the parenting skill.

Furthermore, to identify which dimension of mental health (depression, anxiety, and stress) harms the caregiver and the child more, the DASS-21 three subscale scores (*dass_d*, *dass_a*, *dass_s*) were used to replace the total DASS-21 score as the independent variables in the model, and indirect effects of the three subscale scores through parental investments and parenting skills were estimated again. Similarly, to identify which component of parental investments and which component of parenting practices strongly mediates in the interrelationship chains, the FCI five subscale scores (*soutoy*, *vartoy*, *playact*, *book*, *magz*) and the PAFAS seven subscale scores (*consist_p*, *coer_p*, *encour_p*, *rela_pc*, *adjust_p*, *rela_fmy*, *team_p*) were then used to replace the FCI total score and the PAFAS total score as mediate variables, and the indirect effects through these mediators were estimated.

To test the statistical significance of the indirect effects, following Preacher and Hayes (2008), three types of 95% confidence interval (CI), including the percentile 95% CI, the bias-corrected (BC) 95% CI, and the bias-corrected and accelerated (BCa) 95% CI, were computed, respectively. The indirect effect is considered statistically significant if the zero does not fall into the range of the CIs.

All statistical analyses were performed by using the statistical software Stata 15.0. p values below 0.05 were considered statistically significant.

4. Results

4.1. Descriptive statistics

Table 1 presents the descriptive statistics in the sample. In terms of child development, the mean ± SD of the child's BSID-III cognitive, language, motor, and social-emotional subscale scores were 96.0 ± 12.6, 92.5 ± 13.5, 97.3 ± 16.5, and 86.0 ± 15.3, respectively. In terms of mental health, the mean ± SD of the caregiver's DASS-21 total score was 9.38 ± 8.50. In terms of parental investments and parenting skills, the mean ± SD of the caregiver's FCI total score and PAFAS total score were 12.77 ± 4.56 and 61.78 ± 7.81, respectively. In terms of socioeconomic characteristics, on average, slightly over half (52%) of children were male; children were < 15 months old; four percent of children had low birth weight; caregivers were around 35 years old; caregivers' completed education was about eight years; 69% of the mother was the primary caregiver in the households.

Table 1
Descriptive statistics ($N = 1787$ for all variables).

Variable	Definition	Mean ± SD
Dependent variable		
cog	child's cognitive subscale score in BSID-III	95.97 ± 12.55
lang	child's language subscale score in BSID-III	92.47 ± 13.50
motor	child's motor subscale score in BSID-III	97.29 ± 16.48
soemo	child's social-emotional subscale score in BSID-III	86.04 ± 15.29
Independent variable		
dass	caregiver's DASS-21 total score	9.38 ± 8.50
Mediate variable		
pinvest	caregiver's FCI total score	12.77 ± 4.56
pskill	caregiver's PAFAS total score	61.78 ± 7.81
Socioeconomic characteristics		
male	1 = child is male, 0 = no	0.52 ± 0.50
month	child's age in months	14.44 ± 5.40
lbw	1 = child is born with low weight, 0 = no	0.04 ± 0.20
cage	caregiver's age	35.38 ± 12.28
cedu	caregiver's completed year of education	8.05 ± 3.32
momcare	1 = mother is the child's primary caregiver, 0 = no	0.69 ± 0.46

4.2. Estimates of the interrelationships

Table 2 presents the estimates of the mediation model. Panel A reports the unadjusted estimates. As presented in row (1), the direct effect of the caregiver's DASS-21 total score on the child's four development outcomes (cognition, language, motor, and social-emotion) are not statistically significant at the 5% level (row 1; columns 1 – 4). The caregiver's FCI total score, however, is positively associated with all four development outcomes of the child at the 1% level (row 2; columns 1 – 4). The caregiver's PAFAS total score is also positively and significantly associated with the child's language score and social-emotional score (row 3; columns 2, 4). In the meantime, the caregiver's DASS-21 total score is negatively associated with the FCI total score (row 1; column 5) and the PAFAS total score (row 1; column 6) at the 1% level.

Panel B reports the adjusted estimates that are almost identical to the unadjusted estimates. One standard deviation (SD) increase in the caregiver's FCI total score is significantly associated with a 0.12 SD, 0.11 SD, 0.12 SD, and 0.11 SD increase in the child's four development scores, respectively (row 5; columns 1 – 4). One SD increase in the caregiver's PAFAS total score is significantly associated with 0.07 SD and 0.23 SD increase in the child's language score and social-emotional score, respectively (row 6; columns 2, 4). In the meantime, one SD increase in the caregiver's DASS-21 total score is significantly associated with 0.05 SD decline in the FCI total score (row 4; column 5), and 0.20 SD decline in the PAFAS total score (row 4; column 6).

4.3. Mediation effects of parental investments and parenting skills

Table 3 presents the estimated indirect effects of the caregiver's DASS-21 total score on the child's BSID-III scores through parental investments and parenting skills based on the adjusted estimates. The indirect effects through parental investments on the child's four development outcomes are all significantly smaller than zero at the 5% level. Through parental investments, one SD increase in the caregiver's DASS-21 total score is significantly associated with the decline in the child's four development scores by 0.6% of one SD, respectively (rows 1 – 4; column 1). Additionally, the zero does not fall into the range of the corresponding 95% CIs (rows 1 – 4; columns 3–5), which strongly suggests that the indirect effects through parental investments are statistically significant. Furthermore, the indirect effects through parenting skills on the child's language and social-emotional development are also significantly negative at the 1% level (rows 6, 8; column 1), which is verified by the corresponding 95% CIs (rows 6, 8; columns 3–5). Through parenting skills, one SD increase in the caregiver's DASS-21

Table 2
Estimates of the interrelationships between the caregiver's DASS-21 total score, FCI total score, PAFAS total score, and the child's BSID-III scores ($N = 1787$).

