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Nutritional status of foster children in the U.S.: Implications for cognitive and behavioral development☆

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Abstract

Objective—Children in foster care are at greater risk for poor health, physical, cognitive, behavioral, and developmental outcomes than are children in the general population. Considerable research links early nutrition to later cognitive and behavioral outcomes. The aim of this narrative review is to examine the prevalence of poor nutrition and its relation to subsequent health and development in foster children.

Method—Relevant studies for inclusion were identified from numerous sources (e.g., PubMed, Google Scholar, and reference sections). Inclusion criteria were studies published between 1990 and 2016 of (i) the nutritional status of children in foster care or (ii) the nutritional status of children exposed to early adversity (e.g., low-income and internationally adopted children) or (iii) the developmental effects of poor nutrition and micronutrient deficiencies.

Results—Two key findings that have adverse implications for cognitive development emerged: (i) the prevalence of anemia and iron-deficiency anemia is higher among foster children than among the general population of children in the U.S., and (ii) the developmental demands of catch-up growth post-placement may lead to micronutrient deficiencies even after children have begun sufficient dietary intake of these nutrients. Moreover, there is a paucity of recent studies on the nutritional status of children in foster care, despite the multiple factors that may place them at risk for malnutrition.

Conclusion—Attention to nutritional status among care providers and medical professionals may remove one of the possible negative influences on foster children's development and in turn significantly alter their trajectories and place them on a more positive path early in life. Recommendations for further research, policy, and practice are discussed.

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Keywords

Iron; Malnutrition; Micronutrients; Cognitive development; Foster care

1. Introduction

There are currently >400,000 foster children in the United States, a number that has been on the rise the past four years, with 1 in 184 children in the U.S. in the foster care system (U.S. Department of Health and Human Services, 2015).More than a third of foster children are 5 years old or younger, a fundamentally important time that shapes the child's future health, growth, emotional wellbeing, development and achievement in school, the family and community, and life in general. Children enter foster care (median age at entry is 6.4 years) at a disadvantage due to early adverse childhood experiences (ACEs) such as poor prenatal and infant health care, food insecurity, chronic stress, and the effects of abuse and neglect. As a result, they are at higher risk for poor physical, psychological, neuroendocrine and neurocognitive outcomes compared to those not in care (Fisher, Stoolmiller, Gunnar, & Burraston, 2007; Pears & Fisher, 2005). Between 20 and 60% of children entering foster care have developmental disabilities or delays, compared to about 10% of the general pediatric population (U.S. Department of Health and Human Services, 2015; Leslie et al., 2003). Compared to the general pediatric population, foster children are also at greater risk for negative health outcomes including chronic medical conditions and developmental issues (Hansen, Mawjee, Barton, Metcalf, & Joye, 2004; Jee et al., 2006; Zill & Bramlett, 2014).

While substantial research has focused on physical and mental health of children in foster care, their nutritional status, eating and food-related behaviors, and the relation to subsequent health and development has received less research attention. Foster children are at risk for growth and nutritional deficiencies due to their nutritional environment prior to placement in foster care, which may be inadequate due to food insecurity (limited or uncertain access to adequate food) and/or a poor diet (Ehrle & Geen, 2002). Insufficient caloric content resulting in growth deficiencies were commonly observed in studies of foster children in the 1990´s (Halfon, Mendonca, & Berkowitz, 1995; Silver et al., 1999). However, there is a notable lack of recent data on the nutritional status of children in foster care, and the prevalence of micronutrient deficiencies—detrimental to development and cognition—in the presence of sufficient calorie intake is less known in this population.

While it is outside the scope of this paper, it is important to note that feeding issues may play a critical role in the growth and nutritional status of children in foster care. Because many children in foster care have experienced ACEs, including food insecurity, maltreatment, and placement in out-of-home care, they have difficulties with trust and attachment and with establishing a responsive feeding relationship (Casey, Cook-Cottone, & Beck-Joslyn, 2012). This makes challenges around food and behavior common in this population, resulting in disrupted regulation of food intake and poor growth and nutritional status (Baer & Martinez, 2006; Black & Aboud, 2011; Dozier, Higley, Albus, & Nutter, 2002).

