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A comprehensive multi-level analysis of the Bucharest Early Intervention Project: causal effects on recovery from early severe deprivation

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Abstract

Objective.—The Bucharest Early Intervention Project is the first randomized controlled trial (RCT) of foster care as an alternative to institutional care (ClinicalTrials.gov Identifier: NCT00747396). We sought to synthesize data from nearly 20 years of assessments of the BEIP to determine the intervention effect size across timepoints and developmental domains. Our goal was to quantify the overall effect of the foster care intervention on children's outcomes and examine sources of variation in this effect, including domain, age, and sex assigned at birth.

Methods.—We used an intent-to-treat approach to examine the causal effects of the RCT for 136 children residing in institutions in Bucharest, Romania (baseline age 6–31 months) randomly assigned to foster care (n = 68) versus care as usual (n = 68). At ages 30, 42, and 54 months, and 8, 12, and 16–18 years, children were assessed for IQ, physical growth, EEG, and symptoms of five types of psychopathology.

Results.—Participants (48% female) provided 7,088 observations. Children randomized to foster care had better cognitive and physical outcomes and less severe psychopathology than did care-as-usual children. The magnitude of these effect sizes remained stable across development. The foster care intervention most influenced IQ and disorders of attachment/social relatedness.

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Conclusions.—Young children benefit from placement in families following institutional care. The benefits of foster care for previously institutionalized children were remarkably stable across development.

Introduction

Over and above basic needs like nutrition, shelter, and safety, infants require psychosocial care, including nurturance and stimulation, for healthy development. Unfortunately, millions of children being raised without parents experience severe deprivation in the context of institutional care, where high child-to-caregiver ratios and lack of nurturing care lead to psychosocial neglect even when survival needs are met (1, 2). Furthermore, psychosocial deprivation is not limited to institutions. Neglect is the most common form of maltreatment identified by U.S. Child Protective Services (3). Given that psychosocial deprivation both in institutional and family-based contexts is linked to delays in cognitive, physical, and socioemotional development (2, 4–6), understanding the impact of interventions that aim to promote recovery from early neglect is a public health priority.

Studying children's developmental functioning during and after exposure to institutional care provides insight into the effects of deprivation relevant to neglected children across contexts (7). Specifically, examining children's outcomes following placement in family-based care enhances knowledge of developmental plasticity, including the degree to which lasting improvement following early deprivation is possible (8). In 2001, the Bucharest Early Intervention Project (BEIP) was initiated and remains the only randomized controlled trial (RCT) of foster care as an alternative to institutional care (9). The goal of the BEIP was to examine the impact on development of high-quality family-based care following exposure to institutional care in early life (10). The trial enrolled 136 abandoned Romanian children at a mean age of 22 months. Following randomization to foster care or to care as usual, children were assessed across multiple developmental domains at baseline and at ages 30, 42, and 54 months (at which point the trial concluded and support of the foster care network was transferred to the Romanian authorities) (11). Follow-up assessments were conducted at ages 8, 12, and 16–18 years. Notably, over the intervening years, many children experienced placement changes (e.g., many care-as-usual children received family placements; some foster care group children experienced placement disruptions; and some children in each group returned to biological families). The ethical dimensions of this study have been widely discussed by the study team and others (4, 11–13).

The effects of the foster care intervention across development have been documented extensively (e.g., [14–19]). However, in keeping with scientific conventions, findings published to date largely focus on specific outcomes at discrete timepoints. Consistent with the aims of meta-science techniques like meta-analysis, by aggregating data across nearly 20 years of follow-up assessments, it is possible to provide a more accurate determination of the overall intervention effect size and identify sources of variation in this effect. By using a common approach to analyze data from multiple informants, time points, and developmental domains, we can address concerns about the robustness of scientific findings (20, 21). Further, this approach may help to guide future research and policy by documenting the

potential strengths and limitations of the intervention through capturing the relative breadth and stability of its effects across outcome domains and developmental stages.

In this study, we comprehensively analyzed over 7,000 observations of children's outcomes across domains of development collected from infancy through adolescence in participants of the BEIP. First, using intent-to-treat analyses, we quantified the overall causal effects of the foster care intervention on children's functioning across assessment waves and the domains of cognitive functioning, physical growth, brain electrical activity (EEG: relative alpha power), and psychopathology. Second, we explored moderators of the overall effects of the intervention, testing whether an enhanced foster care intervention has broad or specific effects on the development of children exposed to severe early deprivation. We assessed whether the effect of intervention varied as a function of outcome domain, age, and biological sex. Finally, we examined sources of variation in functioning among children randomized to foster care, allowing us to examine whether the timing and stability of family-based care was associated with children's outcomes.

Methods

Study design and participants

This study is a randomized controlled trial. 187 children residing in six institutions in Bucharest, Romania who were between 6–31 months were initially screened for participation. 51 of these children were excluded from the study due to medical conditions severely compromising development (e.g., genetic syndromes, signs of fetal alcohol syndrome, microcephaly). Thus, the final sample included 136 children (mean age at baseline [range] = 20.74[5.39–31.76] months; 51% female]) who had been abandoned at or shortly after birth and placed in institutions. Half of these children were randomized to the foster care group and the other half to the care-as-usual group (i.e., continued institutional care). Within the foster care group, the mean age of placement into a study-sponsored foster care family was 22.63 months (range = 6.81–33.01).

We present a CONSORT diagram of the flow of participants for the current analyses in Figure 1. Children completed follow-up assessments at ages 30, 42, and 54 months, and ages 8, 12, and 16–18 years. Of the 136 participants, 130 (65 foster care; 65 care as usual) completed at least one of these follow-up assessments. Overall, these 130 participants (48% female) provided 7,088 observations (3,628 foster care; 3,460 care as usual) between the 30-month to 16- to 18-year follow-up waves across the domains of cognitive functioning, physical growth, brain electrical activity, and psychopathology. Here, an observation refers to a single score for a given assessment at a given wave (e.g., each IQ score at each wave is a single observation). Across all waves and outcome domains, participants could complete a total of 68 possible assessments; on average, they completed 55 (80%) assessments. Supplementary analyses indicated that missing data were not differentially associated with intervention group or baseline characteristics. Children randomized to the foster care and care-as-usual groups did not differ on the basis of demographic variables, percent of lifetime in institutional care, cognitive functioning, or physical growth at baseline (Supplementary Table S1; King et al., unpublished 2022 data).