	cog (1)	***lang*** (2)	***motor*** (3)	***soemo*** (4)	***pinvest*** (5)	***pskill*** (6)
Panel A. Unadjusted estimates						
(1) *dass*	0.006	−0.06	−0.001	−0.02	−0.12***	−0.22***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
(2) *pinvest*	0.13*** (0.02)	0.16*** (0.02)	0.19*** (0.03)	0.10*** (0.02)		
(3) *pskill*	0.06	0.05** (0.02)	−0.01	0.23*** (0.02)		
	(0.03)		(0.02)			
Panel B. Adjusted estimates						
(4) *dass*	0.004	−0.04	−0.04	−0.04	−0.05**	−0.20***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
(5) *pinvest*	0.12*** (0.03)	0.11*** (0.02)	0.12*** (0.02)	0.11*** (0.02)		
(6) *pskill*	0.03	0.07** (0.03)	0.02	0.23*** (0.03)		
	(0.03)		(0.02)			
(7) *male*	−0.06	−0.22***	−0.04	0.009 (0.05)	−0.06	−0.05
	(0.05)	(0.05)	(0.04)		(0.04)	(0.04)
(8) *month*	−0.004 (0.005)	0.03*** (0.005)	0.09*** (0.004)	0.009**	0.03***	−0.02***
				(0.004)	(0.004)	(0.004)
(9) *lbw*	−0.41***	−0.28**	−0.24**	−0.32**	−0.09	−0.06
	(0.14)	(0.13)	(0.10)	(0.13)	(0.13)	(0.15)
(10) *cage*	−0.001	0.0002	−0.004	0.003	0.005	−0.001 (0.003)
	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	
(11) *cedu*	0.02** (0.009)	0.03*** (0.009)	0.02*** (0.008)	−0.005	0.09***	0.03***
				(0.008)	(0.007)	(0.008)
(12) *momcare*	−0.21** (0.11)	−0.05	−0.25*** (0.09)	−0.15	0.23**	−0.13 (0.09)
		(0.11)		(0.10)	(0.10)	
(13) County FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: (i) Standardized coefficients are reported in the table, and robust standard errors clustered at the village level are presented in parentheses. (ii) *** $p < 0.01$; ** $p < 0.05$.

Table 3
Estimates of the indirect effects of the caregiver's DASS-21 total score on the child's BSID-III scores through parental investments and parenting skills ($N = 1787$).

Indirect Effect through mediators	Point Estimate (1)	Bootstrap S. E. (2)	95% CI (Percentile) (3)	95% CI (BC) (4)	95% CI (BCa) (5)
(1) *pinvest* on *cog*	−0.006**	0.003	(−0.01, −0.001)	(−0.01, −0.003)	(−0.01, −0.003)
(2) *pinvest* on *lang*	−0.006**	0.003	(−0.01, −0.001)	(−0.01, −0.001)	(−0.01, −0.001)
(3) *pinvest* on *motor*	−0.006**	0.003	(−0.01, −0.001)	(−0.01, −0.001)	(−0.01, −0.001)
(4) *pinvest* on *soemo*	−0.006**	0.003	(−0.01, −0.001)	(−0.01, −0.001)	(−0.01, −0.001)
(5) *pskill* on *cog*	−0.006	0.005	(−0.01, 0.003)	(−0.01, 0.005)	(−0.01, 0.005)
(6) *pskill* on *lang*	−0.02***	0.004	(−0.02, −0.005)	(−0.02, −0.003)	(−0.02, −0.003)
(7) *pskill* on *motor*	−0.005	0.004	(−0.01, 0.003)	(−0.01, 0.004)	(−0.01, 0.004)
(8) *pskill* on *soemo*	−0.05***	0.009	(−0.07, −0.04)	(−0.07, −0.03)	(−0.07, −0.03)

Notes: (i) The dependent variables are the child's four development scores in BSID-III (*cog*, *lang*, *motor*, *soemo*). The independent variable is the caregiver's total DASS-21 score (*dass*). The two mediators are the caregiver's FCI total score (*pinvest*) and the caregiver's PAFAS total score (*pskill*). (ii) Bootstrap S.E. presented in column (2) is based on resampling with 1000 replications. (iii) *** $p < 0.01$; ** $p < 0.05$.

total score is significantly associated with the decline in the child's language and social-emotional scores by 2% and 5% of one SD, respectively.

Table 4 presents the estimated indirect effects of the caregiver's DASS-21 subscale scores on the child's BSID-III scores through parental investments and parenting skills. For the child's cognitive score (Panel A), the indirect effect of the caregiver's depression subscale score through parental investments is statistically significant, with the effect size of −0.02 SD (row 1). For the child's language score (Panel B), the indirect effects of the caregiver's depression subscale score through both parental investments and parenting skills are statistically significant, with the effect size of −0.02 SD (row 7) and −0,01 SD (row 8), respectively. For the child's motor score (Panel C), the indirect effect of the caregiver's depression subscale score through parental investments is statistically significant, with the effect size of −0.02 SD (row 13). For the child's social-emotional score (Panel D), the indirect effects of the caregiver's depression subscale score through both parental investments and parenting skills are statistically significant, with the effect size of −0.02 SD (row 19) and −0,04 SD (row 20), respectively; and the indirect effect of the caregiver's stress subscale score through parenting skills is also statistically significant, with the effect size of −0.02 SD (row 24).

Table 5 presents the estimated indirect effects of the caregiver's DASS-21 total score on the child's BSID-III scores through different components of parental investments and different components of parenting skills. For the child's cognitive development (Panel A), variety of play materials (row 2), parental consistency (row 6), and coercive parenting (row 7) are significant mediators, through which a one SD increase in the caregiver's DASS-21 total score is associated with the decline in the child's cognitive score by 1%, 0.2%, 1% of one SD, respectively. For the child's language development (Panel B), variety of play materials (row 14) is the strongest mediator, followed by coercive parenting (row 19) and family relationships (row 23), through which a one SD increase in the caregiver's DASS-21 total score is associated with the decline in the child's language score by 2%, 1%, 0.8% of one SD, respectively.

For the child's motor development (Panel C), variety of play materials (row 26) and coercive parenting (row 31) are significant mediators, through which a one SD increase in the caregiver's DASS-21 total score is associated with the decline in the child's motor score by 2% and 1% of one SD, respectively. For the child's social-emotional development (Panel D), variety of play materials (row 38), number of play activities (row 39), coercive parenting (row 43), and parental adjustment (row 46) are significant mediators, through which a one SD increase in the caregiver's DASS-21 total score is associated with the decline in the child's social-emotional score by 0.6%, 0.6%, 1% and 2% of one SD,

Table 4
Estimates of indirect effects of the caregiver's DASS-21 subscale scores on the child's BSID-III scores through parental investments and parenting skills (N = 1787).

