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## Article

## Inequalities in socio-emotional development and positive parenting during childhood: Evidence from China 2010–2014

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## A B S T R A C T

Socio-emotional development (SED) is a critical dimension of early childhood development (ECD). However, little research has been conducted thus far regarding inequalities across family income status in children's SED and positive parenting scores in China, which has the second largest population of children in the world. Using nationally representative data from the China Family Panel Survey (CFPS), we addressed this knowledge gap by assessing the levels and trends of inequalities in children's SED scores and positive parenting scores across wealth quintiles between 2010 and 2014. Positive parenting was measured for (1) children aged two and younger (PP\_younger) and (2) children between the ages of three and five (PP\_older). We adopted five inequality measures, including both absolute and relative measures. We found that, between 2010 and 2014, SED scores significantly increased for all five wealth quintiles, with the first quintile (Q1, the lowest income) growing the fastest. Consequently, observed inequalities in SED scores between Q1 and the fifth wealth quintile (Q5, the highest income) no longer existed in 2014. For the two parenting scores, we observed a significant reduction in inequality between Q1 and Q5, from 1.03 (95% CI: 0.71–1.35) in 2010 to 0.51 (95% CI: 0.27–0.74) in 2014 for PP\_younger and from 1.28 (95% CI: 1.09–1.47) in 2010 to 0.53 (95% CI: 0.37–0.70) in 2014 for PP\_older. These changes are due to larger increases in scores for children in Q1 compared to Q5 during this time period. These results are highly consistent over different inequality measurements and indicate that both the absolute level and the equality status of young children's SED score and parenting score experienced improvement during the study period. This suggests that China's large investments since 2010 in pre-primary education may have yielded their desired results. Future research should further investigate the association between positive parenting and SED.

## Introduction

Childhood is a formative stage of life, critical to an individual's future health, academic achievement, productivity, and success (Belli, Bustreo, & Preker, 2017; Chang, Walker, Grantham-McGregor, & Powell, 2017; Glewwe, Jacoby, & King, 2017; Currie, Stabile, Manivong, & Roos, 2017; Victora et al., 2017). The Sustainable Development Goals (SDG) prioritizes improving early childhood development (ECD) as a primary focus for the next 15 years (World Health Organization, 2016; Barros, Ewerling, Lombardi, Barros, & Strupp, 2017), with equality being a central tenet of the SDG era (World Health Organization, 2016; Barros et al., 2017).

Socio-emotional development (SED) is a fundamental part of a child's overall health and well-being, as it impacts brain

development and later-life outcomes in mental and physical health, such as school performance, productivity, etc (Aratani & Cooper., 2017; Evans & English, 2017; Heckman, Pinto, & Savelyev, 2017; Jones, Greenberg, & Crowley, 2017; Denham, 2017). Inequalities in SED can impose the severe challenge of a lack of "equity from the start," and place children in poor families in a vicious circle of poverty (Marmot, Friel, Bell, Houweling, & Taylor, 2017; World Health Organization, 2018). There is mounting evidence from developed countries showing that children's SED scores are significantly higher if their parents are white, better educated, have higher social class, or if their families are wealthier (McLoyd, 1990; Chaux, Molano, & Podlesky, 2009; Votruba-drzal, 2006). However, inequalities in children's SED in developing countries remain mostly unexplored, largely due to a lack of available data.

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Recent studies seeking to understand the determinants of children's SED found that parents' investing time into performing enriching activities with their children is an important predictor of children's SED (Anthony et al., 2017; Weisleder et al., 2017; Weisleder et al., 2017; Calderon, 2000; McWayne, Hampton, Fantuzzo, Cohen, & Sekino, 2004). Evidence from the United States shows that economically advantaged parents display more optimal parenting behaviors by spending more time engaging their children in developmentally enhancing activities, while parents from lower-income families tend to let their children develop without concerted parental intervention (McLoyd, 1990; Lareau, 2011). However, as is the case with most research on inequalities in childhood SED, the vast majority of studies on positive parenting inequalities originated in developed countries, leaving a dearth of information regarding such disparities in developing countries. Our study aims to address this knowledge gap by measuring the inequalities in children's SED and positive parenting scores by wealth quintile using nationally-representative data from the China Family Panel Study (CFPS).

China had 86 million children under five years old in 2015, accounting for 13% of the world under five population (United Nations, 2017). According to a recent study, while China has made progress in reducing the number of children under age five who are at risk of poor early development, it remained the country with the second largest number of at risk children (17 million [nearly 20%] of young children in China) in 2010, behind India (Lu, Black, & Richter, 2017). In 2010, the Chinese Ministry of Education, in partnership with the United Nations Children's Fund (UNICEF), launched its first national early childhood advocacy month and explicitly prioritized early childhood development (UNICEF, 2018). Since 2010, the Chinese government has increased its financial investments in early childhood education and preschool/kindergarten education, from 36.1 billion yuan (around \$5.3 billion USD) in 2010 to 90.3 billion yuan (around \$30.3 billion USD) in 2014.<sup>1</sup> (Ministry of Education of The People's Republic of China, 2015; National Bureau of Statistics of People's Republic of China, 2018) To understand the progress in children's socio-emotional development between 2010 and 2014, this study takes advantage of the CFPS data at the national level and investigates the levels and trends of inequalities in children's SED and positive parenting scores in China.