Within the foster care group, the stability of placement with the original study-sponsored foster family has been previously linked with children's outcomes (17, 22). In the current analyses, for each assessment, participants randomized to the foster care group were identified as "stable" if they remained with their original foster family at the time of the assessment or "disrupted" if they no longer resided with the family at that assessment. At the time of the 16- to 18-year assessment wave, 37 of the 65 (57%) foster care participants who completed at least one of the follow-up assessments had been disrupted from their original foster family. Two participants randomized to the foster care group were reunited with their biological families prior to placement in a study-sponsored foster family and thus are not included in stability analyses given that they were neither stably placed with nor disrupted from foster care. Children who were identified as "disrupted" and "stable" in later childhood and adolescence did not differ at baseline on the basis of symptoms of psychopathology or measures of IQ or physical growth (see Supplementary Material).

Randomization and masking

Young children living in institutions were assessed at mean age 22 months at baseline and randomized into either high-quality foster care or to care as usual; eligible children were randomized 1:1 into the foster care or care-as-usual groups. Assignment to group was done using slips of paper with subject identifiers written on them (sibling pairs included together) and drawn from a hat. Because foster care was extremely limited in Bucharest when the study began, the investigators, in collaboration with Romanian officials, created a foster care network (9, 23). After advertising and subsequent screening, 56 foster families were selected to care for the 68 children randomized to the foster care group. Given the nature of the study, masking of group assignments to children, their caregivers, and study investigators was not possible.

Procedures

Children's legal guardians provided signed informed consent (children age ≥ 8 years provided written or verbal assent). Ethics approval was provided by the institutional review boards of the three principal investigators' universities and by the local Commissions on Child Protection in Bucharest.

The foster care intervention was designed to be affordable, replicable, and grounded in findings from developmental research on enhancing caregiving quality. BEIP social workers who received regular consultation from U.S. clinicians supported the foster parents to provide child-centered care that emphasized meeting children's physical and psychological needs, including how to understand children's behavior in the context of their prior experience in the institution and their developmental stage (9, 23). All decisions regarding placements after randomization were made by child protection authorities and no child was retained in institutional care because of the study. Due to the evolution of child protection efforts in Romania, all but 13 children in the care-as-usual group were placed into family care by the age 18-year assessment wave. At age 54 months, the trial concluded, and support of the foster families was assumed by the Romanian government.

Outcomes

Primary outcomes for the RCT included several measures of cognitive functioning, physical growth, and psychopathology. For the current analyses, the primary outcomes were cognitive functioning, physical growth, brain electrical activity, and symptoms of five forms of psychopathology. Children were assessed for these outcomes at every follow-up wave except 54 months, when physical growth and brain activity were not assessed. We chose these outcomes because they were assessed consistently across waves, allowing for estimation of the overall effect of the intervention across ages. Given many potential outcomes, we down selected outcomes to ensure the feasibility and digestibility of the analyses while maximizing their usefulness for interpreting the impact of the BEIP in the context of previous literature. Importantly, the metrics included here may differ from those reported in prior manuscripts. We provide detailed information about each of the measures, including histograms, in the Supplementary Material.

Cognitive functioning was operationalized as IQ using the Bayley Scales of Infant Development (24) (30, 42 months), the Wechsler Preschool and Primary Scale of Intelligence (25) (54 months), and the Wechsler Intelligence Scale for Children–Fourth Edition (26) (8, 12, 18 years). Physical growth was operationalized as height (cm), weight (kg), and head circumference (cm). Brain electrical activity was operationalized as relative EEG power in the alpha frequency band (defined consistently with past BEIP reports [age 30–42 months: 6–10 Hz (27); age 8 years: 7–12 Hz (28); age 12–16 years: 8–13 Hz (29, 30)]) averaged across ten electrode sites (F3, F4, C3, C4, P3, P4, T7, T8, O1, and O2) collected at rest with eyes open. Relative alpha power, which minimizes interindividual differences in absolute power due to factors such as skull thickness, was computed as the proportion of absolute power in the alpha band relative to the total power across 1–45 Hz.

Psychopathology was operationalized as signs and symptoms of disorders of attachment/social relatedness (disinhibited social engagement disorder and reactive attachment disorder), attention-deficit/hyperactivity disorder (ADHD), externalizing problems (excluding symptoms of ADHD), and internalizing problems. Disinhibited social engagement disorder and reactive attachment disorder symptoms were measured using the Disturbances of Attachment Interview (31) (all waves; caregiver report). ADHD, internalizing, and externalizing symptoms were measured using the Infant-Toddler Social and Emotional Assessment (32) (30, 42 months; caregiver report), the Preschool Age Psychiatric Assessment (33) (54 months; caregiver report via interview), the MacArthur Health and Behavior Questionnaire (34) (8, 12, 16 years; caregiver and teacher report), and the Diagnostic Interview Schedule for Children, 4th Edition (35) (12, 16 years; caregiver report). All measures of psychopathology are well validated in severely deprived children.

Statistical analyses

Analyses were performed in *R* version 4.2.0 (36) and were two-tailed ($\alpha = .05$). Multi-level (i.e., mixed-effects) models were implemented using the “lme4” package (37). Prior to all analyses, scores on the outcome variables were standardized within wave and measure to account for the use of different measures across waves and so that values measuring different outcomes were on the same scale. Therefore, our analyses preclude examination of growth

curves (i.e., within-individual change in outcomes across time) and instead yield information about between-individual differences. Further, between-individual differences in effect sizes based on age of assessment must be interpreted relative to the measures used at those ages. For all models, we computed bootstrapped parameter estimates and 95% confidence intervals (1000 iterations) using the "parameters" package (38). We performed *F*-tests for interactions using the "anova" function from the "lme4" package (37), using Satterthwaite's method for calculating degrees of freedom.

