Development after international adoption

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3. Infants' physical and cognitive development after international adoption from foster care or institutions in China

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Abstract

Objective: To compare the physical, cognitive, and motor development of infants adopted from foster care with infants adopted from institutions. *Method:* Forty-two formerly fostered and 50 post-institutionalized girls adopted from China, aged between 11 and 16 months on arrival, were visited 2 and 6 months after adoption. Children's height, weight, and head circumference were measured. Stress regulation was assessed by diurnal salivary cortisol levels, and cognitive and motor development were assessed using the Bayley Scales of Infant Development - second edition. *Results:* At both assessments, the (modest) physical growth delays were similar for formerly fostered and post-institutionalized children. For weight and head circumference (but not for height) a catch-up over time was found, with a significant interaction between time and age at arrival, showing a more rapid catch-up for earlier adopted children. The daily cortisol curves of the formerly fostered and post-institutionalized children were similar and did not change over time. At both assessments, the former foster children outperformed the post-institutionalized children on mental and motor skills. Both groups showed a similar catch-up for mental development. For motor development, no catch-up was found. *Conclusions:* The influence of pre-adoption foster versus institutional rearing seems more pronounced for cognitive and motor development than for physical development and hormonal stress regulation. Our outcomes suggest that pre-adoption foster care is less detrimental to children's cognitive and motor development than institutional rearing.

Introduction

Do internationally adopted children from institutional care show larger developmental delays than children adopted from foster care, and do they catch up at a different pace after adoption? In this short-term longitudinal study, we compared the physical, cognitive, and motor development of formerly fostered and post-institutionalized Chinese adoptees (aged 11-16 months at adoption), 2 and 6 months after adoptive placement.

Adopted children frequently display developmental delays as a consequence of being raised in institutions where they are often understimulated.[1] Pre-adoption

foster care may offer a more normative family-type rearing arrangement. For example, better cognitive skills have been found in foster children compared with institutionalized children,[2] and more normative auxological outcomes were reported for children adopted from foster care compared with post-institutionalized adopted children.[3] Although studies have examined the catch-up of adopted children in general, hardly any study has examined the development of foster and institutionalized children separately, shortly after adoption.

Research has focused on post-institutionalized Romanian children[4] but less is known about Chinese adoptees, although there are exceptions.[5] Because many international adoptions are from China nowadays, it is the largest sending country worldwide,[6] it is imperative to study this group, because children from different countries may vary in their initial development and catch-up after adoption due to variations in pre-adoption contexts.[7,8] For example, Chinese adoptees exhibit relatively low disability rates,[9] and they may have suffered less prenatal adversity, such as maternal alcohol abuse,[7,10] because most of them have been abandoned as a result of the one-child policy.[11]

In general, children show an impressive catch-up after adoption,[1] though for some developmental domains (e.g., height) the most complete catch-up is documented for children adopted before their first birthday.[1,12] Less or absent catch-up of later adopted children may indicate sensitive periods in development after which recovery becomes more difficult.[2,4]

Growth

Delayed physical growth is the most common medical problem in post-institutionalized adoptees. It is an indicator of poor nutritional intake and lack of psychosocial stimulation, and it has been associated with developmental delays.[7] A study on Guatemalan adoptees has shown that pre-adoption foster care was less detrimental for children's auxological outcomes than pre-adoption institutional care.[3]

Several studies have confirmed the presence of growth delays in Chinese adoptees, both for height, weight, and head circumference.[5,8,10,13,14] In the first 6 months after arrival, Chinese adoptees were reported to show catch-up growth for all three measures,[8,10] although normal growth rates - indicating no "additional" catch-up - 6, 12, and 24 months after adoptive placement have also been found.[5] Information on differential catch-up growth of foster and post-institutionalized children was not reported in these studies. Only one study compared adopted children who had received "some foster care" with post-institutionalized children. Foster children had a larger head circumference but similar weight and height.[10]

Stress regulation

The Hypothalamic-Pituitary-Adrenal axis (HPA-axis), of which cortisol is the end product, has two primary functions: it maintains the circadian cortisol rhythm, characterized by high morning and low evening levels, and it is involved in stress responses.[15] At birth, the HPA-axis is highly unregulated, and it matures

throughout childhood.[15,16] Early adversity can hamper the maintenance of the normal daily cortisol rhythm.[15,17] When sensitive care is lacking children may come to experience chronic stress, which may eventually lead to dysregulation of the HPA-axis. Several studies have focused on cortisol in institutionalized and post-institutionalized children from Eastern Europe. In an Ukrainian sample institutionalized and family-reared children showed similar patterns of diurnal cortisol production with decreases over the day,[18] but other studies found blunted morning cortisol levels and an absence of a systematic decrease over the day in institutionalized children.[19] Blunted cortisol levels may be a consequence of chronic activation of the HPA-axis which in turn leads to downregulation of the HPA-system.[20]