Indirect Effect	Point Estimate (1)	Bootstrap S. E. (2)	95% CI (Percentile) (3)	95% CI (BC) (4)	95% CI (BCa) (5)
Panel A. Dependent variable is the child's cognitive score.					
(1) *dass_d* through *pinvest*	−0.02***	0.006	(−0.04, −0.01)	(−0.04, −0.01)	(−0.04, −0.01)
(2) *dass_d* through *pskill*	−0.005	0.004	(−0.01, 0.003)	(−0.01, 0.002)	(−0.01, 0.002)
(3) *dass_a* through *pinvest*	0.006	0.005	(−0.004, 0.02)	(−0.003, 0.02)	(−0.003, 0.02)
(4) *dass_a* through *pskill*	0.001	0.001	(−0.002, 0.003)	(−0.001, 0.005)	(−0.001, 0.005)
(5) *dass_s* through *pinvest*	0.007	0.005	(−0.002, 0.02)	(−0.001, 0.02)	(−0.001, 0.02)
(6) *dass_s* through *pskill*	−0.003	0.003	(−0.008, 0.002)	(−0.009, 0.001)	(−0.009, 0.001)
Panel B. Dependent variable is the child's language score.					
(7) *dass_d* through *pinvest*	−0.02***	0.005	(−0.03, −0.009)	(−0.03, −0.009)	(−0.03, −0.01)
(8) *dass_d* through *pskill*	−0.01***	0.004	(−0.02, −0.004)	(−0.02, −0.004)	(−0.02, −0.007)
(9) *dass_a* through *pinvest*	0.005	0.004	(−0.001, 0.02)	(−0.001, 0.02)	(−0.001, 0.02)
(10) *dass_a* through *pskill*	0.001	0.003	(−0.004, 0.009)	(−0.007, 0.009)	(−0.007, 0.009)
(11) *dass_s* through *pinvest*	0.006	0.004	(−0.004, 0.001)	(−0.001, 0.002)	(−0.001, 0.002)
(12) *dass_s* through *pskill*	−0.007	0.004	(−0.01, 0.001)	(−0.02, 0.001)	(−0.02, 0.001)
Panel C. Dependent variable is the child's motor score.					
(13) *dass_d* through *pinvest*	−0.02***	0.005	(−0.03, −0.01)	(−0.04, −0.01)	(−0.04, −0.01)
(14) *dass_d* through *pskill*	−0.004	0.004	(−0.01, 0.002)	(−0.02, 0.002)	(−0.02, 0.003)
(15) *dass_a* through *pinvest*	0.006	0.005	(−0.001, 0.02)	(−0.001, 0.02)	(−0.001, 0.02)
(16) *dass_a* through *pskill*	0.0004	0.002	(−0.004, 0.002)	(−0.002, 0.009)	(−0.001, 0.01)
(17) *dass_s* through *pinvest*	0.007	0.004	(−0.002, 0.01)	(−0.002, 0.02)	(−0.002, 0.02)
(18) *dass_s* through *pskill*	−0.002	0.002	(−0.007, 0.001)	(−0.008, 0.001)	(−0.007, 0.002)
Panel D. Dependent variable is the child's social-emotional score.					
(19) *dass_d* through *pinvest*	−0.02***	0.006	(−0.03, −0.007)	(−0.03, −0.003)	(−0.03, −0.003)
	−0.04***	0.01			
(20) *dass_d* through *pskill*			(−0.05, −0.02)	(−0.05, −0.02)	(−0.06, −0.02)
(21) *dass_a* through *pinvest*	0.006	0.003	(−0.003, 0.01)	(−0.001, 0.01)	(−0.001, 0.01)
(22) *dass_a* through *pskill*	0.004	0.01	(−0.01, 0.03)	(−0.01, 0.02)	(−0.01, 0.03)
(23) *dass_s* through *pinvest*	0.006	0.004	(−0.001, 0.02)	(−0.002, 0.02)	(−0.002, 0.02)
(24) *dass_s* through *pskill*	−0.02**	0.01	(−0.04, −0.005)	(−0.04, −0.003)	(−0.05, −0.003)

Notes: (i) The estimation is based on the SEM with control variables. (ii) The independent variables are the caregiver's DASS-21 three subscale scores (*dass_d*, *dass_a*, *dass_s*). The two mediators are the caregiver's FCI total score (*pinvest*) and the caregiver's PAFAS total score (*pskill*). (iii) *** $p < 0.01$; ** $p < 0.05$.

respectively.

4.4. Robustness check

In order to check robustness of above estimation results for the mediation model, the structural equation modeling (SEM) was also used to estimate the interrelationships between the caregiver's mental health, parenting practices, and child development. As presented in Fig. 1, the results are identical to the unadjusted estimates of the mediation model reported in Panel A, Table 2. The caregiver's DASS-21 total score is negatively associated with the FCI total score and the PAFAS total score, with the effect size of 0.12 SD and 0.22 SD, respectively. In the meantime, the caregiver's FCI total score is positively associated with all four development outcomes of the child. One SD increase in the caregiver's FCI total score is significantly associated with a 0.13 SD, 0.16 SD, 0.20 SD, and 0.10 SD increase in the child's cognitive, language, motor, social-emotional development, respectively. The caregiver's PAFAS total score is also positively and significantly associated with the child's language score and social-emotional score, with the effect size of 0.04 SD and 0.23 SD, respectively. The SEM estimation results verify robustness of the estimates for the mediation model.