Overall effects of randomization to foster care as an alternative to institutional care on children's outcomes

We used multi-level models to quantify the overall effect of the foster care intervention on children's IQ, physical growth, EEG relative alpha power, and psychopathology across assessment waves. We conducted two separate models corresponding to cognitive, physical, and neural outcomes (i.e., IQ, physical size, EEG power) and symptoms of psychopathology, respectively. Given that higher scores on IQ, physical size, and EEG power are interpreted as indicating healthier functioning whereas higher scores on each form of psychopathology indicate more difficulties, this grouping of outcome measures accomplished our goal of estimated overall effects of the foster care intervention while allowing straightforward interpretation of effect sizes. The dependent variable in each model was the standardized value on each measure at each assessment wave for the outcomes included in that model, such that the model of cognitive, physical, and neural outcomes contained 2,789 (1,425 foster care; 1,364 care as usual) observations and the model of psychopathology contained 4,299 (2,203 foster care; 2,096 care as usual) observations. In addition to modeling the effect of intervention group (foster care group vs. care-as-usual group, dummy-coded) on these values, we included terms for domain of psychopathology (effect-coded), exact age of assessment in years (mean-centered; see Supplementary Material), sex assigned at birth (effect-coded), a random intercept for participant, and a random intercept for biological family (to account for non-independence of data from six sibling pairs). For the model of psychopathology, we also controlled for informant (caregiver vs. teacher; effect-coded). In summary, this modeling approach allowed us to estimate the overall effect of the intervention across outcomes while accounting for variation across psychopathology.

Sources of variation in the effects of the intervention on children's outcomes

We tested whether outcome domain/type of psychopathology, exact age of assessment, or sex moderated the effect of the foster care intervention on children's outcomes by modeling interactions between these variables and the effect of intervention group. These interactions were tested in separate models from those of the overall effects of randomization to foster care and all interactions were included simultaneously in a single model. In the presence of a significant interaction, we probed simple effects by examining the effect of intervention group at different levels of the moderator(s) in a series of multi-level models. Given our goal of characterizing sources of variation in the effect of the foster care intervention, we did not adjust for multiple comparisons when testing simple effects of significant interactions. Thus, *p*-values for simple effects should be interpreted as nominal.

Sources of variation among children randomized to foster care: timing and stability of placement

Among children randomized to foster care only, we tested the associations of age of placement and stability of foster care placement with children's cognitive, physical, and neural outcomes and on their symptoms of psychopathology (see Supplementary Material for additional information about age and placement stability variables). While causality may be inferred from analyses testing the effects of intervention group on children's outcomes, analyses of sources of variation in outcomes among children in the foster care group are correlational in nature. Placement stability was treated as a time-varying dummy-coded variable. Given that the likelihood of disruption from the original foster care family increased with age (see Supplementary Material), this variable was only interpreted in interaction with age of assessment so that parameter estimates reflected the difference in functioning between currently stable and disrupted children at a given assessment occasion.

Results

We present descriptive statistics of the measures for each outcome as well as correlations among outcome scores averaged across assessment waves in the Supplementary Material.

Overall effects of randomization to foster care as an alternative to institutional care on children's outcomes

Results for analyses of the overall effects of the foster care intervention are displayed in Figure 2.

Cognitive, physical, and neural—We found an overall effect of the foster care intervention on cognitive, physical, and neural outcomes when considered collectively across assessment waves (β = 0.26, 95% CI[0.07, 0.46]). Compared to care as usual, children in the foster care group had significantly higher scores collapsing across IQ, physical growth, and EEG relative alpha power.

Psychopathology—We found an overall effect of the foster care intervention on symptoms collapsing across all five types of psychopathology and across assessment waves (β = −0.25, 95% CI[−0.42, −0.08]). Children in the foster care group had significantly lower symptoms of psychopathology than children in the care-as-usual group.

Sources of variation in the effects of the intervention on children's outcomes

Results for analyses examining variation in the effects of the intervention based on outcome domain and type of psychopathology are displayed in Figure 2. Standardized scores across ages of assessment for each group, outcome domain, and type of psychopathology are depicted in Figure 3.

Cognitive, physical, and neural—We found that outcome domain moderated the strength of the effect of the foster care intervention on children's cognitive, physical, and neural outcomes when considered collectively across assessment waves (F[2, 2664.99] = 5.57, p = .004). There were significant effects of the intervention on IQ (β = 0.39, 95%

CI[0.16, 0.63]) and physical growth (β = 0.28, 95% CI[0.07, 0.48]) but not on EEG relative alpha power (β = 0.06, 95% CI[−0.16, 0.29]). Children in the foster care group had significantly higher average IQ scores and were, on average, physically larger than were children in the care-as-usual group. The effects of the intervention on IQ and physical growth were significantly larger than on EEG alpha power, but there was no significant difference between the effects on IQ and physical growth (see Supplementary Material).

In two-way interactions, neither age of assessment (F[1, 2718.16] = 0.44, p = .506) nor sex (F[1, 124.13] = 0.01, p = .916) significantly moderated the effect of the intervention on cognitive, physical, and neural outcomes. However, there was a significant three-way interaction between intervention group, outcome domain, and sex. The effect of the intervention on physical size was similar for male and female children, whereas the effect on IQ was larger for female than male children (see Supplementary Material).