Two months after adoption, institutionalized children have been reported to show smaller decreases in cortisol level during the day compared with non-adopted family-reared children, whereas 8 months after adoption, this difference had disappeared.[21] In another study, 6 and a half year after adoption, post-institutionalized children displayed a fairly normal diurnal rhythm, but children who had experienced longer institutionalization showed slightly higher cortisol levels during the day.[17] In addition, several years after adoption, post-institutionalized children who had experienced extremely deprived care had significant growth delays, which in turn predicted high morning cortisol levels and a large decrease during the day.[22] Although it may be expected that post-institutionalized adopted children show a more deviant diurnal cortisol curve than children adopted from foster care, this has not been studied yet. In addition, the cortisol curves of adopted children may differ from those of non-adopted children[21,23] (as foster children differ from non-foster children[23]).

Cognitive and motor development

Virtually all international adoptees show cognitive and motor delays. Studies on formerly fostered and post-institutionalized children from various countries have shown slightly different outcomes, with two studies showing better cognitive and motor skills for foster children,[10,24] one study showing better motor skills,[25] and one study showing better cognitive skills[3] for foster children. Regarding catch-up, one small-scale study found that within 6 months after adoption (age at adoption: 5-36 months; six countries of origin), former foster children (n = 7) were found to maintain their developmental rate, whereas post-institutionalized children (n = 18) showed catch-up in cognitive and motor development.[24] Chinese adoptees have also been reported to show cognitive and motor delays at arrival and a partial catch-up within the first 6 months after arrival.[5,8,10] Whether catch-up differed for children adopted from foster care or from institutions in China was not reported.

Hypotheses

We examined the possible delays of the adopted children by comparing their scores with the norm scores of non-adopted children regarding physical growth and cognitive and motor development, and by comparing their cortisol curves

with those of non-adopted children. We hypothesized that (*a*) infants from institutions present larger delays in physical growth than children from foster care, with both groups showing catch-up in growth after adoption. (*b*) Infants from foster care show a more normal diurnal cortisol curve than children from institutions; after 6 months of exposure to adoptive family life the curves of the two groups may be more similar. Additionally, as the cortisol curves of adopted children may differ from those of non-adopted children raised in their biological families, we examined possible differences between the cortisol curves of adopted and non-adopted children. (*c*) Infants from institutions display more delayed cognitive and motor skills than children from foster care, and both groups show catch-up in cognitive and motor development after adoption.

Method

Participants and procedure

All three Dutch agencies mediating adoptions from China contacted all parents adopting an infant girl between 11 and 16 months of age on arrival in the Netherlands and handed out information packages about the study. We selected girls to prevent a skewed gender distribution (89% of Chinese adoptees were female when the data collection started[26]). In total, 198 families received an information package, of which 152 families responded (77%). Of these 152 families, 100 families agreed to participate (66%), 52 families did not want to participate (34%; most families mentioned that the laboratory was too far away, they found participating too time-consuming/ exhaustive for their child). Eight families dropped out (five families found participation too exhaustive, one family considered the distance to the laboratory too large, one parent fell sick, and one child unexpectedly had to undergo surgery).

All children were involved in assessments 2 months after the child's arrival (Time 1) and again 4 months later (Time 2: 6 months after adoption). The parents completed questionnaires on background variables (e.g., parental education) and the background of the child (e.g., time in institutional/foster care). Parental age and education of the institutionalized and foster children did not differ. Based on their rearing background in China, the 92 children were classified as institutionalized or foster children. The 50 institutionalized children had lived in an institution for most of their pre-adoption life and experienced other types of care for a maximum of 1 month. The 42 foster children had experienced foster care - sometimes combined with another type of family care - (n = 16), or a combination of foster and institutional care (n = 26). The foster children had on average experienced 3.65 months of institutional care (range = 0 - 14) and 9.31 months of foster care (range = 1.44 - 14.85). To control for this variation, all analyses were repeated only including the foster children who had experienced foster care only (n = 16). As results were similar, we present the analyses of the foster group (including the mixed group) versus the institutionalized group. In 66 families, the adopted infant was the first child, 13 families already had an adopted child, and 13 families had birth children. Most children were reared

