Early child development and caregiver subjective well-being in rural China

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Abstract

Purpose – This study aims to bridge the gaps in the existing literature by studying the links between children's development and the subjective well-being of the caregivers using first-hand data collected in rural China.

Design/methodology/approach – Although the broad array of literature has examined the effects of child development on the subjective well-being of caregivers, the relationship between early childhood development and caregiver subjective well-being has not been well-studied using sample families with potential developmental delay in rural China. Also, existing research has relied on maternal reports to evaluate the developmental status of children. The study used data collected from 32 townships in seven nationally designated poverty counties in the Qinling mountainous area in 2016. The authors measure child development using the social-emotional module of the Ages & Stages Questionnaire and Bayley Scales of Infant and Toddler Development–Third Edition.

Findings – The authors find that child development indicators are correlated with caregiver subjective well-being. In particular, social-emotional skills are positively associated with life evaluations and positive emotion. However, we do not find any significant correlation between child development and negative emotion or depression, anxiety and stress scores.

Originality/value – The value of this study is to report the indicators of child development in rural China and examines the correlation between child development and caregivers' subjective well-being.

Keywords Early child development, Subjective well-being, Rural China, Bayley score

Paper type Research paper

1. Introduction

Parenthood remains one of the most important aspects of the lives of adults, even in highly developed countries where people generally do not count on their children for support in their old age. How parenthood relates to the subjective well-being of adults typically receives a lot of attention. Most of the existing studies on parenthood and subjective well-being focus on whether parenthood matters for the happiness of parents. Among them, some find a positive effect (Aassve *et al.*, 2012; Herbst and Ifcher, 2016; Hansen, 2012; Margolis and Myrskylä,

2011), while many other studies find a lower or similar level of subjective well-being compared to nonparents (Beja, 2015; Bhargava *et al.*, 2014; Brothers and Maddux, 2003; Clark and Oswald, 2002; Frey and Stutzer, 2000; Mclanahan and Adams, 1987). There are also studies showing that the impact of baby birth is changing across time and depends on parents' age and socioeconomic resources (Myrskylä and Margolis, 2014).

In addition to studies on the general effect of parenthood on the subjective well-being of caregivers, other studies examine the effects of child development status. Studies have shown that parents of children with intellectual disabilities (ID), compared to the parents of children without ID, report lower levels of happiness, self-esteem and self-efficacy (Emerson *et al.*, 2006), higher levels of stress (Beck *et al.*, 2004; Dyson, 1997; Khamis, 2007), higher levels of anxiety and depression (Emerson, 2003; Feldman *et al.*, 2007; Olsson and Hwang, 2001; Singer, 2006) and worse physical health (Emerson, 2003; Eisenhower *et al.*, 2009; Mackey and Goddard, 2006).

Despite the broad array of literature, there are several problems with existing studies on this topic. First, they mainly focus on children aged 2–17. A child's first years of life, however, comprise a critical developmental period that has implications for lifelong outcomes due to the child's rapid brain development and brain malleability during these early years (Attanasio *et al.*, 2015; Knudsen *et al.*, 2006; Huttenlocher, 1979). Hence, it seems inappropriate to overlook this critical stage when we study the relationship between children's development and the well-being of their caregivers. Second, existing studies mainly focus on emotion, particularly negative emotions such as stress, anxiety and depression and overlook other important aspects of subjective well-being, such as positive emotions and life evaluations. However, these aspects may reveal important information about caregiver quality of life (Helliwell *et al.*, 2012, 2016; OECD, 2013). Third, existing research has relied heavily on maternal reports to evaluate the developmental status of children (see the review by Lee, 2013). When considering the possibility that a mother's mental and emotional health may influence her judgment when reporting on her child's behavior, finding a more objective way to define and measure children's early childhood developmental delay should be put into consideration.

This study aims to bridge the gaps in the existing literature by studying the links between children's development and the subjective well-being of the caregivers using first-hand data collected in rural China. To do so, we have three objectives. First, we describe child development and subjective well-being among caregivers. Second, we examine the correlations between child development indicators and caregiver subjective well-being. Third, we examine the impacts of developmental delays on caregiver well-being.

To meet these objectives, we conduct a survey of 390 households in rural western China. Using two self-reported questionnaires, we measure the subjective well-being of caregivers in terms of life evaluations, emotions, depression, anxiety and stress. We also measure child development using the Ages & Stages Questionnaire and Bayley Scales of Infant and Toddler Development. Together, these tests measure socioemotional, cognitive, language and psychomotor development.

Following this protocol, our results demonstrate that a large share of caregivers is grandparents rather than parents and that developmental delay is very prevalent in western rural China. Ordinary least squares (OLS) analysis of correlations between child development indicators and caregiver subjective well-being shows that children's social-emotional skills are positively associated with the life evaluations and positive emotion of caregivers. Bayley scores are also positively correlated with caregiver life evaluations and positive emotion but not significantly. However, we do not find any significant correlation between socioemotional, cognitive, language or psychomotor development and negative emotion or depression, anxiety and stress (DASS) scores. Our findings differ from previous studies which have often found that intellectual disability is associated with higher negative emotions.