Psychopathology—We found that type of psychopathology moderated the effect of the foster care intervention on children's symptoms of psychopathology (F[4, 4157.60] = 11.85, p<.001). Children in the foster care group had significantly lower symptoms of disorders of attachment/social relatedness (disinhibited social engagement: β = −0.35, 95% CI[−0.56, −0.15]; reactive attachment: β = −0.61, 95% CI[−0.81, −0.39]) and internalizing problems (β = −0.22, 95% CI[−0.42, −0.03]) than did children in the care-as-usual group. In contrast, there was no significant overall effect of the foster care intervention on symptoms of ADHD or externalizing problems (ADHD: β = −0.05, 95% CI[−0.24, 0.15]; externalizing: β = −0.15, 95% CI[−0.32, 0.05]). The effects of the intervention on symptoms of disinhibited social engagement disorder and reactive attachment disorder were significantly larger than the effects on ADHD and externalizing symptoms; further, the effect of the intervention on reactive attachment disorder symptoms was significantly larger than the effects on internalizing and disinhibited social engagement disorder symptoms (see Supplementary Material).

In two-way interactions, neither age of assessment (F[1, 4261.80] = 2.16, p = .142) nor sex (F[1, 114.50] = 2.37, p = .127) moderated the effect of the foster care intervention on symptoms of psychopathology. However, there was a significant three-way interaction between intervention group, type of psychopathology, and age of assessment. Whereas effect sizes for disinhibited social engagement disorder, ADHD, and internalizing symptoms were similar across ages of assessment, the effect of the intervention on externalizing symptoms was close to zero at younger ages but medium in magnitude and significant in adolescence. In contrast, the effect of the intervention on reactive attachment disorder symptoms, although significant throughout development, was larger at younger ages than in adolescence (see Supplementary Material).

Sources of variation among children randomized to foster care: timing and stability of placement

The associations of placement stability with scores for each cognitive, physical, and neural outcome and type of psychopathology by age of assessment are displayed in Figure 4.

The associations of age of placement with scores for each cognitive, physical, and neural outcome and type of psychopathology are displayed in Supplementary Figure S15.

Cognitive, physical, and neural—We found a significant overall effect of age of placement in foster care on children's cognitive, physical, and neural outcomes ($\beta = -0.18$, 95% CI [−0.35, −0.03], $p = .016$). On average, across assessment waves and outcome domains, children placed in foster care relatively earlier within the range of 6–33 months had better cognitive, physical, and neural outcomes than did children placed in foster care later within this range. Outcome domain ($F[2, 1325.48] = 4.71$, $p = .009$) and age of assessment ($F[1, 1354.20] = 5.51$, $p = .019$) each moderated the association between age of placement in foster care and children's cognitive, physical, and neural outcomes. The magnitude of the effect of age placement in foster care was largest for IQ ($\beta = 0.30$, 95% CI [−0.48, −0.13], $p<.001$), followed by EEG relative alpha power ($\beta = -0.21$, 95% CI [0.40, −0.03], $p = .008$), and physical size ($\beta = -0.12$, 95% CI [−0.29, 0.03], $p = .116$). The effect of age of placement on IQ was significantly larger than on physical size but did not significantly differ between IQ and EEG alpha power or between EEG alpha power and physical size (see Supplementary Material). Further, age of placement was more strongly negatively associated with children's outcomes at younger compared to older ages (early childhood [3.5 years/42 months]: $\beta = -0.23$, 95% CI [−0.40, −0.08], $p = .002$; middle childhood [8 years]: $\beta = -0.18$, 95% CI [0.35, −0.03], $p = .018$; adolescence [16 years]: $\beta = -0.09$, 95% CI [−0.27, 0.08], $p = .306$; see Supplementary Material). Sex did not moderate the effect of age of placement in foster care on children's cognitive, physical, and neural outcomes.

In interaction with age of assessment, placement stability explained variation in children's cognitive, physical, and neural outcomes ($\beta = 0.21$, 95% CI [0.09, 0.33], $p<.001$). Placement stability was not associated with children's cognitive, physical, and neural outcomes in early childhood ($\beta = -0.11$, 95% CI [−0.31, 0.10], $p = .344$) or middle childhood ($\beta = 0.07$, 95% CI [−0.10, 0.23], $p = .448$), but, in adolescence, children who remained with their original foster family had better cognitive, physical, and neural outcomes than children who had been disrupted from this family ($\beta = 0.37$, 95% CI [0.16, 0.57], $p<.001$).

Psychopathology—There was no significant overall association of age of placement in foster care with children's symptoms of psychopathology when considered collectively across types of psychopathology and assessment waves ($\beta = 0.06$, 95% CI [−0.06, 0.19], $p = .296$). Age of assessment moderated the association between age of placement in foster care and symptoms of psychopathology ($F[1, 2118.47] = 15.30$, $p<.001$). Age of placement in foster care was positively associated with symptoms of psychopathology in early childhood ($\beta = 0.14$, 95% CI [0.01, 0.27], $p = .032$) but was not associated with symptoms in middle childhood ($\beta = -0.08$, 95% CI [−0.05, 0.20], $p = .236$) or adolescence ($\beta = -0.04$, 95% CI [−0.17, 0.09], $p = .530$; see Supplementary Material). Neither type of psychopathology nor sex moderated the association of age of placement in foster care with children's symptoms of psychopathology.

In interaction with age of assessment, placement stability was associated with children's symptoms of psychopathology ($\beta = -0.11$, 95% CI [−0.20, −0.02], $p = .019$). Placement

stability was not associated with children's symptoms of psychopathology in early childhood ($\beta = 0.01$, 95% CI [−0.16, 0.18], $p = .944$) or middle childhood ($\beta = -0.09$, 95% CI [−0.22, 0.04], $p = .200$) but, in adolescence, children who remained with their original foster family had fewer symptoms of psychopathology than children who had been disrupted from this family ($\beta = -0.25$, 95% CI [−0.40, −0.09], $p = .002$).

