

Motor Outcomes in Children Exposed to Early Psychosocial Deprivation

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Objectives To determine the effect of psychosocial deprivation early in life on motor development, assess the impact of a foster care intervention on improving motor development, and assess the association between motor and cognitive outcomes in children with a history of institutional care.

Study design In a randomized controlled trial, children living in Romanian institutions were randomly assigned to care as usual in the institution or placed in family-centered foster care as part of the Bucharest Early Intervention Project. The average age at placement into foster care was 23 months. At age 8 years, the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition, Short Form (BOT2-SF) was applied to assess the motor proficiency of children in both groups, as well as a never-institutionalized group from the Romanian community.

Results Children in the never-institutionalized group did significantly better on the BOT2-SF than children who had ever been institutionalized ($P < .001$). There was no significant difference in performance between children in the care as usual group and the foster care group. This finding also held true for all individual items on the BOT2-SF except sit-ups. Regression analyses revealed that the between-group and within-group differences in BOT2-SF scores were largely mediated by IQ.

Conclusion Early deprivation had a negative effect on motor development that was not resolved by placement in foster care. This effect was predominantly mediated by IQ. This study highlights the importance of monitoring for and addressing motor delays in children with a history of institutionalization, particularly those children with low IQ. (*J Pediatr* 2014;164:123-9).

During sensitive periods of development, neuronal circuits are thought to be more plastic than at other times and thus most apt to be altered by the experiences to which the child is exposed.¹ Early severe deprivation, as can occur in young children placed in institutions, leads to missed opportunities to modify neuronal circuits in preparation for future learning in multiple domains. Placement in a more enriched setting, such as family care, provides an opportunity to rescue development in these domains if done within an appropriate time frame.²⁻¹³

Previously published data on motor development in populations of institutionalized and previously institutionalized children found significant effects on motor development related to institutionalization. In a Sudanese orphanage, the developmental quotient was <70 for coordination development in 20% of children living in orphanages at age 2 months, and in 57.1% of these children at age 18 months.¹⁴ In children living in Romanian institutions without overt neurologic disabilities, the mean percentile rank was $<6\%$ for both gross motor and fine motor skills when tested at a mean age of 2.4-2.6 years.¹⁵ These findings persist after adoption; a study of international adoptees found gross motor delays in 33% and fine motor delays in 40%.¹⁶

The environment and cultural context of caregiving before adoption can alter these numbers greatly. In a study of children adopted specifically from Eastern Europe and the former Soviet Union at a median age of 26 months (range, 2.5 months to 9 years), 70% had gross motor delays and 82% had fine motor delays,¹⁷ whereas in a study of previously institutionalized children adopted from Guatemala, the majority of children were doing well developmentally.¹⁸ The timing of institutionalization seems to have an important effect as well. In children adopted from Romania, those who had spent less than 6 months in an institution had significantly better motor skills than those who had spent more than 6 months in an institution.¹⁹ Similarly, children with longer institutionalization histories have demonstrated significantly lower scores on vestibular-proprioceptive, visual, and praxis areas of the Sensory Integration and Praxis Tests,²⁰ as well as balance,²¹ compared with those with shorter institutionalization histories. Placement in a family setting has thus far been found to improve outcomes only minimally. Psychomotor development scores in adopted children are generally higher at 6 months after adoption compared with the time of adoption,²² but postinstitutionalized children have delays in balance and bilateral coordination compared with never institutionalized children that are not adequately remediated by placement in a family setting.²¹ A selection bias in the children chosen for adoption was inherent in those previous studies, however,

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BEIP	Bucharest Early Intervention Project
BOT2-SF	Bruininks-Oseretsky Test of Motor Proficiency, Second Edition, Short Form
WISC-IV	Wechsler Intelligence Scale for Children—Fourth Edition

because physically and psychologically healthier children may be more likely to be adopted into families. The Bucharest Early Intervention Project (BEIP), a randomized controlled trial of institutionalization vs foster care, provides the opportunity to examine motor development in institutionalized Romanian children randomly assigned to continued institutional care or to a foster care intervention.