## Methods and measures

### Sample

We obtained data on children's wealth status, SED, positive parenting scores, and children's socioeconomic and demographic characteristics from the CFPS. The CFPS is the first nationally representative survey designed to characterize China's ongoing social transformation by collecting data at the community, family, and individual levels (Xie & Hu, 2018). The CFPS was first launched in 2010 and has since been conducted every two years. We obtained the CFPS data from 2010, 2012, and 2014. A total of 10,236 records were generated across all three years of data collection for children aged 0–5 years old (0–59 months), including 3343 children in 2010, 3411 children in 2012, 3482 children in 2014. The number of observations for each research indicator is presented in Table 1. CFPS did not track a cohort of children for their socio-emotional development and positive parenting over time, but conducted surveys on children of the same age in different survey rounds. Therefore, different cohorts were interviewed in each survey round for SED and parenting questions. Thusly, we treated CFPS data as cross-sectional in this study.

<sup>1</sup> The exchange rate of 2010: 100 USD = 676.95 RMB; The exchange rate of 2014: 100 USD = 614.28 RMB.

**Table 1**  
Numbers of children involved in the analysis.

	2010	2012	2014
Socio-emotional health score (aged 3)	598	660	629
Positive parenting score for children aged 1–2	1290	1209	1258
Positive parenting score for children aged 3–5	1759	1838	1830

### Measures

#### Wealth quintiles

The CFPS constructs household wealth based on the monetary value of household assets, including housing assets, financial assets (e.g., savings, stock, funds, bonds, etc.), agricultural machinery, business assets, detailed items of durable goods (valuables included), and liabilities from housing and other sources (Xie & Jin, 2017). This variable was generated by the CFPS in its 2010 and 2012 data and has been used in previous studies to measure household's socio-economic status (Xie & Jin, 2017; Xu & Xie, 2017; Villas-Boas, Fu, & Judge, 2018). Following the method and formula provided by the CFPS, we calculated total wealth for each household in 2014. Total household wealth was adjusted with GDP inflator to ensure its comparability across the three years. We then calculated household wealth per capita, which was total household wealth divided by household size. After obtaining household wealth per capita, we followed previous practices and separated all interviewed households into five wealth quintiles for each survey wave (Tan, Zeng, & Zhu, 2011).

#### Socio-emotional development (SED)

Numerous previous studies have adopted Positive Behavior Scale (PBS) scores as a measurement of SED (Epps, Eun, Aletha, Huston, & Ripke, 2017; The Child Development Supplement, 2017). The CFPS adopted a 10-item version of the PBS (The Child Development Supplement, 2017). The items are: 1) "This child is cheerful, happy" 2) "This child waits for his/her turn while playing or doing other activities" 3) "This child does things very carefully and in order." 4) "This child is curious and likes to explore." 5) "This child thinks first before acting and is not impulsive." 6) "This child gets on well with others his/her age." 7) "This child usually does what you tell him/her to do." 8) "This child can get over being upset quickly." 9) "This child is admired and well-liked by others his/her age." 10) "This child tries to do things for him/herself and is self-reliant." Answers from the respondents (the caregivers) are classified into five categories, including "1 Totally disagree," "2 Disagree," "3 Neither agree nor disagree," "4 Agree," and "5 Totally agree." We followed previous practices and generated a composite SED score, which is the average of scores attached to the items (Epps et al., 2017; The Child Development Supplement, 2017).

In 2010 and 2012, only children three years old were surveyed with the PBS questions; in 2014, all children aged three to five years old were surveyed with PBS questions. To track changes in inequalities in SED over the study period, we only included children three years old (a totally of 1887 children across the three waves). Sample size in each year is presented in Table 1.

#### Positive parenting

The CFPS contains two instruments to measure positive parenting for children at two age groups: 1) positive parenting for children aged 2 or younger [PP\_younger], and 2) positive parenting for children between ages 3 and 5 [PP\_older]. PP\_younger is measured with three items regarding the frequency caregivers use toys/games/other things to help the child 1) learn numbers, 2) distinguish colors, and 3) distinguish shapes. PP\_older is measured with four items about the frequency of the caregivers 1) reading to the child, 2) buying books for the child, 3) taking the child out to play, and 4) using toys/games/other things to help the child learn characters. The

respondents (caregivers) were asked to choose from five categories: “Several times a year or less,” “Once a month,” “2–3 times a month,” “Several times a week,” or “Every day.” Following the CFPS instruction, we assigned answers the values 1, 2, 3, 4, and 5, respectively (Institute of Social Science Survey (Peking University)). We generated a composite parenting score on caregivers’ behavior with the mean of the scores attached to the questions (3 items for children aged 1–2, 4 items for children aged 3–5), following previous practices (Duncanson, Burrows, & Collins, 2016). These questions have been widely adopted by previous studies to measure parenting performance (Sugland et al., 1995; Wissow, 2001).