Discussion

In this study, we analyzed over 7,000 observations collected from 136 Bucharest Early Intervention Project (BEIP) participants assessed from infancy through adolescence. Our goal was to quantify the overall effects of this randomized clinical trial of high-quality foster care as an alternative to institutional care on children's functioning across multiple developmental domains. We also examined sources of variation in children's outcomes. Using intent-to-treat analyses, we found that children who were randomized to foster care had better cognitive and physical outcomes and less severe symptoms of psychopathology than did their peers who remained in care as usual and therefore experienced more prolonged exposure to psychosocially depriving conditions. The benefits of family-based care were remarkably consistent across development. Nonetheless, outcomes also differed based on developmental domain, the life stage in which children were placed in family-based care, and whether this care was stable across childhood and adolescence.

Although the benefits of the foster care intervention overall have been narratively summarized (4, 10), the current analyses reflect the first quantitative synthesis of individual-level data from the BEIP across domains. Our findings provide the most robust and comprehensive evidence to date that children exposed to severe early psychosocial deprivation benefit substantially when they receive enriching, family-based care. We found causal effects of the foster care intervention on IQ, physical growth, symptoms of disorders of social relatedness (reactive attachment disorder and disinhibited social engagement disorder), and internalizing symptoms. Among these domains, IQ and disorders of social relatedness were most sensitive to the benefits of the intervention (standardized coefficients ranged from .35–.60). The strong effects of the intervention on IQ are noteworthy given that the foster care intervention was not specifically designed to improve cognitive functioning but to improve caregiver–child relationships. The BEIP offers a model for the types of placements to be supported for children who are abandoned and orphaned (see [39] for a review of the policy and practice recommendations). The model of foster care used in the BEIP (4) encouraged foster parents to make a psychological commitment to the child, thereby differing from the model currently used in the U.S. that emphasizes only instrumental care needs. The BEIP model also included regular support from trained social workers and U.S. based psychologists to help foster parents meet the needs of children vulnerable to developmental and socioemotional difficulties.

The enhanced level of care for children post institutionalization may partially explain why the BEIP intervention outperformed in some domains the effects found in a recent meta-analysis of observational studies of recovery from institutionalization (2). For instance, although the BEIP findings are consistent with other studies indicating substantial recovery for cognitive development and physical growth, in contrast to the current findings of,

on average, improved symptoms of psychopathology, the meta-analysis of observational studies does not indicate recovery in children's socioemotional functioning. Importantly, these observational studies generally did not include assessments of reactive attachment or disinhibited social engagement disorder, which have specific etiology in caregiving deprivation (40). In the current analyses, the effect of the intervention on internalizing problems was smaller in magnitude compared to the effects on disorders of social relatedness, and the effect on externalizing problems (which excludes ADHD) emerged only in adolescence. Differences in findings between these observational studies and the BEIP may be related to the experimental design of the BEIP, which controlled for confounders (e.g., bias in selection of children for deinstitutionalization), and to the foster care intervention possibly delivering higher quality care than is typical following deinstitutionalization (2).

When viewed through the conceptual lens of *developmental cascades*, early competence can generate further wellbeing such that positive functioning spreads to other domains over time (41, 42). Generally, however, our intent-to-treat analyses did not reveal cascading positive effects of the foster care intervention. Instead, with the exception of externalizing problems for which we observed a sleeper effect consistent with previous analyses in subsets of these data (17, 43), we found that the benefits of foster care were similar throughout development. Specifically, the positive effects of the intervention on children's functioning persisted across nearly two decades of follow-up assessments during which children in both the intervention and care-as-usual groups experienced changes to their caregiving environments. Thus, the impact of the intervention can be described as rapidly apparent by age 30 months and sustained through late adolescence, with minimal evidence of fadeout over time. It is important to consider, however, that the intervention may have catalyzed subsequent positive experiences among children randomized to foster care that are partially responsible for its enduring effect. Lasting group differences are likely both a product of early exposure to family-based care *and* the longer-term experiences this exposure initialized.

Consistent with previous analyses of discrete timepoints and domains (15–17, 19, 29), we found that, among children who received the intervention, individual differences in timing of placement into foster care between the ages of 6–33 months and the stability of this placement were associated with outcomes in several areas. The current analyses enhance specificity in our understanding of these individual differences. While there was an overall association of age of placement with children's cognitive, physical, and neural functioning such that children placed earlier fared better, this association depended on the outcome domain. Children placed into foster care earlier had significantly higher IQ scores and relative alpha power but did not differ in physical growth from children placed later. Further, for both cognitive, physical, and neural outcomes and symptoms of psychopathology, the effect of age of placement varied from infancy to adolescence. Specifically, the benefits of earlier placement into foster care were apparent in early childhood but faded out by adolescence, possibly as later life experiences diminished the potency of earlier events. Importantly, however, *all* children in the intervention group were placed "early" by most definitions (i.e., by age 33 months), which was likely a key aspect of the overall success of the intervention. Thus, the diminishing effect of age of placement should not be interpreted as evidence that early intervention is not important.

In contrast to the waning effect of age of placement, the effect of placement stability was largest in adolescence, when, overall, children who remained with their original foster families had better cognitive and physical outcomes and less severe symptoms of psychopathology relative to children who experienced placement disruptions. The emergence of the effect of placement stability later in development is likely related both to the fact that more children had experienced disruptions by adolescence and that disruptions have harmful consequences (44). Although it is possible that children who experienced placement disruptions differed to begin with from children with stable placements, supplemental analyses indicated that children with disrupted placements in later childhood and adolescence were similar at baseline to those who remained stable in terms of psychopathology, cognitive functioning, and physical growth. However, we cannot rule out the possibility of bidirectional effects between preexisting child characteristics that contributed to placement disruption and the harmful role that placement disruptions have on child functioning. Outside the context of deinstitutionalization, our findings are consistent with literature documenting the importance of placement stability for the wellbeing of children placed in foster care following maltreatment in their families of origin (45–47).