5. Discussion

This paper investigates how parenting practices mediate between the caregiver's mental health and the child's early development outcomes, in rural households of China. The evidence showed that parental investments strongly mediate between the caregiver's mental health and the child's four development outcomes, and parenting skills significantly mediate between the caregiver's mental health and the child's language and social-emotional development. In addition, compared with the anxiety and stress, the caregiver's depression degree does greater harm to both the caregiver's parenting practices and the child's early development. Furthermore, among measures of parental investments, the variety of play materials has significant mediation effects for all four development outcomes of the child, while the number of play activities only strongly mediate for the child's social-emotional development. Among measures of parenting skills, coercive parenting is the major channel through which the caregiver's mental health is linked to the child's early development.

The findings of this paper indicate that worse mental health outcome

Table 5
Estimates of the indirect effects of the caregiver's DASS-21 total score on the child's BSID-III scores through different components of parental investments and different components of parenting skills ($N = 1787$).

Indirect Effect through mediators	Point Estimate	Bootstrap S. E.	95% CI (Percentile)	95% CI (BC)	95% CI (BCa)
	(1)	(2)	(3)	(4)	(5)
Panel A. Dependent variable is the child's cognitive score.					
(1) *soutoy*	0.003	0.002	(−0.001, 0.006)	(−0.002, 0.006)	(−0.002, 0.007)
(2) *vartoy*	−0.01***	0.004	(−0.02, −0.004)	(−0.02, −0.005)	(−0.02, −0.005)
(3) *playact*	0.001	0.002	(−0.004, 0.01)	(−0.005, 0.01)	(−0.005, 0.01)
(4) *book*	−0.001	0.001	(−0.003, 0.002)	(−0.004, 0.002)	(−0.004, 0.002)
(5) *magz*	−0.002	0.002	(−0.004, 0.002)	(−0.004, 0.001)	(−0.004, 0.001)
(6) *consist_p*	−0.002**	0.001	(−0.01, −0.001)	(−0.01, −0.001)	(−0.01, −0.001)
(7) *coer_p*	−0.01**	0.006	(−0.03, −0.002)	(−0.03, −0.004)	(−0.03, −0.004)
(8) *encour_p*	0.001	0.002	(−0.002, 0.005)	(−0.001, 0.007)	(−0.001, 0.007)
(9) *rela_pc*	−0.0002	0.001	(−0.002, 0.002)	(−0.002, 0.002)	(−0.002, 0.002)
(10) *adjust_p*	0.004	0.007	(−0.01, 0.02)	(−0.01, 0.02)	(−0.01, 0.02)
(11) *rela_fmy*	0.001	0.006	(−0.01, 0.006)	(−0.01, 0.007)	(−0.01, 0.007)
(12) *team_p*	−0.006	0.004	(−0.009, 0.003)	(−0.009, 0.003)	(−0.009, 0.003)
Panel B. Dependent variable is the child's language score.					
(13) *soutoy*	0.001	0.001	(−0.001, 0.002)	(−0.001, 0.003)	(−0.001, 0.003)
(14) *vartoy*	−0.02***	0.004	(−0.03, −0.008)	(−0.03, −0.007)	(−0.03, −0.007)
(15) *playact*	−0.001	0.002	(−0.01, 0.003)	(−0.01, 0.002)	(−0.01, 0.002)
(16) *book*	−0.0002	0.001	(−0.003, 0.003)	(−0.002, 0.004)	(−0.002, 0.004)
(17) *magz*	−0.001	0.002	(−0.007, 0.003)	(−0.007, 0.002)	(−0.007, 0.002)
(18) *consist_p*	−0.001	0.001	(−0.003, 0.002)	(−0.003, 0.002)	(−0.003, 0.004)
(19) *coer_p*	−0.01***	0.004	(−0.02, −0.004)	(−0.03, −0.006)	(−0.03, −0.006)
(20) *encour_p*	−0.002	0.002	(−0.004, 0.002)	(−0.005, 0.002)	(−0.005, 0.002)
(21) *rela_pc*	0.0002	0.003	(−0.006, 0.002)	(−0.006, 0.001)	(−0.006, 0.001)
(22) *adjust_p*	0.002	0.006	(−0.01, 0.02)	(−0.01, 0.02)	(−0.01, 0.02)
(23) *rela_fmy*	−0.008**	0.005	(−0.02, −0.001)	(−0.02, −0.002)	(−0.02, −0.002)
(24) *team_p*	0.006	0.004	(−0.001, 0.02)	(−0.001, 0.02)	(−0.001, 0.02)
Panel C. Dependent variable is the child's motor score.					
(25) *soutoy*	0.002	0.001	(−0.002, 0.003)	(−0.002, 0.002)	(−0.002, 0.002)
(26) *vartoy*	−0.02***	0.006	(−0.04, −0.01)	(−0.04, −0.01)	(−0.04, −0.01)
(27) *playact*	−0.001	0.002	(−0.01, 0.001)	(−0.01, 0.001)	(−0.01, 0.001)
(28) *book*	−0.001	0.001	(−0.002, 0.004)	(−0.001, 0.005)	(−0.001, 0.005)
(29) *magz*	−0.0003	0.001	(−0.004, 0.005)	(−0.004, 0.005)	(−0.004, 0.005)
(30) *consist_p*	−0.001	0.001	(−0.003, 0.002)	(−0.003, 0.001)	(−0.003, 0.001)
(31) *coer_p*	−0.01**	0.006	(−0.02, −0.002)	(−0.02, −0.003)	(−0.02, −0.003)
(32) *encour_p*	0.002	0.002	(−0.002, 0.006)	(−0.002, 0.008)	(−0.002, 0.008)
(33) *rela_pc*	0.001	0.001	(−0.002, 0.003)	(−0.001, 0.003)	(−0.001, 0.003)
(34) *adjust_p*	0.007	0.006	(−0.007, 0.02)	(−0.007, 0.02)	(−0.007, 0.02)
(35) *rela_fmy*	−0.003	0.005	(−0.02, 0.004)	(−0.02, 0.005)	(−0.02, 0.005)
(36) *team_p*	−0.002	0.004	(−0.009, 0.008)	(−0.009, 0.008)	(−0.01, 0.008)
Panel D. Dependent variable is the child's social-emotional score.					
(37) *soutoy*	−0.0003	0.001	(−0.004, 0.001)	(−0.004, 0.001)	(−0.004, 0.001)
(38) *vartoy*	−0.006***	0.002	(−0.01, −0.002)	(−0.01, −0.001)	(−0.01, −0.001)
(39) *playact*	−0.006**	0.003	(−0.01, −0.004)	(−0.01, −0.002)	(−0.01, −0.002)
(40) *book*	−0.0002	0.001	(−0.003, 0.001)	(−0.003, 0.001)	(−0.003, 0.001)
(41) *magz*	−0.001	0.001	(−0.003, 0.004)	(−0.003, 0.006)	(−0.003, 0.006)
(42) *consist_p*	0.001	0.001	(−0.001, 0.006)	(−0.001, 0.007)	(−0.001, 0.007)
(43) *coer_p*	−0.01**	0.006	(−0.03, −0.003)	(−0.03, −0.002)	(−0.03, −0.003)
(44) *encour_p*	0.005	0.004	(−0.001, 0.01)	(−0.001, 0.01)	(−0.001, 0.02)
(45) *rela_pc*	−0.004	0.004	(−0.01, 0.003)	(−0.01, 0.003)	(−0.01, 0.003)
(46) *adjust_p*	−0.02**	0.008	(−0.03, −0.002)	(−0.03, −0.002)	(−0.03, −0.002)
(47) *rela_fmy*	−0.002	0.006	(−0.01, 0.007)	(−0.01, 0.006)	(−0.01, 0.006)
(48) *team_p*	−0.003	0.004	(−0.01, 0.007)	(−0.01, 0.005)	(−0.01, 0.005)