#### Inequality measurements

Following previous practices, we adopted the five most commonly used inequality measurements (Barros et al., 2012; Victora et al., 2012; Hancioglu et al., 2016). The first measurement is the mean difference of the indicators between the richest wealth quintile [Q5] and the poorest wealth quintile [Q1]. The second measurement is the ratio of Q5 to Q1, which assesses the indicator’s relative inequality status. The third measurement is the concentration indexes, which is generated from the concentration curves that plot the cumulative proportion of one variable against the cumulative proportion of the population ranked by wealth. Concentration indexes capture the extent to which health outcomes/health interventions differ across individuals’ ranks by wealth. Detailed calculation methods for concentration indexes are referred to in the World Bank’s instructions (World Bank, 2016). The concentration index is expressed in a scale ranging from -100 to 100, with zero representing perfect equality. In our study, a higher positive value of a concentration index represents greater inequality in the related indicator.

The fourth measurement is the absolute slope index of inequality

(SII). The SII are regression-based indexes representing the absolute difference in a health indicator between the richest and poorest populations. To calculate SII, we followed the method introduced by World Health Organization, and ranked household wealth per capita from the poorest (at rank zero) to the richest (at rank one) (World Health Organization, 2018). Then, we performed a regression comparing socio-emotional scores/positive parenting scores against individual’s SES rank by use of a linear weighted least-square model. We controlled for covariates in the regression, including children’s gender, mothers’/fathers’ education levels, whether the mother/father lives with the child, residence of the child, and household size. The coefficient for the rank variable represents the estimated difference in outcomes by individual’s SES rank after controlling for these covariates (Regidor, 2004). The fifth measurement is the relative slope index of inequality (RII). In comparison with SII, which estimates the absolute gap in outcomes between the poorest and richest quintiles, RII estimates the relative ratio in outcomes between these groups (World Health Organization, 2018). We used the same regression method as SII and controlled for the same covariates.

Calculations, features and limitations of the five measurements are presented in Appendix Table A1.

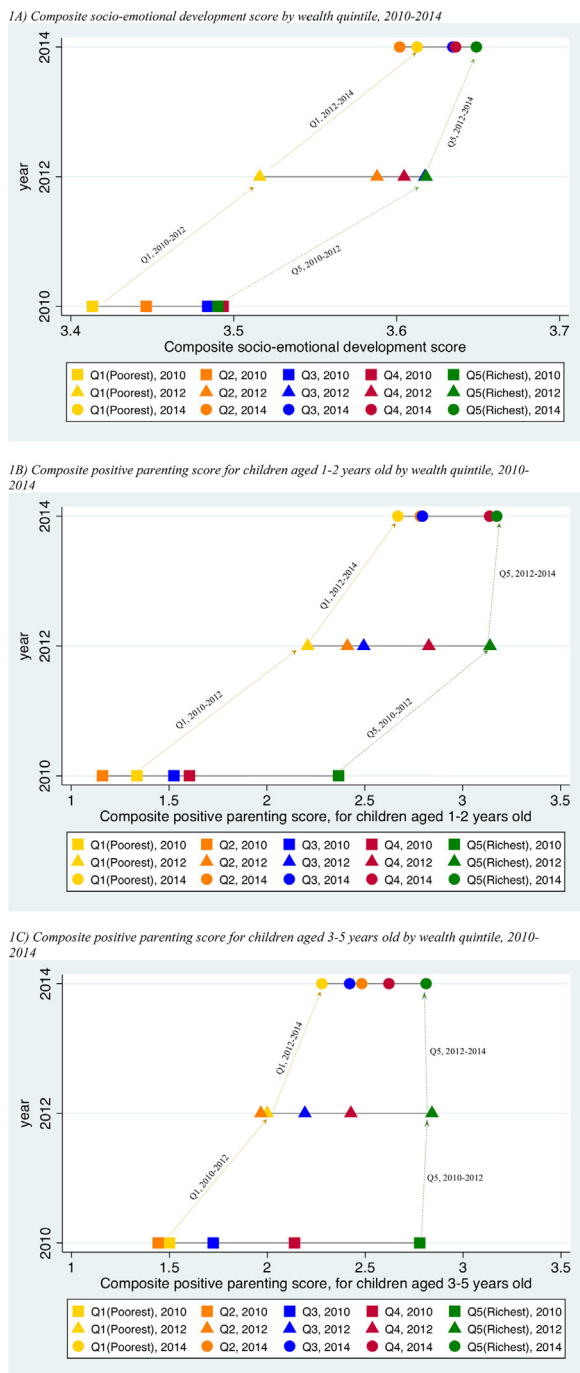
STATA 14 is used in analysis.