in two-parent families (n = 90), with highly educated parents (scale: 1 [primary school only] to 5 [university]; mothers: M = 3.79, SD = 0.92; fathers: M = 4.09, SD = 0.89). At arrival, the children were on average 13.03 months (SD = 1.35, range = 10.84 - 16.53). The assessments were on average 2.21 (SD = 0.19; Time 1) and 6.30 months (SD = 0.26; Time 2) after arrival. No significant differences were found between children from institutions and foster care.

Measures

Physical growth. At Time 1 and Time 2 data on weight, height, and head circumference were obtained by the parents following instructions of the examiner, and converted into z-scores using Anthro statistical software.[27] Missing values were imputed based on the regression line, which predicted the physical measures at Time 2 based on the assessments at Time 1 (range = 0 - 6 missing). When children with missing values were excluded from the analyses, or when missing values were substituted with mean growth delays, results were similar. Two outliers ($|z|>3.29$) were winsorized.

Stress regulation. Stress regulation was assessed by measuring salivary cortisol. To capture children's diurnal cortisol rhythm, the parents used cellulose-cotton tip sorbettes (Salimetric) and collected three saliva samples during an ordinary day. The samples were collected half an hour after the child woke up (M = 8:15 a.m.), before lunch (M = 13:00 p.m.), and in the evening, half an hour before the child went to bed (M = 19:15 p.m.). Sampling times were similar for institutionalized and foster children, and for Time 1 and Time 2. Families were informed that their children were not supposed to eat, drink, or brush their teeth half an hour before collection. Parents registered time of awakening, time of sampling, and medication intake.

Assays were performed at the University of Trier. Cortisol was assayed using a time-resolved fluorescence immunoassay. The intra-assay coefficient of variation of this immunoassay was between 4.0% and 6.7%, and the corresponding inter-assay coefficients of variation were between 7.1% and 9.0%. Cortisol samples with values ≤ 0.1 nmol/L and ≥ 100 nmol/L were coded as missing because of impossible values. All values were log10 transformed to normalize the skewed distribution.

To compare the daily curve of the adoptees with a non-adopted group, we selected 15 non-adopted Dutch children in the same age range (mean age 21.93 months, SD = 1.67) from a study on day care (M.G. Groeneveld, et al, unpublished data, 2009). For these children, four cortisol samples were collected during an ordinary day at home. Materials, protocols, analyses, and assay procedures (University of Trier) were identical to those used in the adoption sample. Mean collection times were 7:38 a.m. (SD = 35 minutes), 11:01 a.m. (SD = 13 minutes), 15:17 p.m. (SD = 26 minutes), and 18:00 p.m. (SD = 22 minutes). We intrapolated the cortisol values of the comparison group to estimate their cortisol values at the collection times of the adopted children. The (log transformed) mean intrapolated morning, afternoon, and evening

Table 1. *Correlations between time 1 and time 2 child outcomes for post-institutionalized (n = 50) and formerly fostered children (n = 42)*

	Time 2									
	Institutionalized					Foster care				
Time 1	Height	Weight	Head	MDI	PDI	Height	Weight	Head	MDI	PDI
Height	.80***	.73***	.45***	.25	.15	.83***	.69***	.43**	-.10	.12
Weight	.69***	.85***	.39**	.19	.12	.61***	.91***	.50***	-.00	.07
Head	.19	.33*	.62***	.16	-.05	.29	.35*	.70***	-.11	-.09
MDI	.14	-.01	-.12	.70***	.70***	.09	-.10	-.13	.54***	.28
PDI	.21	.01	-.01	.65***	.75***	.11	-.01	-.10	.40**	.49**

Note. *p<.05, **p<.01, ***p<.001; Head: Head Circumference; MDI: Mental Development Index; PDI: Psychomotor Development Index.

values of the non-adopted children were 0.89 (*SD* = 0.29), 0.39 (*SD* = 0.13), and -0.11 (*SD* = 0.44), respectively.

