Institutional Care and Iron Deficiency Increase ADHD Symptomology and Lower IQ 2.5-5 Years Post-adoption

Jenalee R. Doom, Michael K. Georgieff, & Megan R. Gunnar
Institute of Child Development & Center for Neurobehavioral Development, University of Minnesota

Introduction
- Increased ADHD symptomology and lower IQ have been reported in internationally adopted (IA) children compared to non-adopted peers (Hostinar et al., 2013; Kreppner, O’Connor, & Rutter, 2001).
- It is unclear whether these outcomes are due to institutional deprivation specifically or to co-occurring micronutrient deficiencies that disrupt brain development (Fuglestad et al., 2008).
- In this study, IA children adopted from 12 countries in Asia, Europe, Africa, and Latin America were compared to children raised in their biological families:
  - to examine differences in ADHD symptomology and IQ 2.5-5 years post-adoption.
  - to assess the contributions of iron deficiency (ID) and duration of deprivation to these cognitive outcomes.
  - to assess whether IQ mediates the ID-ADHD association.
  - to examine longitudinal associations between ADHD symptoms and IQ assessed 12 months post-adoption and again 2.5-5 years post-adoption.

Methods
Participants
- 88 IA (M= 62.1 months, SD = 2.4) non-adopted children (M= 61.4 months, SD = 1.6)
- IA children spent between 0-34 months (M = 12.4, SD = 11.2) in an institution (e.g., orphanage or hospital) before arrival
- IA children were assessed 29-64 months post-adoption (M = 41.9 months, SD = 10.2)
- Subset (n = 30) of IA children also assessed at 12 months post-adoption for longitudinal analyses

Iron Deficiency
- Assessed during the initial post-adoption medical visit in 69 children (range 0-5 months post-adoption; M = 0.73, SD = 0.83)
  - Hemoglobin, transferrin saturation, mean corpuscular volume, ferritin, and iron-binding capacity
- Classified into 4 groups by iron status, ranging from normal to ID anemia (most severe)

ADHD symptoms
- Parent-reported attention and impulsivity problems assessed using the MacArthur Health and Behavior Questionnaire
- Experimenter-reported attention to tasks, inhibitory control/impulsivity, and hyperactivity during the session
- Average of 5 z-scored variables (α = .72), with higher values indicating greater symptomology

IQ
- 12-month session: Mullen Early Learning Composite
- Age 5: Stanford-Binet Scales of Intelligence

Results
ADHD symptoms
- IA children had greater ADHD symptomology, p < .01, than non-adopted children.
- Within the IA group, children with more severe ID at adoption had greater ADHD symptomology, r(69) = .40, p = .001.
- Duration of institutional care was positively correlated with ADHD symptoms, r(86) = .28, p < .01.

IQ: Improvement in IQ for both the pre-anemic and anemic groups, but not for the normal iron group.

Mediation
- ID impacts IQ at least in part through its effect on ADHD symptoms.

Longitudinal Analyses
- ADHD: No significant improvement in ADHD symptoms by ID severity group.
- IQ: Improvement in IQ for both the pre-anemic and anemic groups, but not for the normal iron group.

Discussion
As duration of deprivation and ID have independent effects, they should be understood as separate risk factors for neurodevelopment. These results signify continuing effects of early deprivation and ID on ADHD symptoms and IQ years after adoption. Prevention and treatment should focus on prenatal and early postnatal iron supplementation and cognitive interventions that support brain development after nutritional and institutional deprivation. Researchers studying early deprivation should assess micronutrient deficiencies as part of their overall assessment.