Notes: (i) The estimation is based on the SEM with control variables. (ii) The independent variable is the caregiver's total DASS-21 score (*dass*). The mediators are the FCI five subscale scores (*soutoy*, *vartoy*, *playact*, *book*, *magz*) and the PAFAS seven subscale scores (*consist_p*, *coer_p*, *encour_p*, *rela_pc*, *adjust_p*, *rela_fmy*, *team_p*). (iii) *** $p < 0.01$; ** $p < 0.05$.

of the caregiver, especially the depression, is detrimental to early child development in rural China. This adds to the existing literature around the world on the relationships between maternal depression and ECD outcomes. In developed countries, the children whose mother suffered from depression had poor cognitive development (e.g., Cogill, Caplan, Alexandra, Robson, & Kumar, 1986). Similar problems also existed in developing countries (e.g., Petterson & Albers, 2001).

As shown by the key findings, the important pathways between the caregiver's mental health and ECD outcomes are parental investments and parenting skills. Worse mental health would decrease parental investments and decline the parenting skills. In the meantime, the deteriorated parenting practices of the caregiver would be accompanied by worse ECD outcomes of the child. This is in line with one branch of evidence on that the caregiver who has mental health problems is less likely to engage in positive parenting practices, such as singing songs and playing with the child (Lovejoy, Graczyk, O'Hare, & Neuman, 2000). It is also consistent with the other branch of evidence on the positive associations between parenting practices and child development in cognition, personality, and behaviors (Francesconi & Heckman, 2016).

Furthermore, the findings show the heterogeneous roles of different components of parental investments and parenting skills in the interrelationships. In terms of components of parental investments, on the one hand, play materials are essential to early child development (Wang & Yue, 2019; Wang & Zheng, 2019). The caregiver with worse mental health, however, would provide fewer varieties of play materials to the