#### Results

Table 2 presents the sample characteristics in the baseline survey by children’s age group. The characteristics appear to be similar among different age groups. The proportion of girls is around 45% in all groups; The proportion of fathers with a middle school education or higher ranged from 67.5% among children aged 1–2 to 63.7% among children aged 3–5; similarly, the proportion of mothers with a middle

**Table 2**  
Characteristics of the baseline sample in 2010 survey by children’s age group.

	Age 0–5 (N = 3343)	Age 3 (N = 598)	Age 1–2 (N = 1290)	Age 3–5 (N = 1759)
<b>Child characteristics</b>				
Sex				
Female	45.2%	45.0%	45.3%	44.9%
Male	54.8%	55.0%	54.7%	55.1%
Mean age (years) <sup>1</sup>	2.67 (2.62, 2.72)	–	1.47 (1.45, 1.50)	3.99 (3.95, 4.03)
Mean composite socio-emotional health score (aged 3) <sup>1</sup>	–	3.46 (3.42, 3.50)	–	–
Mean composite parenting score (aged 1–2) <sup>1</sup>	–	–	1.59 (1.50, 1.68)	–
Mean composite parenting score (aged 3–5) <sup>1</sup>	–	–	–	1.92 (1.86, 1.98)
<b>Parent characteristics</b>				
Father’s education level				
Illiterate or semi-literate	10.6%	11.4%	9.3%	11.5%
Primary school	24.2%	24.2%	23.3%	24.9%
Middle school or high school	56.2%	56.6%	57.0%	56.2%
College or higher	9.0%	7.8%	10.5%	7.5%
Mother’s education level				
Illiterate or semi-literate	18.3%	18.8%	16.4%	20.3%
Primary school	24.2%	24.8%	23.4%	25.3%
Middle school or high school	49.7%	49.5%	51.8%	47.6%
College or higher	7.9%	6.9%	8.5%	6.9%
Father lives with the child (1 yes, 0 no) <sup>2</sup>	70.8%	71.9%	70.3%	69.9%
Mother lives with the child (1 yes, 0 no) <sup>2</sup>	82.3%	79.6%	83.8%	78.7%
<b>Household characteristics</b>				
Residence (1 urban, 0 rural)	37.6%	38.3%	36.0%	38.4%
Household size <sup>3</sup>	5.51 (5.44, 5.57)	5.51 (5.35, 5.67)	5.56 (5.46, 5.67)	5.37 (5.28, 5.46)
Household wealth per capita (¥1, 000 RMB) <sup>1</sup>	51.92 (46.99, 56.84)	57.29 (45.08, 69.51)	51.50 (42.69, 60.31)	52.00 (45.65, 58.36)



**Fig. 1.** Composite socio-emotional development score and composite positive parenting scores by wealth quintile, 2010–2014. 1A) Composite socio-emotional development score by wealth quintile, 2010–2014 1B) Composite positive parenting score for children aged 1–2 years old by wealth quintile, 2010–2014 1C) Composite positive parenting score for children aged 3–5 years old by wealth quintile, 2010–2014.

school education or higher decreased from 60.3% among children aged 1–2 to 54.5% among children aged 3–5. Roughly 70% of fathers and 80% of mothers live with their children; 36.0% to 38.4% of children

**Table 3**

Inequality status (95% confidence intervals) in socio-emotional development and positive parenting scores, and the changing trends between 2010 and 2014.

	Absolute difference between Q5 and Q1	Concentration index
2010	0.13 (0.02, 0.25)**	0.55 (-0.13, 1.24)*
2012	0.14 (0.02, 0.25)**	0.53 (-0.07, 1.13)*
2014	0.03 (-0.12, 0.19)	0.27 (-0.53, 1.13)
Trend in inequality between 2010 and 2014, p-value	No significant change	No significant change
2010	1.03 (0.71, 1.35)***	10.50 (7.05, 13.94)***
2012	0.93 (0.65, 1.22)***	4.55 (2.49, 6.62)***
2014	0.51 (0.27, 0.74)***	3.47 (1.56, 5.38)***
Trend in inequality between 2010 and 2014, p-value	Inequality significantly reduced p < 0.001	Inequality significantly reduced p < 0.001
2010	1.28 (1.09, 1.47)***	6.13 (4.56, 7.70)***
2012	0.84 (0.68, 1.00)***	4.86 (3.59, 5.91)***
2014	0.53 (0.37, 0.70)***	3.26 (2.01, 4.52)***
Trend in inequality between 2010 and 2014, p-value	Inequality significantly reduced p < 0.001	Inequality significantly reduced p < 0.001

Note:

Asterisks \*\*\*, \*\*, and \* indicate statistically significant at 1%, 5%, and 10% significance levels, respectively

live in urban areas and the mean household size is roughly 5.5. We present the sample characteristics in 2012 and 2014 by children’s age groups in [Appendix Tables 2 and 3](#). Children of different ages appear to have very similar characteristics.