This study makes several key contributions to the literature. First, this is the first study to explore the impacts of early childhood developmental indicators on the subjective well-being

of caregivers. Overall, the relationship between early childhood development and caregiver subjective well-being has not been well-studied using large samples of families with potential developmental delay in China, especially in western rural areas. Previous studies have shown that young babies and children in rural China are not reaching their full developmental potential (Luo *et al.*, 2019; Yue *et al.*, 2017; Bai *et al.*, 2019; Wang *et al.*, 2019), yet to our knowledge, no studies have addressed the impact of these developmental delays on caregivers. This study uses large samples of families with potential developmental delay in rural western China to deepen our understanding of this topic.

Second, this study deepens our understanding of overall subjective well-being of caregivers. Unlike previous studies, which have mainly focused on depression, anxiety and stress, this study also includes caregiver life evaluations as a measurement of subjective well-being. This information offers more comprehensive information on the quality of life among caregivers of young children, as well as the potential positive impacts of child development on caregiver subjective well-being.

Finally, this study also contributes to the broader literature on the impacts of child development. James Heckman and others have argued that a child's development levels have long-run impacts on the rest of their life (e.g. Conti *et al.*, 2016; Francesconi and Heckman, 2016; Heckman, 2012). Complementary to their studies, we show that child development levels may also have immediate impacts, such as impacts on their parents' subjective well-being. This adds to the evidence supporting policy interventions on early child development.

The rest of this paper is organized as follows. Section 2 discusses data collection and statistical analysis. Section 3 reports the main results of our study and various robustness checks. Section 4 concludes.

2. Data and methodology

2.1 Sampling

This paper uses data collected in seven nationally designated poverty counties in the Qinling mountainous area in 2016. This area is one of the 14 nationally designated concentrated stricken areas of China. We selected our sample in two steps. First, we selected the sample townships (the middle level of administration between county and village). We excluded townships that housed the county seat or did not have any villages with a population of 800 or more. We then selected all remaining townships within each county. After imposing the exclusion criteria, 47 townships were included in the study.

Next, we selected sample villages and households within the 47 townships. We randomly selected one village from each township to participate and enrolled all households with children in the designated age range. However, the outcome variables were added into the survey amidst the field work and thus some villages do not have data on outcome variables. We exclude those villages with missing data. Our final sample included 390 children and 390 primary caregivers from 390 households in 32 villages.

This study has been conducted with full compliance of research ethics norms. All survey respondents provided written informed consent. This study received ethical approval from the Stanford University Institutional Review Board (Protocol ID 35921).

2.2 Data collection and variables

In April of 2016, we conducted a three-block survey of infants and their primary caregivers. In the first block of the survey, we collected data on the subjective well-being of caregivers. We use two methods to measure subjective well-being. The first is a self-reported questionnaire that measured each caregiver's life evaluations, positive emotions and negative emotions. We asked caregivers to respond to questions about life evaluations, positive emotion and

negative emotion on an 11-point scale, where 0 signifies the worst outcome (e.g. "not happy at all;" "not satisfied at all") and 10 signifies the best outcome (e.g. "very happy;" "very satisfied"). We measured three aspects of life evaluations: satisfaction with life, overall happiness and Eudaimonia (worthwhileness or meaningfulness of life). We asked caregivers, "Overall, how satisfied are you with your life as a whole these days?" "Overall, are you happy?" and "How do you evaluate the meaning of things you are doing?" To measure positive emotion, we asked caregivers, "How happy were you yesterday?" [1] To measure negative emotion, we averaged caregiver responses to two questions on anxiety and depression, respectively. We asked caregivers, "How worried were you yesterday?" and "How depressed were you yesterday?" These measures are very similar to those suggested by *OECD's Guidelines on Measuring Subjective Well-being* published in 2013 (OECD, 2013, p. 253), except that we include one additional evaluative question concerning overall happiness, following the European Social Survey (ESS).

In addition, we utilize the Depression Anxiety Stress Scale (DASS) to measure depression, anxiety and stress among caregivers (Lovibond and Lovibond, 1995) [2]. The DASS is a set of three self-reported scales, each of which contains 14 items in the basic version. There is also a short version, the DASS-21, which contains 7 items per scale. For simplicity, we used the DASS-21 in our survey. Respondents are asked to use 4-point severity/frequency scales (0–3) to rate the extent to which they have experienced each state over the previous week. Scores for depression, anxiety and stress are calculated by summing the scores for the relevant items.

In the second block of our survey, we collected data on child development. We use two tests to measure child development. We first use the social-emotional module of the Ages & Stages Questionnaire (ASQ:SE) to measure socioemotional development. The ASQ:SE is an instrument administered to caregivers to screen for social-emotional delay. It consists of a series of age-appropriate questions about child behavior and caregiver–child interactions. Based on caregiver responses to these questions, the ASQ:SE indicates children at risk of social-emotional delay.

Additionally, we use the Bayley–III to measure child development in terms of cognition, language and psychomotor abilities. The Bayley Scales of Infant and Toddler Development is an individually administered instrument that assesses the development of infants and young children aged 0–42 months. This test evaluates an infant's performance on a series of tasks using a standardized toy kit, taking into consideration each infant's age in days and whether they were born prematurely. Based on these three factors, the test establishes three independent, internationally standardized scores: the Cognitive Composite Score, which assesses sensorimotor development, exploration and manipulation, object relatedness, concept formation and other aspects of cognitive processing; the Language Composite Score, which evaluates receptive communication and expressive communication; and the Motor Composite Score, which evaluates fine motor skills (visual tracking, reaching, object manipulation and grasping) and gross motor skills (movement of the limbs and torso). Bayley–III is a revision of the Bayley Scales of Infant Development–Second Edition (BSID–II; Bayley, 1993).