The objective of this review is to highlight research gaps in nutrition issues among children in foster care and inspire action among the scientific and health practitioner community to generate evidence-based guidance on how to prevent and address these issues. Relevant studies for inclusion were identified from numerous sources (e.g., PubMed, Google Scholar, and reference sections). Inclusion criteria were studies published between 1990 and 2016 of (i) the nutritional status of children in foster care or (ii) the nutritional status of children exposed to early adversity (e.g., low-income and internationally adopted children) or (iii) the developmental effects of poor nutrition and micronutrient deficiencies.

In this review we first examine the available research about the nutritional status of foster children in the U.S. We then review the available literature about the nutritional status of other populations similarly exposed to early adversity. We subsequently consider the literature on the cognitive and behavioral effects of malnutrition, and we conclude with recommendations for further research, policy, and practice.

2. Nutrition among children in foster care

This section presents current research related to nutrition among foster children, including general measures of health and growth and micronutrient status among this population.

2.1. Growth

Stunting or short stature (height-for-age < −2 z-scores on World Health Organization [WHO] growth charts or height-for-age < 5th percentile on Centers for Disease Control and Prevention [CDC] growth charts), but not wasting (weight-for-height < −2 z-scores on WHO growth charts), was reported among children in foster care. Pears and Fisher (2005) compared 3–6-year-old children entering, re-entering, or switching placements within foster care with a community sample of similarly low-income children and found that 8% of foster children had short stature compared to 0% of community children. No differences in wasting were found between the two samples.

Hansen et al. (2004) found that short stature was common in children in foster care (average age 5.1 years), with 11% having short stature. Although the purpose of the Hansen et al. study was to compare the health status between children in foster care and age- and sex-matched low-income children to determine if health in children living in foster care is not just due to living in poverty, this comparison was not done for physical growth. However, children in foster care did have a greater prevalence of physical, developmental, and mental health problems. Similarly, a large statewide cohort study of 2- to 5- year-olds entering foster care found evidence of stunting (7%) and underweight (10%) in this population (Steele & Buchi, 2008). Given the higher prevalence of stunting among foster children compared to children with similar demographics, and findings that in foster children stunting is associated with a child's experience of neglect, it has been suggested that stunted growth may be associated with exposure to chronic adversity (Pears & Fisher, 2005).

While under-nutrition (short stature and underweight) has been frequently reported among children entering foster care, overweight and obesity is the most common medical condition noted among foster children 2–19 years of age. Assessments of children at their time of entry into the foster care system revealed that 35% to 44% of those older than 2 years of age were overweight/obese (BMI ≥ 85th percentile) and 17–37% were obese (BMI ≥ 95th percentile) (Steele & Buchi, 2008; Helton & Diaz, 2012; Schneiderman, Arnold-Clark, Smith, Duan, & Fuentes, 2013). These rates are disproportionately higher than the 2011–2013 national averages of 32% for overweight/obesity and 17% for obesity among youths 2–19 years (Ogden, Carroll, Kit, & Flegal, 2014). The foster child's age (older vs. younger), ethnicity (Hispanic vs. non-Hispanic), placement type (group home vs. traditional foster care), early exposure to abuse and neglect, use of psychotropic medications, and problematic eating behaviors are likely to be associated with the high rates of weight dysregulation among foster children (Casey et al., 2012; Schneiderman et al., 2013).

Whether underweight or overweight, this body of research suggests that foster children are frequently malnourished at entry into care. Thus, careful screening of children upon entering foster care and the development of individualized intervention plans is necessary to simultaneously address the need for catch up in growth and to mitigate the long-term risk for obesity. Additionally, research on the extent to which malnutrition persists after entry into care, as well as the factors that subsequently lead to a higher prevalence of overweight and obesity among foster children, is warranted.

2.2. Anemia and iron deficiency

Information on micronutrient intake and deficiencies that are critical to physical and cognitive development has been limited in the foster care population in the U.S. To date, the most widely studied nutrient deficiency has been anemia (the inability to produce enough red blood cells) with and without iron deficiency (ID). ID, a shortage of iron in the body, is the primary cause of anemia in children, referred to as iron-deficiency anemia (IDA).

Anemia prevalence was 7.4% among children ages 3 months to 6 years at admission into foster care, though the etiology of anemia (ID present or absent) was not assessed (Leslie et al., 2005). This is more than double the 3.6% prevalence of anemia in U.S. children ages 1 to 5 years during the same time period (Cusick et al., 2008). To our knowledge, no recent study measured iron status in foster children. We know that the prevalence of IDA among the general pediatric population is 1.6% and we suspect that it would be significantly higher among foster children (Cusick et al., 2008). ID is also more prevalent among low-income populations, an added risk factor for foster children (U.S. Department of Health and Human Services, 2010).