It is important to note that we identified robust benefits of foster care as an alternative to institutional care. Findings regarding which domains of development were more or less sensitive to the intervention could be partially due to informant and/or measurement choices. For example, foster parents may be more likely to provide positive reports of their children than informants for children in institutional care. In terms of measurement, to facilitate comparison of effects sizes across ages, we processed EEG data from each assessment wave using a common protocol and focused only on data recorded from electrode sites sampled at every wave. To reduce the number of analyses, we examined only relative alpha power. It is possible that different processing choices or alternative indices of brain electrical activity would have revealed significant effects of the foster care intervention. Nonetheless, we did identify an association of age of placement into foster care with relative alpha power, suggesting that this measure is sensitive to the *timing* of intervention. Because specific assessment tools changed based on age of assessment, we were not able to examine trajectories of children's functioning, which would have provided important information about within-individual development, such as the rate and shape of growth. Relatedly, between-individual differences in effects sizes based on age of assessment are relative to the specific assessment tools used at those ages and could be partially driven by differences in those tools. Due to concerns regarding statistical power for analyses within the foster care group, we did not test three-way interactions in analyses of the associations of timing and stability of placement with outcomes; thus, we cannot determine whether these associations varied based on the confluence of multiple factors such as domain and development stage. Further, specific features of the institutional care or foster care environment In Bucharest at the time of the study may limit generalizability to all institutional and foster care settings worldwide. Finally, although the BEIP provides firm causal evidence of the benefits of family placements for children following early institutional care, many questions remain unanswered, including fully understanding how aspects of the prenatal, early institutional, and eventual family environments influence recovery.

Conclusions

Millions of children worldwide experience psychosocial deprivation in institutions, and many more are neglected in their families of origin. Against this backdrop, 6.7 million children have lost a parent or caregiver due to the COVID-19 pandemic (48–50). As the only randomized clinical trial of foster care as an alternative to institutional care, the BEIP provides unique evidence for the causal effects of deprivation and subsequent caregiving enrichment on development. By quantitatively synthesizing data from the BEIP across nearly 20 years of follow-up assessments, the current study addresses potential concerns about the robustness of the effects of this intervention. Specifically, using a common analytic approach for all outcomes and timepoints, we provide strong and conclusive causal evidence that children exposed to early deprivation benefit from high quality family-based care, and, more broadly, that the nature of the early caregiving environment has an extensive and lasting impact on development. In line with recent policy recommendations (39), our findings indicate that providing high quality and stable family-based care, which includes biological, foster, or adoptive families, is critical for children's wellbeing, and, in turn, the wellbeing of society.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data sharing:

Anonymized participant data can be made available through GitHub (https://github.com/lucysking/BEIP_comprehensive_analysis/tree/master)

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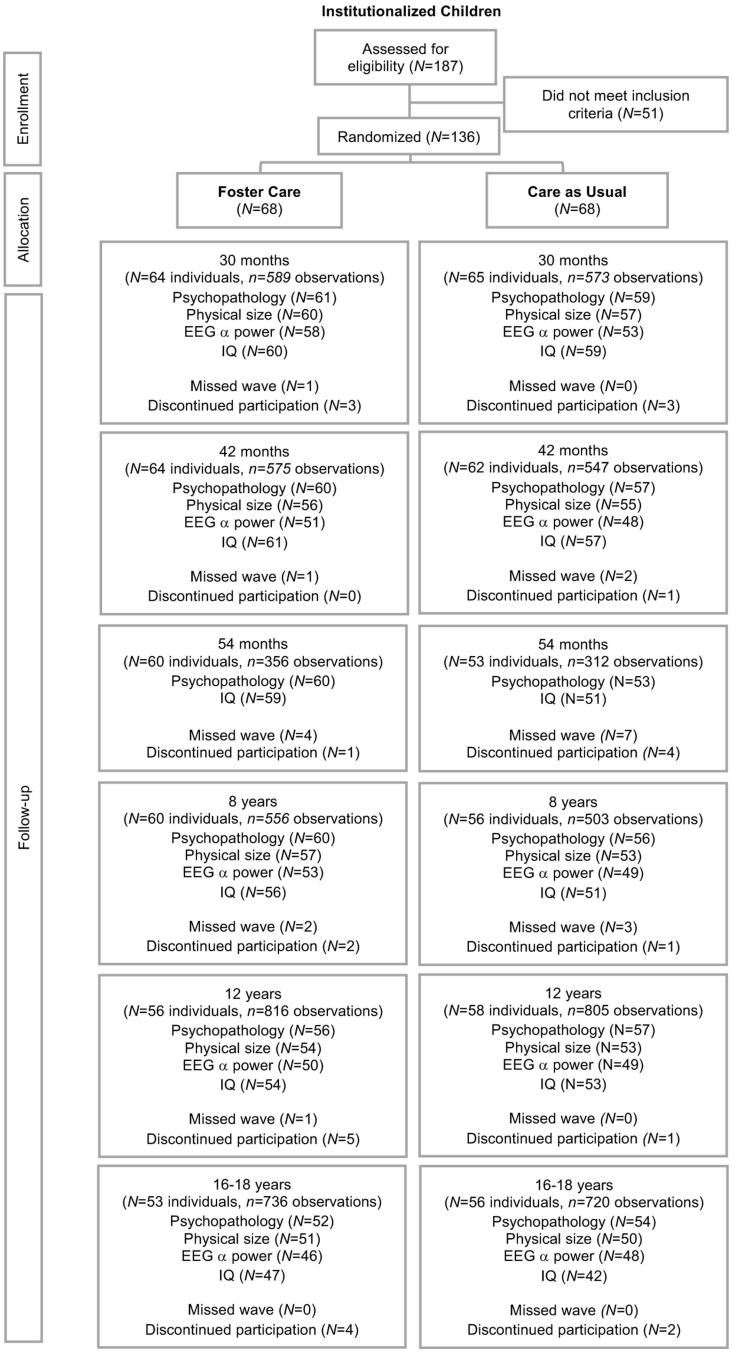

Figure 1. CONSORT flow diagram.

Discontinued participation = withdrew from study after previous wave. Missed wave = unavailable for assessment.