Besides using raw scores of the four development indicators, as shown in Figure 1, we also define delay in each indicator as our explanatory variables to check the consistency. Development in social-emotional, cognitive, language and motor skills is considered delayed if the raw score in each indicator is lower than 85, 95.4, 96.7 and 93, respectively, following Luo *et al.* (2019) and Bos (2013).

Since cognitive, language and psychomotor development are strongly correlated, we use correlation coefficients in our statistical analysis. In our sample, the correlation coefficient is 0.51, 0.47 and 0.54 between cognitive and language, between cognitive and psychomotor and between language and psychomotor, respectively. As measured by Bayley Scales of Infant Development, we generate an average Bayley score to reduce the dimension.
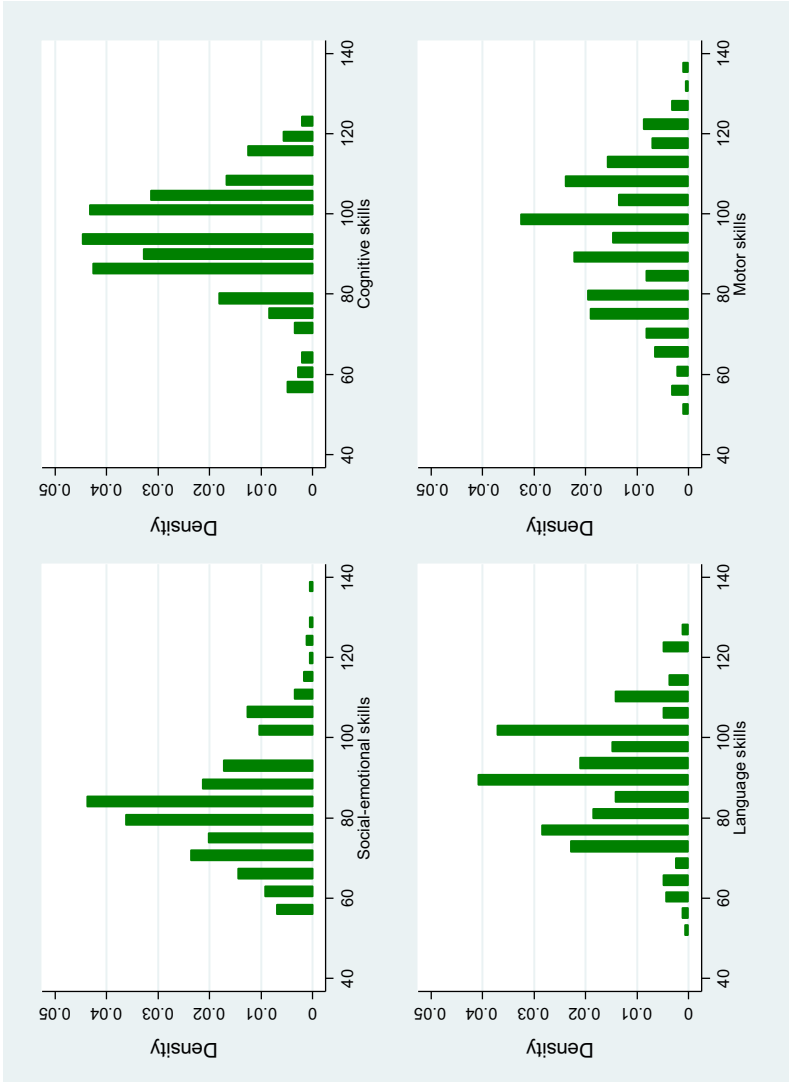
Figure 1.
Histogram of child
development
indicators

In the third block of the survey, we collected child and caregiver characteristics from all households participating in the study. We administered a survey to each child's primary caregiver (typically the child's mother or grandmother) regarding individual and household background, including child's age in months, child's health condition in the last two weeks, caregiver's gender, caregiver's age, caregiver's education levels, whether the child's father was at home and household income [3]. The birth date of the infant was confirmed by checking the birth certificate issued by the birth hospital.

The dependent variables measure caregiver subjective well-being; this includes life evaluations (life satisfaction, overall happiness and worthwhile life), positive emotion, negative emotion, depression, anxiety and stress. Explanatory variables are child development indicators including cognition, language, motor and social-emotional score. We also control for a set of covariates based on child and caregiver characteristics. This set of covariates includes child age, child being sick in the last weeks, caregiver being female, caregiver's age, caregiver's education, child's father being at home and household income.