The last study we identified that examined iron intake and ID in foster children dates back to 1991. DuRousseau, Moquette-Magee, and Disbrow (1991) conducted a dietary recall and medical records assessment for foster children in a California clinic. Their findings, while dated, are still relevant. The study revealed that 21% of foster children demonstrated evidence of IDA despite an adequate intake of nutrients. This persistent deficiency may be explained by the extended time required for iron repletion, which requires up to several months of adequate iron intake (Powers & Buchanan, 2014). Also, these children experience high levels of stress, which has been shown to affect nutrient absorption by altering the microbial content and motility of the gut (Boudry, Cheeseman, & Perdue, 2007; Wang, 2005). As such, foster children who have marginal or even adequate nutritional intake may still have deficits because of decreased absorption or lack of sufficient repletion time.

Lead exposure among children living in low-income communities remains a risk to this day. Children from households below the federal poverty level, who comprise over a third of children entering the foster care system, continue to be more likely to have elevated blood lead levels (Barth, Wildfire, & Green, 2006; Jones et al., 2009). Studies have found that ID, regardless of the presence of anemia, increases lead absorption and hinders lead chelation, thus increasing susceptibility to lead poisoning, particularly during the vulnerable period of toddlerhood (Kleinman & Greer, 2013; Wright, Tsaih, Schwartz, Wright, & Hu, 2003). Chung, Webb, Clampet-Lundquist, and Campbell (2001) compared foster children prior to admission to care and after placement in care. They found that pre-placement children were almost twice more likely to have elevated blood lead concentrations than were children in the general population, their siblings outside of foster care, or children in foster care, suggesting that the home environment prior to placement in foster care may put children at higher risk for lead exposure.

Given the potential compounding effects of ID and lead exposure in foster children and the complex relation between nutrient intake, absorption, and stress, research into this aspect of foster children's health is sorely needed. Nutritional deficiencies may have disproportionately large effects on foster children's development that have hitherto gone undetected.

3. Nutrition in other populations exposed to early adversity

In light of the relative lack of research into the prevalence of specific nutrition-related deficiencies and their impact on children in foster care, we reviewed the nutrition research conducted with populations similar to that of foster children. Internationally adopted children share commonalities with foster children in terms of adversity, unpredictability of housing and caregiving, and caregiver stress. Moreover, children in both of these populations present with nutrient deficiencies prior to being placed in favorable environments (Fuglestad, Kroupina, Johnson, & Georgieff, 2016).

Research involving internationally adopted children has illuminated an interesting nuance in the relationship between early adversity and ID that is also pertinent to the foster care population: both populations commonly display growth issues and catch-up growth following placement into a nurturing and nutritionally adequate environment. Fuglestad et al. (2008) found that among international adoptees younger than age 2 years, ID persisted at 6-month follow-up despite iron intake that exceeded the recommended daily allowance. This persistent deficiency was presumably the result of the demand for iron due to erythropoiesis, or red blood cell production, during catch-up growth.

Notably, Fuglestad et al. (2016) found that other micronutrient deficiencies (zinc, vitamin D) were also not fully resolved 6 months after placement. Foster children too may be vulnerable to persistent nutrient deficiencies after placement in care due to the developmental demands of catch-up growth. This indicates the need for providing adequate nutrition to sustain catch-up growth in foster children as well as continual monitoring of their nutritional status, both six months after placement into care and longitudinally, as it cannot be assumed that deficiencies have been resolved after placement. Additionally, providers and foster parents should be aware that nutrient deficiencies may develop over the course of catch-up growth, even when foster children do not present with deficiencies at initial placement.

4. Cognitive and behavioral effects of malnutrition

Extensive empirical research has documented the association between early childhood malnutrition and subsequent cognitive and behavioral development, in terms of both micro- and macronutrients (e.g., United Nations Children's Fund, 2013). In this section, we review the commonly studied factors that influence cognition and development, including growth status, iron levels, lead exposure, and other micronutrients. Because there is relatively limited research in this area specific to foster children, we also draw upon research involving internationally adopted children and typically developing children.