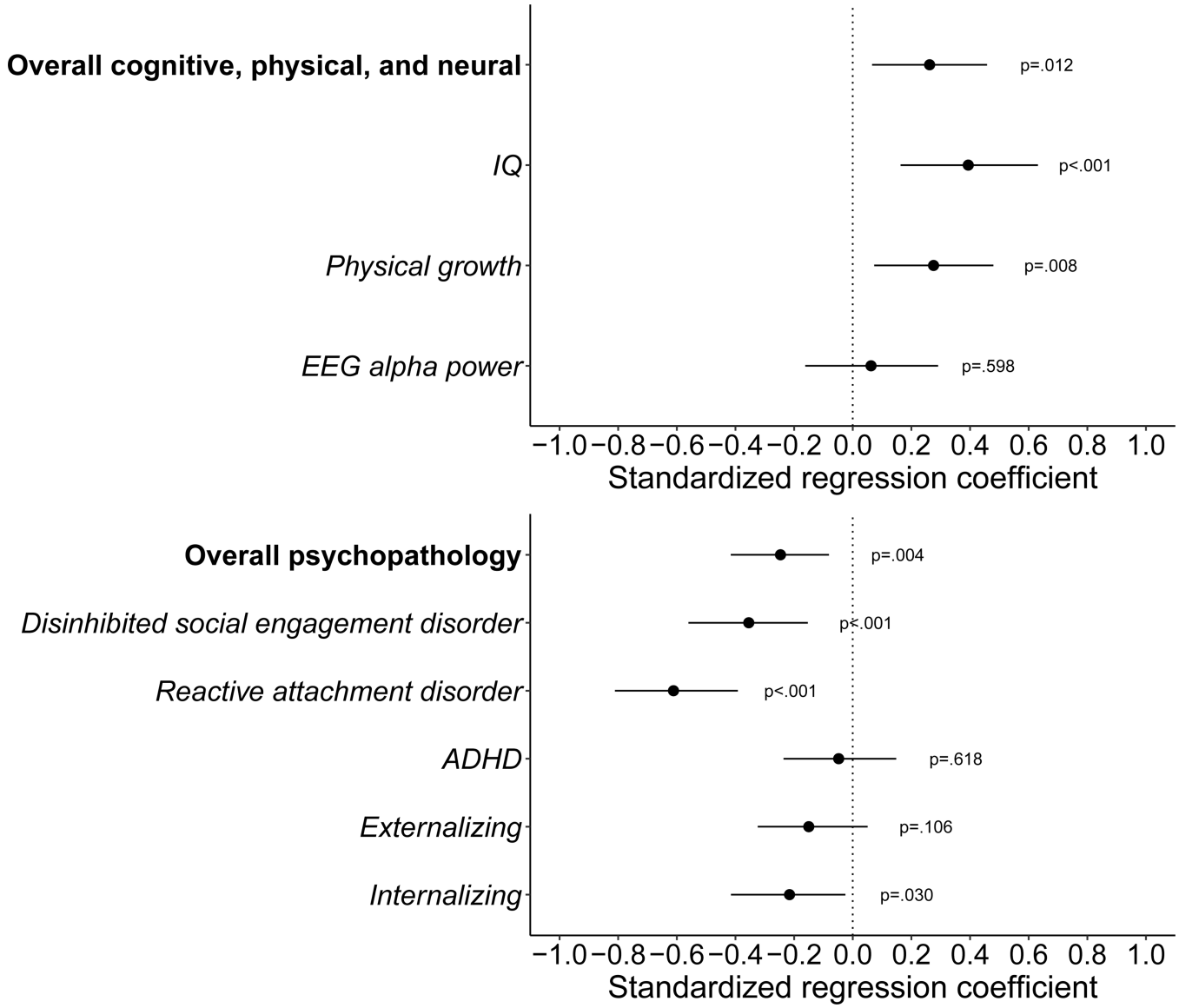

Figure 2. Overall and domain-specific standardized mean differences between children randomized to the foster care intervention compared to children randomized to care as usual.
Points are standardized regression coefficients from multi-level models, controlling for covariates. Point ranges are 95% bootstrapped confidence intervals.