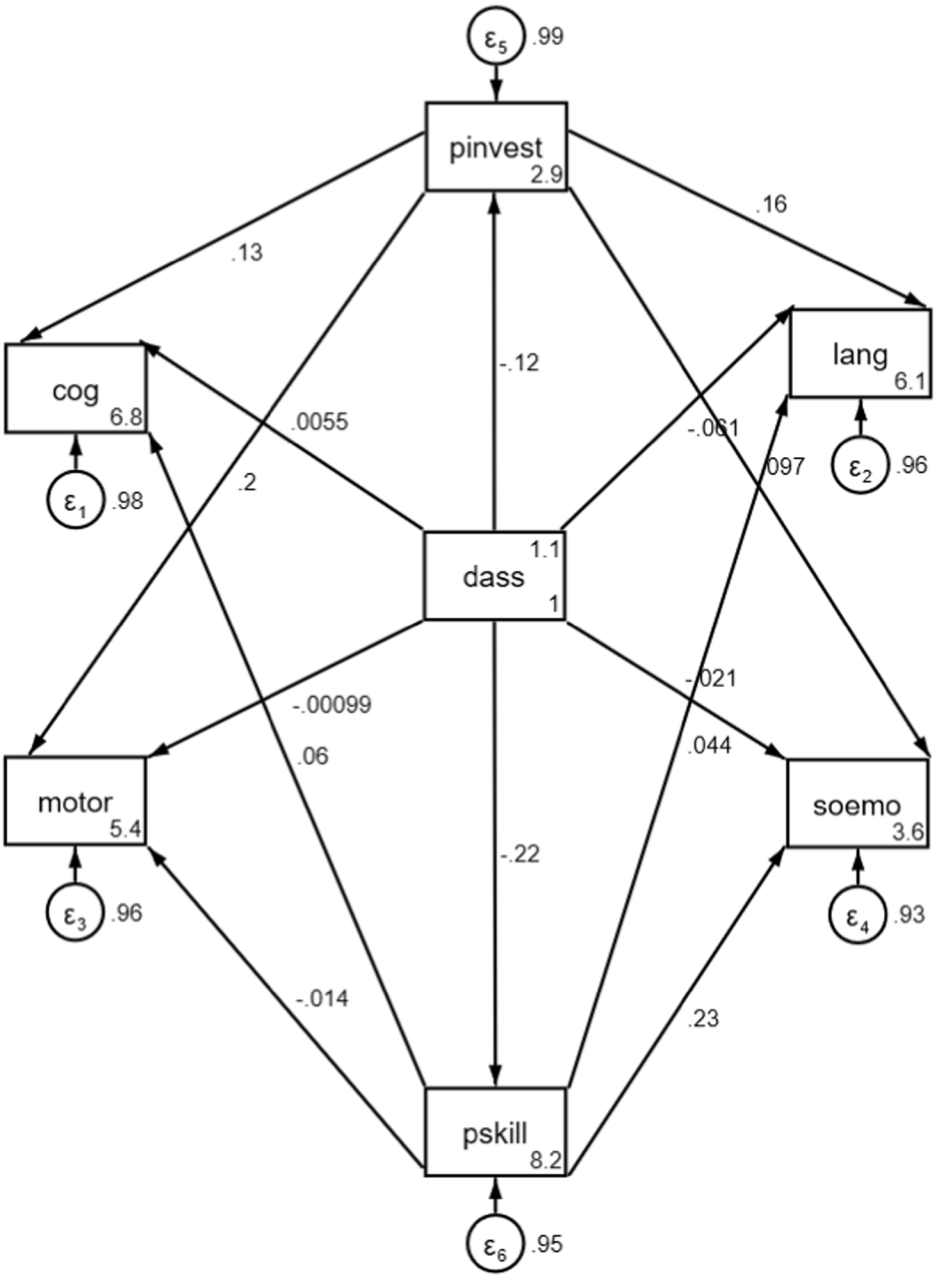

Fig. 1. Structural equation modeling (SEM) for the mediation model. Note: (i) This figure was drawn by using the SEM builder in the software Stata 15.0. (ii) The independent variable is the caregiver's total DSAA-21 score (*dass*). The two mediators are the caregiver's FCI total score (*pinvest*) and the caregiver's PAFAS total score (*pskill*). The dependent variables are the child's four development scores in BSID-III (*cog*, *lang*, *motor*, *soemo*).

child, which in turn, hinders the child's early development in cognition, language, motor, and social-emotion. It is noteworthy that the channel through sources of play materials is not significant. This is in line with Hamadani et al. (2010), which found that sources of play materials cannot significantly predict ECD outcomes of the children in Bangladesh.

On the other hand, play activities are also productive parental investments for early child development, in both developed countries (Del Bono, Francesconi, Kelly, & Sacker, 2016; Fiorini & Keane, 2014) and developing countries (Luo et al., 2017; Yue et al., 2017, 2019). The caregiver with worse mental health, however, would engage in fewer play activities, which are corresponding to the worse social-emotional development of the child. A child's early social-emotional development could improve the cognitive function in the adolescence, and has more lasting influences on the long-term welfares in adulthood (Francesconi & Heckman, 2016). This adds to the existing evidence on the key role of the play-based learning during early childhood for the child development (e.g., Synodi, 2010).

In terms of components of parenting skills, the caregiver with worse mental health would adopt more coercive parenting behaviors, which are harmful to the child's early development. This is consistent with the previous researches showing that coercive parenting behaviors are positively correlated with the child's maladjustment, including emotional problems and behavioral problems, in both developed countries (Sanders et al., 2014) and developing countries (Sumargi et al., 2018).

This study might contribute to the existing knowledge by exploring the black box of how caregiver's mental health is linked to child's early development outcomes via parental investments and parenting skills, and by examining how different dimensions of mental health and

different components of parental investments and parenting skills work in the interrelationship chains. This study could be informative for the policymakers to improve early child development services in rural China and might shed light on future studies on similar issues with similar contexts.

Although the findings of this study are informative, it has two major limitations as follows. One limitation is the methodological issue. Due to its cross-sectional nature, the estimation results of this study do not interpret the causal inference between caregiver mental health, parenting practices, and child development, even though the estimates are indeed helpful to understand their interrelationships. Another limitation is the sample size. As the sample data in this study was collected from only one typical underdeveloped area in rural China, which cannot represent whole China, the results could not be generalizable to other settings.

This study offered future studies two broad perspectives. For one thing, future studies based on a longitudinal dataset could use other advanced regression analysis to examine the causal links between caregiver mental health, parenting practices, and early child development. For another thing, future studies could collect more representative sample for general population in whole China with abundant sample size, so that generalizable conclusions could be applied across China.

6. Conclusion

In summary, this paper demonstrated that parenting practices strongly mediate between caregiver mental health and ECD outcomes in rural households. The key findings of this study have some important policy implications. Targeted interventions to examine and improve caregiver's mental health at a child's early age, such as delivering the home-visit mental health checks and village-based mental health care services, may be effective to improve the parenting practices and boost child development in rural households. For the caregivers who are at higher risk of mental health problems, the training aimed at improving parenting practices, especially those aimed at increasing the varieties of play materials and the play activities in the households and decreasing the caregiver's coercive parenting behaviors, might be also helpful to early childhood development there.

CRediT authorship contribution statement

Jingdong Zhong: Methodology, Formal analysis, Writing - original draft, Writing - review & editing. **Tianyi Wang:** Formal analysis, Software. **Yang He:** Visualization, Validation. **Jingjing Gao:** Formal analysis, Project administration. **Chengfang Liu:** Supervision, Writing - review & editing. **Fang Lai:** Writing - review & editing. **Liuxiu Zhang:** Funding acquisition. **Renfu Luo:** Conceptualization, Resources, Investigation, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

The team would like to gratefully acknowledge the participants in this study for their cooperation. This research was funded by the National Natural Science Foundation of China, China (Grant Nos. 71873008), the UBS Optimus Foundation (switzerland, Grants Nos. 10969), and the International Initiative for Impact Evaluation (Grants Nos. PW3.06.CH.IE).

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.childyouth.2020.105855.

References

Almond, D., & Currie, J. (2011). Human capital development before age five. In *Handbook of Labor Economics* (Vol. 4, pp. 1315–1486). Elsevier.

Almond, D., Currie, J., & Duque, V. (2018). Childhood circumstances and adult outcomes: Act II. *Journal of Economic Literature, 56*(4), 1360–1446.

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment, 10*, 176.

Bayley, N. (2006). Bayley Scales of Infant and Toddler Development: Administration Manual (3rd ed.). Harcourt Assessment: San Antonio, TX, USA. https://www.pearsonassessments.com/store/usassessments/en/Store/Professional-Assessments/Behavior/Adaptive/Bayley-Scales-of-Infant-and-Toddler-Development-%7C-Third-Edition/p/100000123.html (Accessed May 2020).

Camacho, A. (2008). Stress and birth weight: Evidence from terrorist attacks. *American Economic Review: Papers and Proceedings, 98*(2), 511–515.