*Level and trends of SED and positive parenting scores by wealth quintile between 2010 and 2014*

As seen in [Table 2](#), we noted a significant increase in the composite SED score among children aged three during the study period, from 3.46 (95% CI: 3.42, 3.50) in 2010 to 3.62 (95% CI: 3.58, 3.66) in 2014. [Fig. 1A](#) presents composite SED score by wealth quintile in each survey round. Between 2010 and 2014, the SED score increased for all wealth quintiles. For children in Q1, the average SED score increased significantly from 3.41 (95% CI: 3.32 - 3.50) in 2010 to 3.61 (95% CI: 3.54 - 3.69) in 2014, with a significance level of less than 0.001; Average SED score for children in Q5 increased from 3.49 (95% CI: 3.41 - 3.57) in 2010 to 3.65 (95% CI: 3.59 - 3.72) in 2014. The other wealth quintiles show similarly increasing trends.

The average positive parenting score for children in both age groups increased significantly from 1.59 (95% CI: 1.50, 1.68) in 2010 to 2.93 (95% CI: 2.84, 3.03) in 2014 for the PP\_younger score, and from 1.92 (95% CI: 1.86, 1.98) in 2010 to 2.53 (95% CI: 2.48, 2.58) in 2014 for the PP\_older score. [Table 2](#). [Fig. 1B](#) demonstrates a significant increase in the PP\_younger score for all wealth quintiles. For children in Q1, the average PP\_younger score increased from 1.34 (95% CI: 1.17 - 1.51) in 2010 to 2.67 (95% CI: 2.46–2.87) in 2014. For children in Q5, the average PP\_younger score increased from 2.37 (95% CI: 2.13–2.60) in 2010 to 3.17 (95% CI: 2.95–3.40) in 2014, slower than all other wealth quintiles. Across all years, the PP\_younger score of Q5 is the highest among the five wealth quintiles, but the difference between Q5 and other wealth quintiles showed a reduction over time.

Differing from the PP\_younger score, the average composite positive

parenting scores for children aged 3–5 years old (PP\_older score) in Q5 did not show any notable changes between 2010 and 2014, although it maintained the highest score across all years (Fig. 1C). For the other four wealth quintiles, increases in the PP\_older score appeared to be large and statistically significant at the 0.001 level.

#### *Level and trends of inequalities in SED and positive parenting scores between 2010 and 2014*

Table 3 presents the inequality status of SED scores and positive parenting scores with the five inequality measurements. In terms of SED scores, the absolute difference between Q5 and Q1 appeared to be significantly larger than zero in 2010 and 2012. We did not find a significant gap between Q1 and Q5 in 2014, suggesting that inequality between the richest and poorest quintiles has diminished. The other inequality measurements showed consistent results with these findings.

We found significant inequality in the PP\_younger scores and the PP\_older scores in all survey rounds, with a significance level of less than 0.001. The absolute difference between Q5 and Q1 in both the PP\_younger scores and PP\_older scores was reduced significantly, from 1.03 (95% CI: 0.71–1.35) / 1.28 (95% CI: 1.09–1.47) in 2010 to 0.51 (95% CI: 0.19–0.82) / 0.53 (95% CI: 0.37–0.70) in 2014 for PP\_younger and PP\_older respectively. The results are consistent over different inequality measurements; see Table 3 and Appendix Table 4.

#### **Discussion**

Our study estimates the levels and trends of inequalities in two indicators of early childhood development (SED and positive parenting scores). The results show that both the SED score and positive parenting scores improved remarkably between 2010 and 2014, especially for the poorer quintiles. Inequality in children's SED scores was significant in 2010 and 2012, but not significant in 2014. Although PP\_younger scores and PP\_older scores appeared to be significantly unequal in all three survey years, the poorer groups experienced faster improvement than did the richer groups, leading to significant reductions in the gaps between the richer and poorer quintiles.

One potential explanation for the remarkable progress made in reducing inequalities in SED and positive parenting scores could be the implementation of China's national strategy in ECD. In 2010, the Chinese government, in partnership with UNICEF, embarked on an ambitious goal to universalize early childhood education and launched the first national campaign to promote early childhood development. Early childhood education for children aged 0–3 years old has since been prioritized, particularly for children located in poor and remote areas (UNICEF, 2018; Brookings, 2018). As part of this effort, China's education authorities have issued a series of ECD policies for children in poor and remote areas, including the government's poverty alleviation plan, state-led compensatory education programs, and projects to build educational facilities, among others (Zhu, 2009). Between 2010 and 2016, central and western China, where poor and rural families are concentrated, received 85%

of the central government's investment in early childhood education; Prior to 2010, these regions barely received any funding from the central government (New Financial Website, 2018). This heavily increasing financial investment on ECD for disadvantaged children may be a key factor behind the rapidly improving equality status in SED score and positive parenting scores.

Despite the rapid improvement in equality status during this period, we noticed that positive parenting scores in richer groups were still significantly higher than in poorer groups in 2014. This is concerning, as positive parenting is significantly associated with children's cognitive development, academic achievements, psychological maturity, and engagement in risky behaviors (e.g. illicit drug use, alcohol consumption, smoking in country name) (Hahlweg, Heinrichs, Kuschel, Bertram, & Naumann, 2010; Aquilino & Supple, 2001; Englund, Luckner, Whaley, & Egeland, 2004; Senechal & LeFevre, 2002). As Heckman states-, inequalities in positive parenting indicate that "inequality begins at home." (Heckman, 2011) With more evidence emerging on the role of positive parenting in children's socio-emotional development, we need to advocate for UNICEF and policy makers in China to engage in heavy investments in interventions targeting positive parenting, including the development of a mobile App for Chinese parents and the implementation of parenting programs in rural Chinese communities (UNICEF, 2018; UNICEF, 2018).