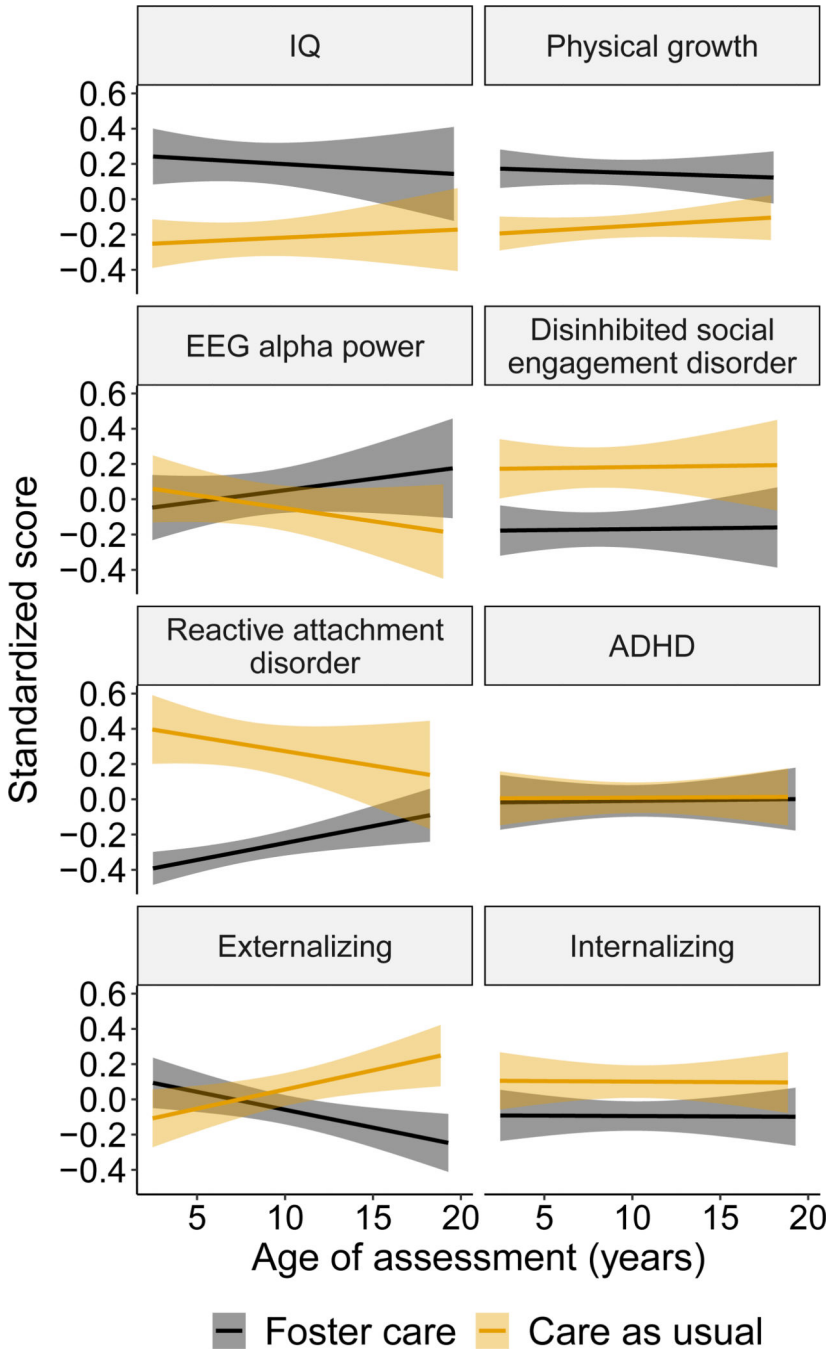

Figure 3. Standardized scores for children randomized to the foster care intervention and care-as-usual children across ages for each outcome domain and type of psychopathology.

Because scores are standardized within assessment wave, plots do not show within-individual change across time but depict between-individual differences. Lines are linear regression lines of best fit and shaded areas are standard errors of regression lines.

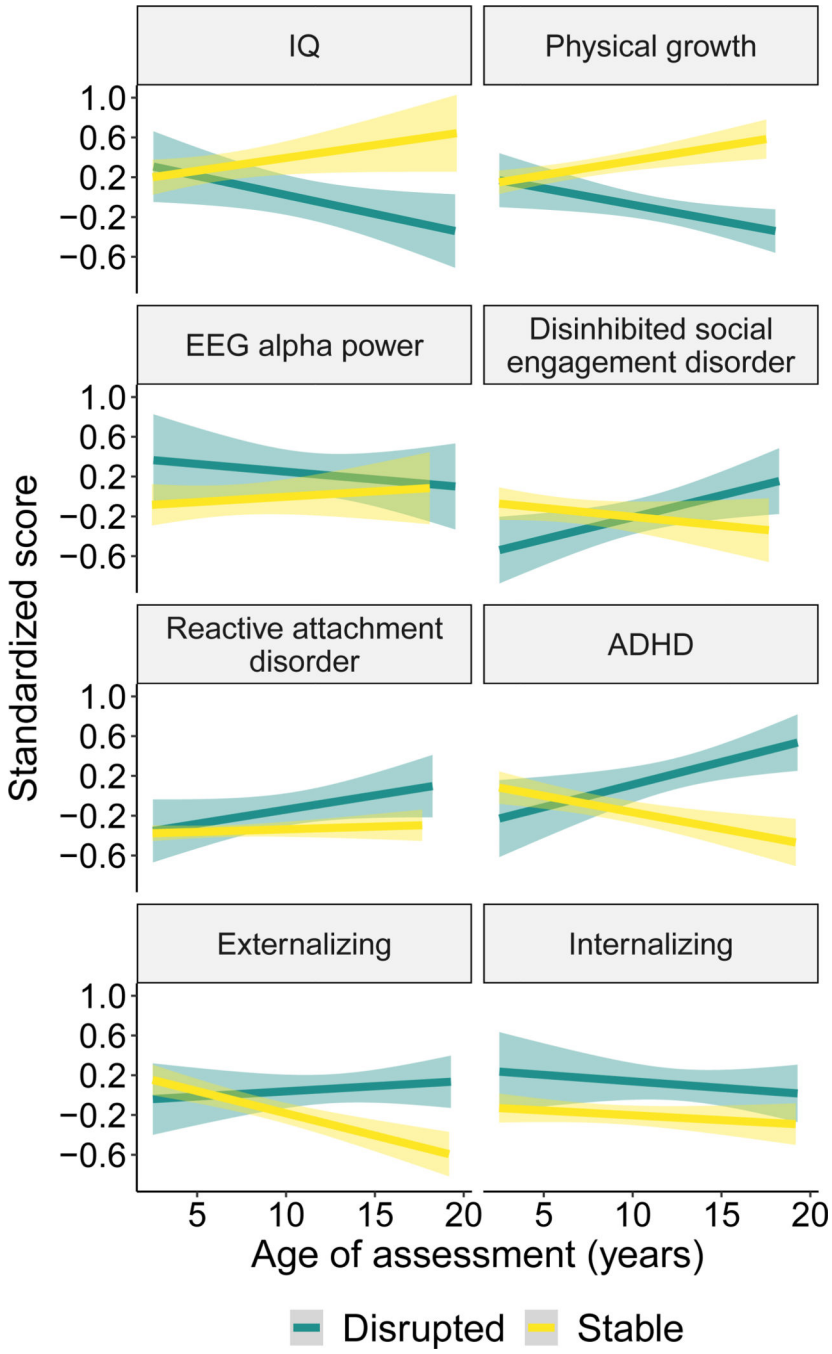

Figure 4. Among children randomized to foster care, associations of placement stability with outcomes in each domain across ages of assessment.

Because scores are standardized within assessment wave, plots depict between-individual differences but *do not* show within-individual change across time. Lines are linear regression lines of best fit and shaded areas are standard errors of regression lines.