Bayley scales of infant development. To examine cognitive and motor development, the Dutch Bayley Scales of Infant Development - second edition[28] - was administered by a qualified examiner or a research assistant (trained by the examiner). The Bayley Scales of Infant Development was administered at home to ensure optimal test conditions, because children feel more at ease in a familiar environment and do not have to undertake a potentially tiring trip to the university. Cognitive development was assessed using the non-verbal Bayley Scales of Infant Development.[29] All children received a score for cognitive development (Mental Developmental Index) and psychomotor development (Psychomotor Developmental Index) by converting their raw scores into standard scores (*M* = 100, *SD* = 15, range = 55-145). Children with raw scores that placed their standard scores below 55 were assigned a score of 54 (for a comparable practice see Nelson et al, 2007[2]). Correlations between Psychomotor Developmental Index and Mental Development Index scores were .57 ($p < .001$) for Time 1 and .62 for Time 2 ($p < .001$).

Data-analysis

To test whether the growth and development of the adopted infants differed from the norm group, one-group *t*-tests were used. With repeated measures analysis of (co)variances, we examined catch-up and investigated whether outcomes differed for the institutionalized and foster children. Age at adoption was included as a covariate, as age at adoption proved to be an important predictor in adoption research.[1,4,25] When the contribution of age at adoption was not significant, it was removed from the final analyses. Correlations were computed between child outcomes and for the associations between Time 1 and Time 2 (Table 1). Two-tailed tests were used in all analyses.

Results

Growth

On average, the adopted children showed modest growth delays. For height, weight, and head circumference, the mean *z*-scores at Time 1 were -0.75 (*SD* = 1.04), -0.42 (*SD* = 0.86), and -.50 (*SD* = 0.85), respectively, and at Time 2 -0.69 (*SD* = 1.04), -0.26 (*SD* = 0.92), and -0.24 (*SD* = 0.95), respectively. All mean *z*-scores were significantly below zero (*t*-values ranging from -6.91 to -2.45, $p < .05$) with no significant differences between foster and institutionalized children. The correlations between the auxological measures were all significant (Time 1: range = .27 - .74; Time 2: range = .33 - .68).

For weight and head circumference, we found main effects for time and significant interaction effects between time and age at adoption, suggesting more pronounced catch-up for earlier adopted children than for later adopted children, $F(1,89) = 5.50$, $p < .05$, partial $\eta^2 = .06$ and $F(1,89) = 5.93$, $p < .05$, partial $\eta^2 = .06$,

respectively. No differences were found between the foster and institutionalized children. Regarding height, we did not find an increase in *z*-scores over time, nor a difference between the groups or an interaction effect.

Stress regulation: Diurnal cortisol curve

In total, 53 children had complete sets of three cortisol samples at Time 1 (27 institutionalized, 26 foster children) and 44 children had complete sets at Time 2 (21 institutionalized, 23 foster children). Seventeen institutionalized and 14 foster children had complete data for both assessments. There were no significant differences between the morning, afternoon, and evening values of children with and without complete cortisol sets (*t*-values ranging from -1.49 to 1.83, n.s.). The cortisol values of the children with two complete sets of values were not significantly different from the children who had only one complete set of values (*t*-values: -0.66 to 1.55, n.s.).

Figure 1 shows the cortisol curves of the institutionalized, foster, and non-adopted children. The cortisol values of the non-adopted children did not differ from those of the adopted children (*t*-values: -0.45 to 0.77, n.s.), with one exception. Compared with the non-adopted children, the former foster children had significantly higher afternoon cortisol values at the first assessment (non-adopted children, $M = 0.39$, $SD = 0.13$; foster children: $M = 0.56$, $SD = 0.17$, $t(39) = 3.33$, $p < .01$).