Data issues imposed limitations on our analysis. Firstly, although CFPS is formatted as a panel structure, we can only use it as a repeated cross-section survey, due to CFPS not following any specific cohort, but interviewing children of the same age in each survey round. Secondly, positive parenting is a multifaceted concept. The CFPS measurements could not capture all aspects of positive parenting, such as whether parents tailor specific activities to their children's developmental stage. Moreover, the validity of the related CFPS questions have not been previously verified. Thirdly, although the PBS score is a well-recognized measurement of SED and has been adopted by studies from many countries, no previous studies in the Chinese context have ever used it or testified to the validity of the measurement.

Despite these limitations, our study is the first in the Chinese context to track the levels and trends of inequality status for these two critical aspects of ECD: socio-emotional development and positive parenting. Moving forward, continuing to update assessments on ECD inequality as more data become available is essential. Future studies should investigate the association between positive parenting and SED and examine the impact of China's national strategy of ECD on improvements in equality in SED and positive parenting scores. Although the costs and effectiveness of early education programs is beyond the scope of this study, we recognize its importance and call for more future studies on it to provide scientific evidence on cost-effective interventions for policymakers.

#### **Ethical approval**

Ethical approval is not required for this study.

## Appendix

See Tables A1–A4.

**Table A1**  
Comparison of three inequality measurements.

Inequality measurement	Calculation	Features	Limitations
Difference between Q5 and Q1	Absolute inequality measures the different in percentage points between the most-advantaged group (Q5) and the least-advantaged group (Q1)	Improvement in this measurement implies Q1 group improve faster in terms of the absolute number in the health indicator comparing to the Q5 group, or Q5 group experienced faster absolute health deterioration than the Q1 group.	<ul style="list-style-type: none"> <li>• Even if the Q1 group improves at a slower rate than the Q5 group, the absolute difference may still shrink. For example, a country's infant mortality was 200 per 1,000 live births for the Q1 group and 100 for the Q5 group in 1990. The absolute difference was <math>200-100=100</math>. In the decade, the infant mortality in Q1 group declined by 20% and the Q5 group declined faster by 30%. The absolute difference decreased to <math>200*(1-20\%)-100*(1-30\%)=90</math>. In this case, the absolute difference between Q1 and Q5 groups decreases from 100 to 90 per 1,000 live births, which indicates the Q1 and Q5 groups are being more equal. However, in fact, the Q5 group improves at a faster rate than the Q1 group, which appears to suggest the Q5 group did better than the Q1 group and these two groups should become less equal. This is counter-intuitive.</li> <li>• It won't reflect the overall status of a health indicator in a country. For example, the absolute inequality of a country with 90% the children in Q1 and 100% of the children in Q5 covered by polio vaccine is the same as that of a country with 5% of the children in Q1 and 15% of the children in Q5 covered. Yet intuitively, the latter one should be of higher concern.</li> </ul>
Ratio of Q5 to Q1	Ratio of Q5 to Q1 measures the rate of the health indicator between the most-advantaged group and the least-advantaged group	Improvement in the ratio implies a faster relative rate of health improvement among disadvantaged groups	<ul style="list-style-type: none"> <li>• If the ratio is very large/small, we don't have a clear clue of whether it is because the Q1 group is doing particularly poor/good or the Q5 group is doing very well/poor.</li> <li>• The ratio will improve if the health status of the Q5 gets worse. For example, if 90% of the children in Q5 received polio vaccine and 10% of the children in Q1 received it. The ratio of Q5 to Q1 is 9. If the polio vaccine coverage of Q5 decreased to 20%, while that of Q1 remains unchanged, the ratio will drop to 2, and we would falsely conclude that we are making progress towards health equality.</li> </ul>
Concentration index	Concentration indexes were generated from the concentration curves. The detailed calculation method could refer to the World Bank instruction <sup>1</sup>	Concentration index quantified the degree of socioeconomic-related inequality in a health variable, which incorporates information from all income groups instead of simply the poorest and the richest.	<ul style="list-style-type: none"> <li>• It has higher data requirements than the other equality measurements. There are usually two ways to obtain concentration index: One is using grouped-data, which requires data on the health indicator and the number of individuals for each income group. The second approach uses micro-data, which requires health status data and wealth score for each individual. This study adopted the first way.</li> <li>• It could be sensitive to the living standards measure, such as consumption, expenditure, and wealth index. We follow Wagstaff's study and use wealth index to measure living standard.</li> </ul>
SII and RII <sup>2</sup>	SII (RII) are calculated by fitting a linear (logistic) regression line to the category-specific values by means of weighted least-squares, with the weights being the proportion of the population in each SES category	SII and RII considered information from all income groups instead of simply the poorest and the richest. Moreover, they took the proportion of population in each SES category. We could also take account the effects of confounders by involving them into regressions.	<ul style="list-style-type: none"> <li>• It is questionable whether a linear regression model is suitable</li> <li>• The regression estimate has not to show significant deviations from linearity; otherwise, the magnitude of the index would be biased</li> <li>• The values are less intuitive for the policymakers</li> </ul>