Table 1 presents our summary statistics for caregivers' subjective well-being, child development indicators, and child and caregiver characteristics. Although there was a great

Variable	Obs	Mean	Std. Dev	Min	Max
Subjective well-being: life evaluations					
Satisfaction with life	390	7.228	2.439	0	10
Overall happiness	294	7.408	2.715	0	10
Worthwhile life	390	7.769	2.384	0	10
Subjective well-being: emotion					
Positive emotion	390	7.085	2.777	0	10
Negative emotion	295	2.961	2.808	0	10
Subjective well-being: DASS					
Depression score	387	6.114	6.431	0	28
Anxiety score	387	6.057	6.021	0	34
Stress score	387	8.672	7.016	0	34
Child development indicators					
Cognitive score	389	94.126	13.033	55	125
Language score	389	89.931	13.645	50	129
Motor score	389	94.437	17.021	49	139
Social-emotional score	389	82.712	13.974	55	140
Delay in cognitive skills (Raw score < 95.4)	389	0.589	0.493	0	1
Delay in language skills (Raw score < 96.7)	389	0.663	0.473	0	1
Delay in motor skills (Raw score < 93)	389	0.427	0.495	0	1
Delay in social-emotional skills (Raw score < 85)	389	0.494	0.501	0	1
Average Bayley score (average of cognitive, language and motor score)	389	92.831	11.954	58.333	121.333
Child age (months)	390	14.821	5.180	5	25
Child being sick in the last two weeks	376	0.332	0.253	0	1
Caregiver being female	390	0.977	0.150	0	1
Caregiver's age	390	35.564	11.967	19	65
Caregiver's age squared/100	390	14.076	9.631	3.61	42.25
Caregiver's education (ref.: primary or below)					
Middle school	390	0.559	0.497	0	1
High school or above	390	0.133	0.340	0	1
Child's father being at home	390	0.374	0.485	0	1
Ln household income	390	9.994	0.833	6.908	12.206

Table 1.
Summary statistics

deal of variation between individual caregivers, average scores for life evaluations and positive emotions are somewhat high: the average scores for satisfaction with life, overall happiness, worthwhile life and positive affect are 7.228, 7.408, 7.769 and 7.085, respectively, out of 10. Average scores for negative affect are fairly low, at 2.961 out of 10. Additionally, average scores for depression are 6.114 out of 28, and average scores for anxiety and stress are 6.057 and 8.672 out of 34, respectively. Looking at child development indicators, the share of developmentally delayed children is surprisingly high: 58.9%, 66.3%, 42.7% and 49.4% for cognitive, language, motor and social-emotional skills, respectively.

2.3 Statistical analysis
We use an OLS analysis to estimate the correlations between caregivers' subjective well-being and child development. We use the following equation for our main empirical model:

$$SWB_i = \alpha + D_i'\delta + X_i'\Phi + \epsilon_i, \tag{1}$$

where SWB_i is the measure of caregiver i's subjective well-being, D_i is the set of child development indicators, and X_i is the set of covariates, including child and caregiver characteristics, county and enumerator dummies. ϵ_i is the error term. Standard errors are clustered at the village level to allow for arbitrary correlation within villages. δ is the vector of coefficients we are interested in.

We mainly conduct the OLS analysis for our correlational empirical analysis. Though some subjective well-being measures are categorical with ordered values, OLS results would be very similar to nonlinear models, as shown in Ferrer-i-Carbonell and Frijters (2004). We thus rely on OLS estimates for easier interpretation of coefficients but conduct robustness checks by conducting ordered probit regressions.

As caregivers consist of mothers, grandmothers and others, we want to see if there is any heterogeneity in the correlation between child development and caregiver's subjective well-being. In other words, we want to test if the correlation between child development and caregiver's subjective well-being differ between mothers and nonmothers. We then modify Eqn (1) to include interaction term between mother caregivers and child development indicators for the heterogeneity analysis:

$$SWB_i = \alpha + D_i'\delta + \beta Mother_i + Mother_i * D_i'\gamma + X_i'\Phi + \epsilon_i, \tag{2}$$

where $Mother_i$ is a dummy variable indicating whether the mother is the primary caregiver (yes = 1, no = 0) and γ is the vector of coefficients we are interested in.

3. Main results
Table 2 presents the results of our OLS analysis examining links between the four child development indicators and measures of caregiver subjective well-being, where the key explanatory variables are the raw scores of the four child development indicators, specifically cognitive skills, language skills, psychomotor skills and social-emotional skills. The dependent variables in columns 1–3 are life evaluations, including satisfaction with life, overall happiness and worthwhile life, respectively. The dependent variables in columns 4–8 are emotional well-being measures, they are positive emotion (happiness yesterday), negative emotion and three scores from DASS (depression score, anxiety score, and stress score), respectively. Columns 1–8 have the same set of control variables, as specified in Section 2.

Our results show that children's social-emotional scores are positively associated with all three measures of life evaluation (satisfaction with life, overall happiness and worthwhile life) and with positive emotion in caregivers, significant at the 1%, 10%, 1% and 1% levels, respectively. In addition, language and motor skills are positively correlated with overall