Campbell, F., Conti, G., Heckman, J. J., Moon, S. H., Pinto, R., Pungello, E., & Pan, Y. (2014). Early childhood investment substantially boost adult health. *Science, 343*, 1478–1485.

Carneiro, P., & Heckman, J. J. (2002). The evidence on credit constraints in post-secondary schooling. *The Economic Journal, 112*(482), 705–734.

Cogill, S. R., Caplan, H. L., Alexandra, H., Robson, K. M., & Kumar, R. (1986). Impact of maternal postnatal depression on cognitive development of young children. *British Medical Journal, 292*, 1165–1167.

Clutton-Brock, T. H. (1991). *The Evolution of Parental Care*. Princeton, NJ, USA: Princeton University Press.

Crook, S. R., & Evans, G. W. (2014). The role of planning skills in the income–achievement gap. *Child Development, 85*(2), 405–411.

Cunha, F., Heckman, J. J., Lochner, L., & Masterov, D. V. (2006). Interpreting the evidence on life cycle skill formation. *Handbook of the Economics of Education, 1*, 697–812.

Currie, J., & Rossin-Slater, M. (2013). Weathering the storm: Hurricanes and birth outcomes. *Journal of Health Economics, 32*(3), 487–503.

Dahl, G. B., & Lochner, L. (2012). The impact of family income on child achievement: Evidence from the earned income tax credit. *American Economic Review, 102*(5), 1927–1956.

Davis, E. P., & Sandman, C. A. (2012). Prenatal psychobiological predictors of anxiety risk in preadolescent children. *Psychoneuroendocrinology, 37*(8), 1224–1233.

Del Bono, E., Francesconi, M., Kelly, Y., & Sacker, A. (2016). Early maternal time investment and early child outcomes. *Economic Journal, 126*, F96–F135.

Eskenazi, B., Marks, A. R., Catalano, R., Bruckner, T., & Toniolo, P. G. (2007). Low birthweight in New York City and upstate New York following the events of September 11th. *Human Reproduction, 22*(11), 3013–3020.

Fan, P., Pei, J., & Hou, Z. (2013). The discussion of current mental health status and mental health management strategy in China. *Journal of Practical Medical Techniques, 20*(8), 911–912.

Feldman, R., Granat, A., Pariente, C., Kanety, H., Kuint, J., & Gilboa-Schechtman, E. (2009). Maternal depression and anxiety across the postpartum year and infant social engagement, fear regulation, and stress reactivity. *Journal of the American Academy of Child & Adolescent Psychiatry, 48*(9), 919–927.

Fernald, L. C., 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.

Fernald, L. C., Weber, A., Galasso, E., & Ratsifandrihamanana, L. (2011). Socioeconomic gradients and child development in a very low income population: Evidence from Madagascar. *Developmental Science, 14*(4), 832–847.

Field, T. (2010). Postpartum depression effects on early interactions, parenting, and safety practices: A review. *Infant Behavior and Development, 33*(1), 1–6.

Fiorini, M., & Keane, M. P. (2014). How the allocation of children's time affects cognitive and non-cognitive development. *Journal of Labor Economics, 4*, 787–836.

Francesconi, M., & Heckman, J. J. (2016). Child development and parental investment: Introduction. *Economic Journal, 126*, F1–F27.

Frank, R. G., & Meara, E. (2009). *The effect of maternal depression and substance abuse on child human capital development, No. w15314*. National Bureau of Economic Research.

Frongillo E. A., Sywulka S. M., & Kariger P. (2003). UNICEF psychosocial care indicators project. Final report to UNICEF. Ithaca, NY: Division of Nutritional Sciences, Cornell University. https://scholar.google.com/scholar_lookup?title=UNICEF+psychosocial+care+indicators+project.+Final+report+to+UNICEF&author=EA+Frongillo&author=SM+Sywulka&author=P+Kariger&publication_year=2003& (Accessed May 2020).

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*, 998–1001.

Glover, V., O'connor, T. G., & O'Donnell, K. (2010). Prenatal stress and the programming of the HPA axis. *Neuroscience & Biobehavioral Reviews, 35*(1), 17–22.

Greenspan, S. I. (2004). Greenspan social-emotional growth chart: A screening questionnaire for infants and young children. Harcourt Assessment: San Antonio, TX,