1. The world bank instruction could be found from: <http://siteresources.worldbank.org/INTPAH/Resources/Publications/459843-1195594469249/HealthEquityCh8.pdf>

2. Reference:

a. Regidor E. Measures of health inequalities: part 2. *Journal of Epidemiology & Community Health*. 2004 Nov 1;58(11):900-3

b. Moreno-Betancur, Margarita, et al. Relative index of inequality and slope index of inequality: a structured regression framework for estimation. *Epidemiology* 26.4 (2015): 518-527

c. World Health Organization. Health Equity Assessment Toolkit Built-in Database Edition. 2016 [cited 2018 Jan 3]; Available from: [http://www.who.int/gho/health\\_equity/heat\\_technical\\_notes.pdf](http://www.who.int/gho/health_equity/heat_technical_notes.pdf)

**Table A2**  
Characteristics of 2012 sample survey by children's age group.

	Age 0–5 (N = 3411)	Age 3 (N = 660)	Age 1–2 (N = 1209)	Age 3–5 (N = 1838)
<b>Child characteristics</b>				
Sex				
Female	47.3%	46.5%	47.9%	47.2%
Male	52.7%	53.5%	52.1%	52.8%
Mean age (years) <sup>1</sup>	2.65 (2.62, 2.74)	–	1.48 (1.45, 1.50)	3.96 (3.92, 4.00)
Mean composite socio-emotional health score (aged 3) <sup>1</sup>	–	3.60 (3.56, 3.64)	–	–
Mean composite parenting score (aged 1–2) <sup>1</sup>	–	–	2.58 (2.49, 2.68)	–
Mean composite parenting score (aged 3–5) <sup>1</sup>	–	–	–	2.25 (2.19, 2.30)
<b>Parent characteristics</b>				
Father's education level				
Illiterate or semi-literate	12.1%	11.5%	12.2%	12.9%
Primary school	25.2%	27.5%	23.7%	26.8%
Middle school or high school	53.7%	52.9%	54.3%	52.7%
College or higher	9.1%	8.0%	9.8%	7.7%
Mother's education level				
Illiterate or semi-literate	18.4%	19.0%	15.3%	20.4%
Primary school	23.8%	23.8%	23.0%	24.7%
Middle school or high school	49.6%	50.9%	53.3%	47.6%
College or higher	8.2%	6.3%	8.5%	7.4%
Father lives with the child (1 yes, 0 no) <sup>2</sup>	71.9%	67.0%	73.3%	68.9%
Mother lives with the child (1 yes, 0 no) <sup>2</sup>	84.30%	83.3%	89.8%	83.5%
<b>Household characteristics</b>				
Residence (1 urban, 0 rural)	36.2%	37.1%	36.2%	36.2%
Household size <sup>3</sup>	5.84 (5.76, 5.92)	5.82 (5.66, 5.98)	5.86 (5.73, 5.98)	5.72 (5.62, 5.81)
Household wealth per capita (¥1, 000 RMB) <sup>1</sup>	61.58 (56.28, 66.87)	59.29 (47.08, 71.51)	61.50 (52.58, 70.42)	62.02 (55.69, 68.36)

1. 95% confidence intervals are presented in the parentheses.

2. In 2012 and 2014, CFPS didn't ask whether the father/mother is living with the child as in 2010, but ask about the time span for which child lived with his/her father/mother last year. The respondents were asked to choose from the following categories: "Almost entire year", "around 11 months", "around 8-10 months", "around 5-7 months", "around 2-4 months", around "1 month", "almost none". We counted the children living with the father/mother for more than 5 months last year as living with the father/mother