	(1) Satisfaction with life	(2) Overall happiness	(3) Worthwhile life	(4) Positive emotion	(5) Negative emotion	(6) Depression score	(7) Anxiety score	(8) Stress score
Social-emotional skills	0.028*** (0.009)	0.023* (0.012)	0.030*** (0.008)	0.042*** (0.009)	−0.014 (0.012)	−0.028 (0.032)	−0.045 (0.034)	−0.023 (0.038)
Cognitive skills	−0.005 (0.014)	−0.017 (0.013)	−0.000 (0.013)	−0.020 (0.018)	0.001 (0.017)	0.041 (0.028)	0.013 (0.035)	0.043 (0.029)
Language skills	−0.005 (0.013)	0.037** (0.017)	0.018 (0.012)	0.023 (0.019)	0.013 (0.017)	0.023 (0.040)	−0.006 (0.035)	0.010 (0.035)
Motor skills	0.020 (0.015)	0.026** (0.011)	0.002 (0.012)	0.032* (0.016)	0.002 (0.012)	−0.037 (0.030)	−0.014 (0.031)	−0.049 (0.035)
Child age (months)	−0.008 (0.036)	−0.113** (0.047)	−0.037 (0.046)	−0.088* (0.051)	0.010 (0.043)	0.053 (0.102)	0.014 (0.068)	0.054 (0.114)
Child being sick in the last two weeks	−0.364 (0.480)	0.082 (0.672)	0.058 (0.412)	−0.639 (0.706)	1.301 (0.795)	0.192 (1.132)	0.691 (1.100)	0.048 (1.355)
Caregiver being female	−0.350 (0.957)	0.690 (1.393)	−0.961 (0.884)	−2.095*** (0.759)	0.578 (0.655)	−1.509 (1.364)	−0.918 (0.859)	−3.997** (1.910)
Caregiver's age	−0.190* (0.101)	−0.224* (0.119)	0.001 (0.107)	−0.181 (0.114)	0.193 (0.130)	0.005 (0.213)	0.073 (0.232)	−0.024 (0.284)
Caregiver's age squared/100	0.236* (0.130)	0.271* (0.155)	−0.020 (0.137)	0.209 (0.143)	−0.238 (0.160)	−0.003 (0.268)	−0.075 (0.291)	0.051 (0.360)
Middle school (caregiver)	−0.503 (0.397)	0.232 (0.415)	0.018 (0.293)	−0.279 (0.453)	−0.168 (0.507)	−1.651** (0.814)	−0.995 (0.837)	−0.282 (1.062)
High school or above (caregiver)	−0.696 (0.460)	−0.236 (0.612)	−0.273 (0.485)	−0.999** (0.444)	0.257 (0.655)	−1.717 (1.280)	−1.597 (1.031)	−1.128 (1.439)
Child's father being at home	0.406 (0.246)	0.459 (0.284)	−0.339 (0.274)	0.321 (0.359)	−0.863* (0.442)	−0.227 (0.730)	−1.878** (0.802)	−0.952 (0.702)
Ln household income	0.287* (0.164)	0.245 (0.204)	0.559*** (0.133)	0.292 (0.195)	−0.081 (0.210)	−0.584 (0.598)	−0.101 (0.439)	−0.433 (0.534)
Number of observations	376	283	376	376	284	375	375	375
Number of villages	32	28	32	32	28	32	32	32
R^2	0.101	0.159	0.150	0.133	0.140	0.111	0.119	0.102

Note(s): Standard errors in parenthesis are clustered at the village level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.
OLS regressions using
original child
development scores

happiness (significant at the 5% level), and motor skills are positively correlated with positive emotion (significant at the 10% level). However, neither language skills nor motor skills are significantly correlated with satisfaction with life and worthwhile life. Cognitive skills are not significantly correlated with any outcome variables of caregiver well-being, and none of the four child development indicators is significantly correlated with negative emotion or DASS scores.

The correlations between child development indicators and caregiver life evaluations and positive emotion are not only statistically significant, they are also economically meaningful. Based on the results presented in Table 2, an increase in child's social-emotional development score by one standard deviation (13.974) is associated with a 0.39 point increase in caregiver's satisfaction with life (13.974 × 0.028), which is equal to 5.41% of the sample mean for satisfaction with life (0.16 standard deviations). The impact of the same increase in a child's social-emotional development score on overall happiness is an increase of 0.32, which is 4.34% of the outcome's mean (0.12 standard deviations) The impact on worthwhile life is 0.42, which is 5.40% of the outcome's mean (0.18 standard deviations). The increase in positive emotion is 0.59, which is 8.28% of the mean outcome (0.21 standard deviations).

In Table 3, we define an indicator of delay in each skill to check the robustness of our main results. The model structure is the same as in Table 2, except that we replace the raw scores of the four development indicators with four dummy variables indicating developmental delay in each indicator. This yields qualitatively similar results as in Table 2. Delays in social-emotional skills are negatively correlated with life evaluations and positive emotion, though the effect on overall happiness is not statistically significant. Moreover, the coefficients are economically meaningful. For example, delays in child's social-emotional skills reduce a caregiver's life satisfaction by 0.487, which is 6.74% of the mean outcome (0.2 standard deviations). Delays in motor skills are also negatively correlated with life evaluations, overall happiness and positive emotion but not significantly correlated to worthwhile life. Delays in cognitive and language skills are not significant for any outcome variables at 5% significance level. Consistent with results in Table 2, none of these delays are significantly correlated with negative emotion or DASS scores.

Table 4 reports the results of our regression analysis using only two indicators to measure child development: social-emotional skills and average Bayley scores (average of the raw scores for cognitive, language and psychomotor development skills). Social-emotional skills are positively and significantly correlated with life evaluations and positive emotion, with almost identical coefficients as shown in Table 2. Average Bayley scores are also positively correlated with life evaluations and positive emotion but only statistically significant for overall happiness and positive emotion. Again, both social-emotional skills and average Bayley score are not significantly correlated with negative emotion or DASS scores.