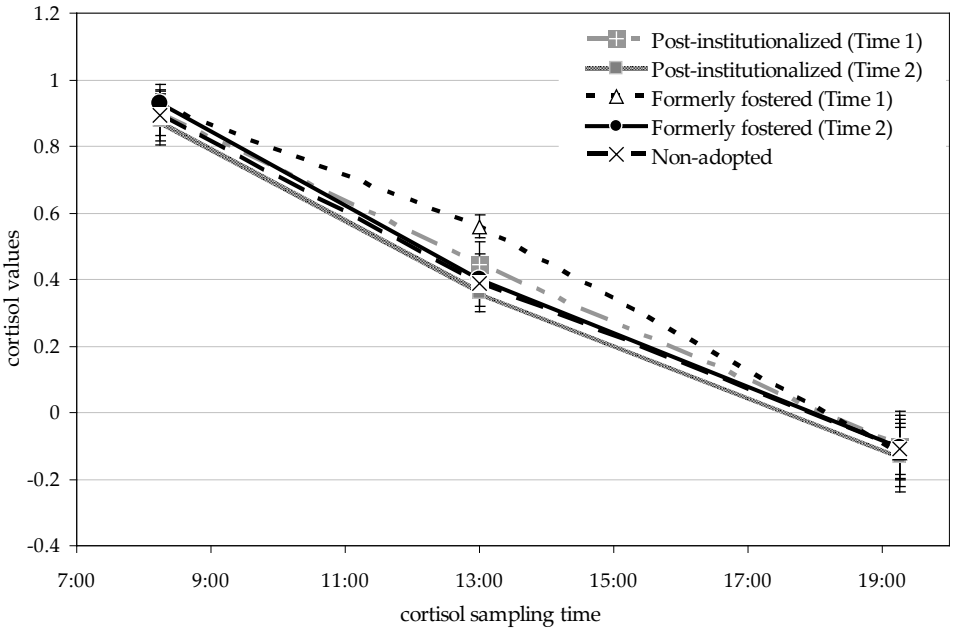

Figure 1. *Diurnal cortisol levels (log transformed) of the adopted and non-adopted children.*

For all six cortisol values (morning, afternoon, and evening values, at Time 1 and Time 2) no differences were found between the foster and institutionalized children (*t*-values ranging from -1.51 to 0.16, n.s.). The foster and institutionalized children did not show a change in their cortisol values from Time 1 to Time 2 (*t*-values: -0.18 to 1.87, n.s.).

At both Time 1 and Time 2 significant decreases in cortisol level were found across the day, $F(1.78, 90.65) = 173.72$, $p < .01$, partial $\eta^2 = .77$, and $F(2,84) = 119.87$, $p < .01$, partial $\eta^2 = .74$, respectively, but no difference between the two groups of adoptees and no interaction between group and time were found. The daily curve of the adopted children did not differ from the curves of the non-adopted children, $F(4,107) = 0.36$, n.s..

Cognitive and motor development

Cognitive development. A repeated measures analysis of variance showed that at both assessments the foster children had significantly better cognitive skills than the institutionalized children, $F(1,89) = 6.76$, $p < .05$, partial $\eta^2 = .07$ (Time 1: institution: $M = 74.04$, $SD = 18.41$, foster: $M = 84.40$, $SD = 17.62$; Time 2: institution: $M = 84.38$, $SD = 20.01$, foster: $M = 92.26$, $SD = 17.83$), although both groups had below average scores at both Time 1 and Time 2 (*t*-values ranging from -9.97 to -2.82, $p < .01$). The adopted children showed catch-up between the two assessments, $F(1,89) = 29.77$, $p < .001$, partial $\eta^2 = .25$, which was similar for both groups.

Motor development. A repeated measures analysis of variance showed that, at both assessments, the foster children had significantly better motor skills than the institutionalized children, $F(1,90) = 5.39$, $p < .05$, partial $\eta^2 = .06$ (Time 1: institution: $M = 85.16$, $SD = 18.84$, foster: $M = 93.05$, $SD = 17.94$; Time 2: institution: $M = 84.58$, $SD = 14.58$, foster: $M = 90.88$, $SD = 12.58$). Both groups showed a delayed development compared to the reference group (*t*-values: -7.48 to -2.51, $p < .05$). The adopted children did not show a catch-up between Time 1 and Time 2, as their motor skills developed in a similar pace as those of the norm group.

Discussion

In a group of 92 infant girls adopted from China, we found small to moderate delays in physical growth and cognitive and motor development at 2 months post-adoption, and catch-up 6 months after adoption for cognitive development, as well as for weight and head circumference, which was more pronounced for earlier adopted children. The daily cortisol curves of adopted and non-adopted children did not differ from each other, except for the foster children who showed higher afternoon values at Time 1. Contrary to our hypotheses, we found remarkably few significant differences in the development of the formerly fostered and post-institutionalized children. For example, no differences were found for physical growth and stress regulation. We did, however, find better cognitive and motor skills among foster children than among institutionalized children at both assessments.