3. The number of children in each age group/Total number of children aged 0-5 are presented in the parentheses.

**Table A3**  
Characteristics of 2014 sample survey by children's age group.

	Age 0–5 (N = 3482)	Age 3 (N = 629)	Age 1–2 (N = 1258)	Age 3–5 (N = 1830)
<b>Child characteristics</b>				
Sex				
Female	47.3%	50.2%	47.0%	47.1%
Male	52.7%	49.8%	53.0%	52.9%
Mean age (years) <sup>1</sup>	2.75 (2.69, 2.82)	–	1.51 (1.48, 1.54)	4.01 (3.97, 4.04)
Mean composite socio-emotional health score (aged 3) <sup>1</sup>	–	3.62 (3.58, 3.66)	–	–
Mean composite parenting score (aged 1–2) <sup>1</sup>	–	–	2.93 (2.84, 3.03)	–
Mean composite parenting score (aged 3–5) <sup>1</sup>	–	–	–	2.53 (2.48, 2.58)
<b>Parent characteristics</b>				
Father's education level				
Illiterate or semi-literate	9.9%	10.6%	8.3%	11.3%
Primary school	24.8%	23.5%	24.8%	26.1%
Middle school or high school	54.8%	55.9%	54.2%	53.8%
College or higher	10.6%	10.1%	12.7%	9.0%
Mother's education level				
Illiterate or semi-literate	15.5%	15.3%	13.4%	16.9%
Primary school	22.5%	21.1%	22.7%	23.2%
Middle school or high school	53.4%	55.6%	53.4%	52.7%
College or higher	8.5%	8.1%	10.5%	7.3%
Father lives with the child (1 yes, 0 no) <sup>2</sup>	72.4%	73.8%	78.0%	72.1%
Mother lives with the child (1 yes, 0 no) <sup>2</sup>	86.0%	89.6%	91.1%	86.1%
<b>Household characteristics</b>				
Residence (1 urban, 0 rural)	38.4%	37.8%	39.0%	37.9%
Household size <sup>3</sup>	5.83 (5.74, 5.91)	5.87 (5.68, 6.05)	5.75 (5.61, 5.89)	5.89 (5.78, 6.00)
Household wealth per capita (¥1, 000 RMB) <sup>1</sup>	69.37 (65.49, 73.25)	69.22 (57.08, 81.37)	71.40 (62.38, 80.42)	70.02 (63.79, 76.25)

1. 95% confidence intervals are presented in the parentheses

2. In 2012 and 2014, CFPS didn't ask whether the father/mother is living with the child as in 2010, but ask about the time span for which child lived with his/her father/mother last year. The respondents were asked to choose from the following categories: "Almost entire year", "around 11 months", "around 8-10 months", "around 5-7 months", "around 2-4 months", around "1 month", "almost none". We counted the children living with the father/mother for more than 5 months last year as living with the father/mother

3. The number of children in each age group/Total number of children aged 0-5 are presented in the parentheses.

**Table A4**

Inequality status (95% confidence intervals) in socio-emotional development and positive parenting scores, and the changing trends between 2010 and 2014, full table with five inequality measurements.

	Absolute difference between Q5 and Q1	Ratio of Q5 to Q1	Concentration index	SII	RII
<b>Socio-emotional development (aged 3)</b>					
2010	0.13 (0.02, 0.25)**	1.04 (1.00, 1.07)***	0.55 (-0.13, 1.24)*	0.07 (-0.00, 0.15)*	1.02 (1.00, 1.04)**
2012	0.14 (0.02, 0.25)**	1.04 (1.01, 1.08)***	0.53 (-0.07, 1.13)*	0.08 (0.01, 0.15)**	1.02 (1.00, 1.04)**
2014	0.03 (-0.12, 0.19)	1.00 (0.97, 1.03)	0.27 (-0.53, 1.13)	0.03 (-0.06, 0.12)	1.01 (0.98, 1.03)
Trend in inequality between 2010 and 2014, p-value	No significant change	No significant change	No significant change	No significant change	No significant change
<b>Positive parenting score (aged 1–2)</b>					
2010	1.03 (0.71, 1.35)***	1.77 (1.43, 2.11)***	10.50 (7.05, 13.94)***	0.68 (0.50, 0.86)***	1.54 (1.36, 1.75)***
2012	0.93 (0.65, 1.22)***	1.43 (1.27, 1.58)***	4.55 (2.49, 6.62)***	0.34 (0.18, 0.51)***	1.14 (1.07, 1.22)***
2014	0.51 (0.27, 0.74)***	1.19 (1.06, 1.32)***	3.47 (1.56, 5.38)***	0.32 (0.14, 0.49)***	1.09 (1.03, 1.16)***
Trend in inequality between 2010 and 2014, p-value	Inequality significantly reduced p < 0.001	Inequality significantly reduced p < 0.001	Inequality significantly reduced p < 0.001	Inequality significantly reduced p < 0.001	Inequality significantly reduced p < 0.001
<b>Positive parenting score (aged 3–5)</b>					
2010	1.28 (1.09, 1.47)***	1.85 (1.66, 2.05)***	6.13 (4.56, 7.70)***	0.46 (0.37, 0.56)***	1.24 (1.16, 1.32)***
2012	0.84 (0.68, 1.00)***	1.42 (1.32, 1.52)***	4.86 (3.59, 5.91)***	0.31 (0.22, 0.39)***	1.16 (1.12, 1.21)***
2014	0.53 (0.37, 0.70)***	1.23 (1.15, 1.32)***	3.26 (2.01, 4.52)***	0.27 (0.16, 0.37)***	1.11 (1.07, 1.16)***
Trend in inequality between 2010 and 2014, p-value	Inequality significantly reduced p < 0.001	Inequality significantly reduced p < 0.001	Inequality significantly reduced p < 0.001	Inequality significantly reduced p = 0.024	Inequality significantly reduced p = 0.031

Note: Asterisks \*\*\*, \*\*, and \* indicate statistically significant at 1%, 5%, and 10% significance levels, respectively.

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