3.1 Robustness checks
In this section, we conduct a few robustness checks. The results of these robustness checks are presented in Table 5. Our robustness checks mainly focus on life evaluations and positive emotion. These four variables have ordered responses; thus, we conduct ordered probit regressions to check for consistency with OLS estimates. Results are presented in Panel A of Table 5. Child development indicators and control variables are the same as in columns 1–4 of Table 4. We find that social-emotional skills are significantly and positively correlated with all the four outcome variables, and Bayley scores are also positively correlated with all four outcome variables but not significantly correlated with satisfaction with life. These results are similar to the results in Table 4, except that the coefficient of average Bayley score for worthwhile life becomes significant in ordered probit estimates.

	(1) Satisfaction with life	(2) Overall happiness	(3) Worthwhile life	(4) Positive emotion	(5) Negative emotion	(6) Depression score	(7) Anxiety score	(8) Stress score
Delay in social-emotional skills	−0.487** (0.226)	−0.272 (0.348)	−0.512** (0.227)	−0.846*** (0.243)	0.415 (0.348)	0.686 (0.736)	1.197* (0.691)	0.602 (0.764)
Delay in cognitive skills	0.051 (0.255)	−0.274 (0.436)	−0.128 (0.224)	0.202 (0.356)	−0.003 (0.396)	−0.634 (0.711)	−0.351 (0.665)	−0.627 (0.909)
Delay in language skills	0.174 (0.288)	−0.470 (0.333)	−0.342 (0.308)	−0.556* (0.305)	−0.183 (0.350)	−0.045 (0.820)	0.322 (0.663)	−0.024 (0.952)
Delay in motor skills	−0.854*** (0.311)	−1.031** (0.391)	−0.425 (0.336)	−1.051** (0.393)	−0.656 (0.538)	0.745 (0.874)	0.260 (0.836)	0.708 (0.908)
Child age (months)	−0.013 (0.026)	−0.100** (0.038)	−0.047 (0.036)	−0.074** (0.035)	−0.018 (0.052)	0.039 (0.088)	−0.001 (0.059)	0.004 (0.098)
Child being sick in the last two weeks	−0.389 (0.491)	0.049 (0.706)	−0.022 (0.422)	−0.716 (0.751)	1.390* (0.801)	0.149 (1.133)	0.797 (1.150)	0.067 (1.413)
Caregiver being female	−0.257 (0.998)	0.792 (1.324)	−0.907 (0.903)	−1.891** (0.692)	0.576 (0.609)	−1.518 (1.476)	−1.065 (0.882)	−4.180** (1.900)
Caregiver's age	−0.172* (0.100)	−0.229* (0.125)	0.017 (0.110)	−0.156 (0.113)	0.189 (0.132)	−0.018 (0.207)	0.037 (0.228)	−0.038 (0.288)
Caregiver's age squared/100	0.213 (0.129)	0.277 (0.163)	−0.043 (0.141)	0.178 (0.141)	−0.239 (0.163)	0.025 (0.261)	−0.031 (0.285)	0.064 (0.367)
Middle school (caregiver)	−0.516 (0.390)	0.223 (0.464)	−0.021 (0.307)	−0.282 (0.427)	−0.250 (0.479)	−1.622* (0.839)	−0.999 (0.823)	−0.374 (1.060)
High school or above (caregiver)	−0.69 (0.444)	−0.17 (0.718)	−0.250 (0.494)	−0.927** (0.378)	0.254 (0.620)	−1.593 (1.272)	−1.584 (1.005)	−1.212 (1.454)
Child's father being at home	0.330 (0.241)	0.424 (0.304)	−0.384 (0.280)	0.248 (0.332)	−0.897* (0.440)	−0.117 (0.701)	−1.834** (0.764)	−0.889 (0.682)
Ln household income	0.277* (0.161)	0.244 (0.214)	0.565*** (0.137)	0.291 (0.197)	−0.110 (0.213)	−0.585 (0.601)	−0.118 (0.440)	−0.421 (0.539)
Number of observations	376	283	376	376	284	375	375	375
Number of villages	32	32	32	32	28	32	32	32
R^2	0.097	0.138	0.134	0.113	0.146	0.106	0.118	0.097

Note(s): Standard errors in parenthesis are clustered at the village level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3.
OLS regressions using dummy variables indicating delay in child development