Growth

The similar modest growth delays of institutionalized and foster children in our study may reflect fairly adequate diets in institutions nowadays, due to improving resources,[7] especially for those institutions handling international adoptions.[11] Our findings are consistent with the relatively good general health found in recently adopted Chinese children.[30]

For weight and head circumference, we found an interaction between time and age at adoption, suggesting a more pronounced catch-up for earlier adopted children. This converges with the larger catch-up that has been found for earlier placed adoptees in physical growth[12] and other domains, such as cognition and school performance.[1,2] The interaction is remarkable as the age range at adoption was relatively small (11-16 months). The catch-up rate may partly depend on the timing of placement in a beneficial environment, with earlier adopted children being more flexible and benefiting more rapidly, which may indicate sensitive periods during when recovery is easier,[2,4] but replication of this finding is necessary.

Weight recovered faster than height, which is congruent with evidence that weight is more dependent on recent food intake,[7] while for catch-up in height bone growth is necessary. This may take longer and requires "normal" growth hormone secretion, which can be suppressed in post-institutionalized children (D.E. Johnson, et al, unpublished data, 2009). Although catch-up for head circumference is usually less complete than for weight and height,[12] we already found some catch-up during this 6-month period.

Stress regulation

Contrary to expectations, the daily cortisol curves of the institutionalized, foster, and non-adopted children did not differ. This may reflect fairly adequate rearing arrangements for (at least some) institutionalized children. This hypothesis is supported by the modest growth delays of the institutionalized children, but not by their delayed cognitive and motor development. Perhaps the stress regulation system is more robust than the systems underlying cognitive and motor development. When comparing post-institutionalized and non-adopted children, comparable diurnal curves have already been found shortly after placement.[21] Moreover, institutionalized children in Ukraine showed a similar diurnal cortisol production as family-reared children.[18] We found slightly higher afternoon cortisol levels for the foster children at Time 1, compared with the non-adopted children. We speculate that this more dysregulated curve may have resulted from stress or grief experienced by the foster children after the separation from their foster parents.[23] However, replication of this finding is needed.

Cognitive and motor development

Consistent with previous studies, the adopted infants showed cognitive and motor delays.[5,10] Although they showed catch-up in cognitive development, this catch-up was not (yet) complete. Motor development was also below average at Time 2. This concurs with Cohen et al[5] who found complete catch-up for mental

and motor development not earlier than 2 years after adoption. Interestingly, we found no catch-up in motor development, which may be due to the infants' relatively well-developed motor skills at Time 1, leaving less room for the extra development implied in catch-up. The complexity of motor skills in children's second year of life (e.g., walking) may also be relevant. As children need time to practice and master these complicated skills, this may prevent children from showing catch-up growth directly after adoption. Finally, simple motor skills are controlled by the cerebellum, a part of the brain which is most susceptible to environmental influences.[31] In institutionalized children understimulation of the cerebellum before adoption may hinder normal development (and catch-up) of this brain region. It should be mentioned that we might have found catch-up in motor development if the first measurement had taken place directly after arrival.

Our hypothesis regarding better cognitive and motor skills in foster children compared to institutionalized children was supported, probably because of the more optimal rearing background of the foster children,[2] opposed to a relative lack of stimulation experienced by institutionalized children. Nevertheless, the below average development of the foster children at Time 1 suggests suboptimal rearing arrangements also in foster families.[3]

Institutions may be classified into three levels based on their quality of care[32]: (1) institutions characterized by global deprivation of health care, nutrition, stimulation, and relationship needs; (2) institutions with adequate health care and nutrition, but deprivation of stimulation and relationship needs; and (3) institutions that meet all needs except for stable relationships with consistent caregivers. Our results with regard to physical growth and cognitive and motor development suggest that the institutions where the children in our study were raised fall in the second category.

A limitation of the study is that salivary cortisol was sampled on 1 day only at Time 1 and at Time 2 rather than on several days to incorporate the possible instability of the cortisol values. In addition, the physical measures were reported by the parents, which may have introduced error. However, the high correlations between the auxological measures at 2 and 6 months after arrival and the correlations among these measures both at Time 1 and Time 2, indicate reliable assessments. As in many adoption studies,[7,8,22] we lacked reliable information about pre- and perinatal characteristics (e.g., birth weight).

Conclusion

This study is one of the few studies examining adopted children from China and the first to compare the development of foster and institutionalized children shortly after international adoption. It seems that the differential effects of pre-adoption foster and institutional care are more pronounced for cognitive and motor development than for physical growth and stress regulation. Our finding that foster care is less detrimental to children's cognitive and motor development than institutional rearing should be taken into account by clinicians working with adoptive families. It may also encourage adoption authorities to stimulate the increase of the number of foster families in the countries of origin.

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