The Bruininks-Oseretsky Test of Motor Proficiency, Second Edition, Short Form (BOT2-SF) has proven useful for differentiating individuals with motor impairment from those with no motor impairment.²³ The use of standard scores for motor composites has been recommended for comparing motor performance between examinees.^{23,24} The BOT2-SF has been shown to have a positive predictive value of 100% and a negative predictive value of 72.5% for diagnosing motor impairment.²⁵ The objectives of the present study were: (1) to investigate the prevalence of abnormal motor development in children with a history of early institutional care; (2) to describe the specific motor delays seen in children with a history of early institutional care; (3) to evaluate the efficacy of a foster care intervention compared with continued institutional care in improving motor development; and (4) to assess the association between motor and cognitive outcomes in children with a history of institutional care.

Methods

The study participants were children enrolled in the BEIP. The historical background, design, and ethical considerations of this study are described in detail elsewhere.²⁶⁻²⁸ Institutional Review Boards at Boston Children's Hospital, the University of Maryland, and Tulane University approved the study. The Institute for Maternal and Child Health and the local Commissions for Child Protection in Romania also approved the protocols. Informed consent was obtained from biological parents, the Commission for Child Protection, or both for all children in the study.

Among a group of 187 children institutionalized in Bucharest, Romania, children with a genetic syndrome, fetal alcohol syndrome, or microcephaly as assessed on physical examination were excluded from the study. The remaining 136 children constituted the ever-institutionalized group. One-half of these children were randomly assigned to a foster care group, and the other one-half were assigned to continued care as usual in the institution. A never-institutionalized community comparison group was matched to the ever-institutionalized group by child age and sex.²⁶ The BOT2-SF was performed on the children of each group (Figure). Demographic and birth data for each group are provided in Table I.

In the foster care group, the average age at foster care placement was 23 months (range, 8-33 months). The foster care intervention was designed to represent the home experience of a never-institutionalized child and thus provide a replicable, affordable, and culturally relevant alternative to institutionalization. There were an average of 2.5 other people in the

foster households. Using the National Institute of Child Health and Development Early Child Care Research Network's Observational Record of the Caregiving Environment, we previously demonstrated that the quality of caregiving in foster care was indistinguishable from that in the families of never-institutionalized children from the community and was significantly better than that provided in institutions.²⁸ In the care-as-usual group, a policy of noninterference was implemented for ethical reasons, such that children who later had the opportunity to be placed in foster care or return to other family environments were not prevented from doing so.²⁷ Thus, at the time of this study, 14 of the children randomized to the care-as-usual group remained in an institution. Children in the foster care group were not allowed to return to institutions but were allowed to transition to non-BEIP versions of family-centered care in some situations.

All analyses were initially performed following an intent-to-treat model, with children considered within their original assigned group. Thus, our findings represent a conservative estimate of the response to intervention. Follow-up analyses were performed based on the child's living situation at the time of BOT2-SF testing and the percentage of his or her life spent in an institution.

The BOT2-SF was performed on study subjects at the 8-year-old follow-up visit. The BOT2-SF measures a child's proficiency in 4 motor area composites: fine manual control, manual coordination, body coordination, and strength and agility. Fine manual control includes subtests of fine motor precision and fine motor integration. Manual coordination includes subtests of manual dexterity and upper-limb coordination. Body coordination includes subtests of bilateral coordination and balance. Strength and agility includes subtests of running speed and agility and strength. Total point scores on the BOT2-SF were normalized by age and sex to calculate the standard score for each subject.²³ Percentile scores were used only when calculating the relationship between motor outcome and IQ, to allow comparison with other studies. Point scores were used for comparing results for individual items.

IQ was measured using the Wechsler Intelligence Scale for Children—Fourth Edition (WISC-IV).³ All data were analyzed using SPSS version 19 (IBM, Armonk, New York).

Results

Among the children who completed the BOT2-SF, birth weight was significantly lower in the ever-institutionalized group compared with the never-institutionalized group, and ethnicity was significantly different between the two groups. In the ever-institutionalized children, gestational age was significantly different between the care-as-usual and foster care subgroups (Table I).

Previous Institutionalization

Our initial analyses examined whether children with a history of institutional care (ever-institutionalized group) performed differently on total measures of motor function than children without a history of institutional care (never-

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