	(1) Satisfaction with life	(2) Overall happiness	(3) Worthwhile life	(4) Positive emotion	(5) Negative emotion	(6) Depression score	(7) Anxiety score	(8) Stress score
Social-emotional skills	0.028*** (0.009)	0.024* (0.012)	0.031*** (0.008)	0.044*** (0.008)	-0.013 (0.012)	-0.030 (0.031)	-0.046 (0.034)	-0.026 (0.036)
Average Bayley score	0.009 (0.014)	0.047*** (0.015)	0.020 (0.013)	0.034** (0.013)	0.016 (0.011)	0.026 (0.029)	-0.006 (0.026)	0.004 (0.036)
Child age (months)	0.018 (0.027)	-0.087* (0.047)	-0.041 (0.036)	-0.046 (0.034)	0.006 (0.037)	-0.024 (0.082)	-0.010 (0.060)	-0.034 (0.092)
Child being sick in the last two weeks	-0.380 (0.477)	0.006 (0.703)	0.057 (0.405)	-0.671 (0.745)	1.292 (0.783)	0.233 (1.127)	0.709 (1.104)	0.099 (1.389)
Caregiver being female	-0.391 (0.916)	0.729 (1.431)	-0.929 (0.879)	-2.097*** (0.683)	0.601 (0.659)	-1.407 (1.423)	-0.911 (0.910)	-3.902* (2.010)
Caregiver's age	-0.196* (0.100)	-0.232* (0.117)	-0.001 (0.106)	-0.196* (0.110)	0.193 (0.129)	0.026 (0.205)	0.080 (0.230)	0.001 (0.275)
Caregiver's age squared/100	0.246* (0.130)	0.282* (0.152)	-0.020 (0.135)	0.228 (0.139)	-0.240 (0.158)	-0.036 (0.259)	-0.086 (0.288)	0.014 (0.347)
Middle school (caregiver)	-0.461 (0.385)	0.262 (0.437)	0.009 (0.296)	-0.221 (0.463)	-0.185 (0.493)	-1.761** (0.814)	-1.028 (0.844)	-0.407 (1.069)
High school or above (caregiver)	-0.690 (0.463)	-0.088 (0.609)	-0.225 (0.469)	-0.877** (0.430)	0.282 (0.690)	-1.774 (1.236)	-1.653 (0.978)	-1.227 (1.450)
Child's father being at home	0.406 (0.249)	0.526* (0.271)	-0.338 (0.277)	0.324 (0.346)	-0.853* (0.445)	-0.232 (0.740)	-1.879** (0.799)	-0.958* (0.711)
Ln household income	0.290* (0.157)	0.229 (0.201)	0.550*** (0.135)	0.276 (0.202)	-0.087 (0.209)	-0.588 (0.590)	-0.093 (0.437)	-0.430 (0.536)
Number of observations	376	283	376	376	284	375	375	375
Number of villages	32	28	32	32	28	32	32	32
R^2	0.095	0.144	0.147	0.119	0.139	0.105	0.118	0.095

Note(s): Standard errors in parenthesis are clustered at the village level. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 4.
OLS regressions
aggregated child
development scores

	(1) Satisfaction with life	(2) Overall happiness	(3) Worthwhile life	(4) Positive emotion
Panel A: ordered probit regressions				
Social-emotional skills	0.012*** (0.004)	0.008* (0.004)	0.015*** (0.003)	0.017*** (0.003)
Average Bayley score	0.002 (0.006)	0.017*** (0.005)	0.014** (0.006)	0.009* (0.005)
Number of observations	376	283	376	376
Pseudo R^2	0.017	0.025	0.028	0.022
Number of villages	32	28	32	32
Panel B: OLS for dependent variables dropping extreme values ("0" and "10")				
Social-emotional skills	0.020*** (0.006)	0.021* (0.010)	0.028*** (0.010)	0.024** (0.011)
Average Bayley score	0.021* (0.012)	0.024 (0.014)	0.012 (0.014)	0.019 (0.013)
Number of observations	267	181	235	262
R^2	0.169	0.208	0.227	0.249
Number of villages	32	26	32	32
Panel C: OLS for dependent variables converted to binary (=1 if > 6, = 0 otherwise)				
Social-emotional skills	0.004** (0.002)	0.004** (0.002)	0.003*** (0.001)	0.006*** (0.001)
Average Bayley score	0.002 (0.003)	0.005** (0.002)	0.004* (0.002)	0.004* (0.002)
Number of observations	376	283	376	376
R^2	0.091	0.129	0.121	0.143
Number of villages	32	28	32	32

Note(s): Only the two development indicators are reported for brevity, though same set of covariates as in Table 2 are controlled for in all models. Standard errors in parenthesis are clustered at the village level. $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 5.
Robustness checks

In the responses to the four questions, we find that many respondents answer "10" (the best possible outcome). For instance, 26.92% of respondents answer "10" for the satisfaction with life question. We suspect that respondents may have not fully understood or misinterpreted the meaning of "10". If they had not well-differentiated the degree of satisfaction between different scales, "10" may have just meant "satisfied" to them instead of "very satisfied." To relieve this concern, we modify the dependent variables to check the robustness of our results. First, we simply drop extreme values from our dependent variables, converting "0" and "10" into missing values. Second, we recode the dependent variable as binary whereas it has value "1" if the original answer is larger than 5 and "0" if being smaller or equal to 5. By doing so, we are less likely to have inaccurate answers for whether caregivers are "satisfied" or "not satisfied," though we lose the degree of satisfaction.

We report the results of these two modified regressions in Panels B and C of Table 5. Panel B reports OLS estimates for dependent variables when dropping extreme responses (e.g. "0" and "10"). The correlations of social-emotional skills are all significant, though the coefficient size decreases a bit compared to the results in columns 1–4 in Table 4. The coefficient of social-emotional skills for satisfaction with life, overall happiness, worthwhile life and positive emotion decreases by 0.008, 0.003, 0.003 and 0.020, respectively. The coefficients of average Bayley score are still all positive, though only significant at the 10% level for satisfaction with life. The sizes of coefficients are considerably smaller, except for satisfaction with life.

Panel C presents OLS for binary dependent variables. The coefficients of social-emotional skills are all positive and significant, and the coefficients of average Bayley score are also all positive. Overall, results in panels B and C are consistent with the main results in Table 4.