USA. https://www.pearsonclinical.ca/en/products/product-master/item-80.html (Accessed May 2020).
Guo, M., Morawska, A., & Filus, A. (2017). Validation of the parenting and family adjustment scales to measure parenting skills and family adjustment in Chinese parents. *Measurement and Evaluation in Counseling and Development, 50*, 139–154.
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, and Nutrition, 28*, 23–33.
Hamadani, J. D., Tofail, F., Huda, S. N., Alam, D. S., Ridout, D. A., Attanasio, O., & Grantham-McGregor, S. M. (2014). Cognitive deficit and poverty in the first 5 years of childhood in Bangladesh. *Pediatrics, 134*(4), e1001–e1008.
Heckman, J. J. (2006). Skill formation and the economics of investing in disadvantaged children. *Science, 312*, 1900–1902.
Heckman, J. J. (2007). The economics, technology, and neuroscience of human capability formation. *Proceedings of the National Academy of Sciences, 104*, 13250–13255.
Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology, 44*, 227–239.
Hsieh, C. R., Liu, S., & Qin, X. (2019). The Hidden Costs of Mental Depression: Implications on Social Trust and Life Satisfaction. *Manchester School, 87*, 259–296.
Hsieh, C. R., & Qin, X. (2018). Depression hurts, depression costs: The medical spending attributable to depression and depressive symptoms in China. *Health Economics, 27*, 525–544.
Jonas, W., Mileva-Seitz, V., Girard, A. W., Bisceglia, R., Kennedy, J. L., Sokolowski, M., … MAVAN Research Team. (2013). Genetic variation in oxytocin rs2740210 and early adversity associated with postpartum depression and breastfeeding duration. *Genes, Brain and Behavior, 12*(7), 681–694.
Jones, I., Chandra, P. S., Dazzan, P., & Howard, L. M. (2014). Bipolar disorder, affective psychosis, and schizophrenia in pregnancy and the post-partum period. *The Lancet, 384*(9956), 1789–1799.
Larson, K., Russ, S. A., Nelson, B. B., Olson, L. M., & Halfon, N. (2015). Cognitive ability at kindergarten entry and socioeconomic status. *Pediatrics, 135*(2), e440–e448.
Lovejoy, M. C., Graczyk, P. A., O'Hare, E., & Neuman, G. (2000). Maternal depression and parenting behavior: A meta-analytic review. *Clinical Psychology Review, 20*, 561–592.
Luo, R., Jia, F., Yue, A., Zhang, L., Lyu, Q., Shi, Y., … Rozelle, S. (2017). Passive parenting and its association with early child development. *Early Child Development and Care, 189*, 1709–1723.
Murray, L., Cooper, P., Creswell, C., Schofield, E., & Sack, C. (2007). The effects of maternal social phobia on mother–infant interactions and infant social responsiveness. *Journal of Child Psychology and Psychiatry, 48*(1), 45–52.
Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.). New York, NY: McGraw-Hill.
Pawlby, S., Hay, D., Sharp, D., Waters, C. S., & Pariante, C. M. (2011). Antenatal depression and offspring psychopathology: The influence of childhood maltreatment. *The British Journal of Psychiatry, 199*(2), 106–112.
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.
Pearson, R. M., Melotti, R., Heron, J., Joinson, C., Stein, A., Ramchandani, P. G., & Evans, J. (2012). Disruption to the development of maternal responsiveness? The impact of prenatal depression on mother–infant interactions. *Infant Behavior and Development, 35*(4), 613–626.
Petterson, S. M., & Albers, A. B. (2001). Effects of poverty and maternal depression on early child development. *Child Development, 72*, 1794–1813.
Persson, P., & Rossin-Slater, M. (2018). Family ruptures, stress, and the mental health of the next generation. *American Economic Review, 108*(4–5), 1214–1252.
Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*, 879–891.
Qin, X., Wang, S., & Hsieh, C. R. (2018). The prevalence of depression and depressive symptoms among adults in China: Estimation based on a National Household Survey. *China Economic Review, 51*, 271–282.
Rice, F., Harold, G. T., Boivin, J., Van den Bree, M., Hay, D. F., & Thapar, A. (2010). The links between prenatal stress and offspring development and psychopathology: Disentangling environmental and inherited influences. *Psychological Medicine, 40*(2), 335–345.
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.
Sanders, M. R., Morawska, A., Haslam, D. M., Filus, A., & Fletcher, R. (2014). Parenting and Family Adjustment Scales (PAFAS): Validation of a brief parent-report measure for use in assessment of parenting skills and family relationships. *Child Psychiatry & Human Development, 45*, 255–272.
Schofield, D. J., Shrestha, R. N., Percival, R., Passey, M. E., Callander, E. J., & Kelly, S. J. (2011). The personal and national costs of mental health conditions: Impacts on income, taxes, government support payments due to lost labour force participation. *BMC Psychiatry, 11*(1), 72.
Stanley, C., Murray, L., & Stein, A. (2004). The effect of postnatal depression on mother–infant interaction, infant response to the still-face perturbation, and performance on an instrumental learning task. *Development and Psychopathology, 16*(1), 1–18.
Stein, A., Craske, M. G., Lehtonen, A., Harvey, A., Savage-McGlynn, E., Davies, B., … Counsell, N. (2012). Maternal cognitions and mother–infant interaction in postnatal depression and generalized anxiety disorder. *Journal of Abnormal Psychology, 121*(4), 795.
Stein, A., Pearson, R. M., Goodman, S. H., Rapa, E., Rahman, A., McCallum, M., … Pariante, C. M. (2014). Effects of perinatal mental disorders on the fetus and child. *Lancet, 384*(9956), 1800–1819.
Sumargi, A., Filus, A., Morawska, A., & Sofronoff, K. (2018). The Parenting and Family Adjustment Scales (PAFAS): An Indonesian Validation Study. *Journal of Child and Family Studies, 27*, 756–770.
Synodi, E. (2010). Play in the Kindergarten: The Case of Norway, Sweden, New Zealand and Japan. *International Journal of Early Years Education, 18*, 185–200.
Torche, F. (2011). The effect of caregiver's mental stress on birth outcomes: Exploiting a natural experiment. *Demography, 48*(4), 1473–1491.
Tronick, E., & Reck, C. (2009). Infants of depressed mothers. *Harvard Review of Psychiatry, 17*(2), 147–156.
Wang, B., & Yue, A. (2019). *The relationship between family environment and early child development in rural China (REAP working paper)*. Stanford, CA: Stanford University.
Wang, K., Shi, H. S., Geng, F. L., Zou, L. Q., Tan, S. P., Wang, Y., … Chan, R. C. (2016). Cross-cultural validation of the Depression Anxiety Stress Scale–21 in China. *Psychological Assessment, 28*, e88.
Wang, L., & Zheng, L. (2019). *Family care and early childhood development: Evidence from china's four rural subpopulations (REAP working paper)*. Stanford, CA: Stanford University.
Wang, L., Liang, W., Zhang, S., Jonsson, L., Li, M., Yu, C., … Luo, R. (2019). Are infant/toddler developmental delays a problem across rural China? *Journal of Comparative Economics, 47*, 458–469.
Yue, A., Shi, Y., Luo, R., Chen, J., Garth, J., Zhang, J., … Rozelle, S. (2017). China's invisible crisis: Cognitive delays among rural toddlers and the absence of modern parenting. *China Journal, 78*, 50–80.
Yue, A., Shi, Y., Luo, R., Wang, B., Weber, A., Medina, A., Kotb, S., & Rozelle, S. (2019). Stimulation and Early Child Development in China: Caregiving at Arm's Length. *Journal of Developmental and Behavioral Pediatrics, 40*, 458–467.
Zhang, S., Dang, R., Yang, N., Bai, Y., Wang, L., Abbey, C., & Rozelle, S. (2018). Effect of Caregiver's Mental Health on Early Childhood Development across Different Rural Communities in China. *International Journal of Environmental Research and Public Health, 15*, 2341.