3.2 Heterogeneity analysis

People may wonder whether child development outcomes differ across caregiver groups, namely between mothers and nonmothers. In our sample, mothers account for 70.25% of caregivers. Among the nonmother caregivers, grandmothers dominate, accounting for 91.38%. The mean scores of social-emotional skills are 81.72 and 85.04 in the mother and nonmother group. The mean average Bayley score in the mother and nonmother group are 92.47 and 93.67, respectively. Though it seems child development is slightly worse in the mother caregiver group, the differences are not significant at 10% significance level for either variable.

We next test whether the relationships between child development and caregiver's subjective well-being are the same between mothers and nonmothers. We run OLS regressions following Eqn (2) and report the results in Table 6. As we show, the correlation between social-emotional skills and the mother caregiver dummy are not significant for any subjective well-being measures. It is also insignificant for the correlation between average Bayley score and the mother caregiver dummy. Thus, we do not find evidence that child development correlates with caregiver's subjective well-being differently for mother and nonmother caregivers [4].

4. Conclusions

This paper reports the indicators of child development in rural China and examines the correlation between child development and caregivers' subjective well-being. We show that developmental delay is quite prevalent in rural China. In the analysis on the correlation between child development indicators and caregivers' subjective well-being, we find that children's social-emotional skills are positively and significantly associated with life evaluations and positive emotion. In addition, Bayley scores are also positively correlated

	(1) Satisfaction with life	(2) Overall happiness	(3) Worthwhile life	(4) Positive emotion	(5) Negative emotion	(6) Depression score	(7) Anxiety score	(8) Stress score
Social-emotional skills	0.018 (0.018)	0.029 (0.020)	0.038** (0.016)	0.048*** (0.017)	−0.002 (0.027)	0.035 (0.061)	−0.020 (0.051)	−0.021 (0.053)
Average Bayley Score	0.033 (0.027)	0.063** (0.024)	0.008 (0.019)	0.044** (0.016)	0.010 (0.023)	0.016 (0.050)	0.009 (0.048)	0.043 (0.066)
Mother being primary caregiver	2.013 (2.771)	2.607 (2.053)	−1.164 (2.907)	1.518 (2.509)	0.371 (3.976)	5.292 (7.650)	4.988 (5.302)	6.186 (6.180)
Social-emotional skills × mother caregiver	0.014 (0.018)	−0.008 (0.022)	−0.011 (0.021)	−0.006 (0.019)	−0.015 (0.037)	−0.092 (0.062)	−0.035 (0.043)	−0.006 (0.057)
Average Bayley Score × mother caregiver	−0.035 (0.026)	−0.024 (0.023)	0.015 (0.021)	−0.015 (0.021)	0.007 (0.029)	0.013 (0.064)	−0.020 (0.049)	−0.052 (0.063)
Number of observations	376	283	376	376	284	375	375	375
R^2	0.101	0.147	0.151	0.121	0.140	0.113	0.120	0.098
Number of villages	32	28	32	32	28	32	32	32

Note(s): To save space, only the two development indicators are reported, though same set of covariates as in Table 2 are controlled for in all models. Standard errors in parenthesis are clustered at the village level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 6.
Heterogeneity analysis: OLS regressions with interaction terms between development skill and mother caregiver

with caregivers' life evaluations and positive emotion but less significantly. However, we do not find any significant correlation between child development indicators and negative emotion or DASS scores.

The relationship between child development and the subjective well-being of caregivers is an important issue which has sparked discussion for quite some time. Our study shows the immediate impacts of early child development on caregivers, adding to the literature on the short-term and long-term impacts of early childhood development. It also contributes to the growing number of studies on the relationship between parenting and caregiver's subjective well-being. However, our correlational analysis is limited by the nature of the cross-sectional data used. We are not able to fully rule out the possibility of omitted variable bias. We will revisit this analysis once we finish the end-line survey so that we can use the panel data to rule out individual fixed effect.

The correlation between early childhood developmental delay and caregiver subjective well-being found in this paper does not necessarily imply unidirectional causality. Actually studies show that early childhood developmental delays and caregiver subjective well-being negatively affect each other and can potentially turn the child–caregiver interaction into vicious circle. Although parent-focused training interventions are critical, targeting a child's early development directly also may improve outcomes for this population. Children, not families, are typically the focus of early intervention programs, but caregivers of young children with early developmental delays are another group likely in need of services. Psychological interventions concerning positivity and mindfulness improve satisfaction, worthwhile and well-being in caregivers of children with early developmental delay.

Notes

1. The word "happy" in "Overall, are you happy?" was translated as *Xingfu* in Chinese. It is an evaluation of general life state. The word "happy" in "How happy were you yesterday?" was translated as *Kuaile* in Chinese. *Kuaile* is more like a transient measure of emotion.

2. More information on the DASS can be found at the website: www.psy.unsw.edu.au/dass/.

3. The survey question for household income was "What is your annual household income approximately (unit: Yuan)?". To address the possible measurement error of household income, we also collected information about the value of house and other assets, for example: car or trunk, air conditioner, water heater, flash toilet, refrigerator and network connection etc. We also asked whether the family was the low-income household (poor household). By collecting above information, we could double check the household income information in the survey.

4. We also tested the heterogeneity using delay in each of the four development indicators and found no significant difference between mothers and nonmother caregivers in general, though mothers seem to be more depressed in case of delay in social-emotional skills and more stressed in case of delay in motor skills.

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