4.1. Growth deficits and cognitive/behavioral development

As noted, growth deficits have been found to be more common among foster children than among the general population of children (Steele & Buchi, 2008). Various macronutrients, including protein, glucose, and specific fats, are essential for growth and healthy brain development. Because growth issues are typically an indicator of insufficient macronutrient intake, it seems plausible that given the aforementioned studies showing growth impairment in foster children, these children may also be susceptible to developmental delays resulting from lack of macronutrients. Although a specific 3-way linkage between foster children's growth, nutrition, and cognitive development has not been made, associations have been found between growth indices and cognitive development in this and related populations (e.g. Pears & Fisher, 2005).

As noted previously, growth issues are also common among internationally adopted children (Van Ijzendoorn, Bakermans-Kranenburg, & Juffer, 2007). In international adoptees, nutritional status at adoption as assessed by growth indices has been found to be a determinant of cognitive and psychomotor development (Park et al., 2011; Lozoff et al., 2006). In Park et al. (2011), researchers found that after controlling for age, weight-for-height (wasting) and weight-for-age (underweight) at baseline were positively associated with both cognitive and motor development. Longitudinally, the rate of improvement in cognitive and psychomotor functioning was related to how malnourished the child was at adoption.

4.2. Anemia, ID, lead, and cognitive/behavioral development

Iron status has long been known to influence cognitive development in rat models and in humans. With the exception of zinc, iron is the nutrient present in the highest concentration in the brain and is instrumental in many aspects of brain development (Lozoff et al., 2006; Lozoff & Georgieff, 2006). Because ID is the most common nutritional deficiency worldwide, a substantial body of literature pertains to it (WHO, 2001). One review of case-control studies found that infants with IDA scored, on average, 6 to 15 points lower on mental development tests and 6 to 17 points lower on motor development assessments than did infants with better iron status. In addition, long-term detrimental effects of on cognitive, social-emotional, and motor development persisted through adolescence (Lozoff et al., 2006).

4.2.1. Iron and cognition in internationally adopted children—In keeping with results from studies of the general pediatric population in the U.S., in post-institutionalized children the extent of ID at adoption predicts lower cognitive scores, slower processing speed, and imparted performance on executive function tasks independent of the duration of institutional care (Doom et al., 2014; Fuglestad et al., 2016). Fuglestad, Georgieff, et al. (2013) found that internationally adopted children with persistent ID at 6 months after placement were more likely to score below average on a measure of cognitive development, and that this association was mediated by inattention and hyperactivity behaviors during testing. The researchers hypothesized that persistent ID resulted from catch-up growth post-institutionalization, as had previously been shown to be prevalent in internationally adopted children, and that the effects of ID on inattention and hyperactivity may partially account for the lack of consistency between cognitive competence and performance in school

A recent longitudinal study involving post-institutionalized children followed after adoption provided support for Fuglestad, Georgieff, et al.'s hypothesis, in that children with more severe ID at adoption had greater ADHD symptomology and lower IQ 2.5 to 5 years later, and that the effect of ID on IQ was partially mediated by its effect on ADHD symptoms (Doom, Georgieff, & Gunnar, 2015). Studies involving post-institutionalized children are particularly relevant to the foster care population, whose nutrient deficiencies may also be remediated after placement.

4.2.2. Combined effects of lead exposure and ID on cognitive development— Lead exposure is not a nutrient deficiency; however, as persistent ID may place the brain at even higher risk for lead poisoning independent of the direct effects of ID, attention to lead exposure in foster children and its effects on cognitive development is warranted. One study using the NHANES III data found that deficits in children's cognitive and academic skills occurred at blood lead concentrations <5 μg/dL (Lanphear, Dietrich, Auinger, & Cox, 2000). These results are cause for concern, given that the current definition of lead poisoning is a blood lead reference level ≥ 5 μg/dL; it appears that even subclinical lead exposure may have a detrimental impact on cognitive development (CDC, 2012). Longitudinal cohort studies have also found long-term relationships between childhood lead exposure and adult IQ (Mazumdar et al., 2011). Given the previously noted connection between ID and lead uptake, brain development may be placed at even greater risk by the compounding of these two independent risk factors. Current standards to detect and prevent the damaging effects of lead poisoning may need to be revised.

4.3. Other micronutrients and cognitive/behavioral development

4.3.1. Zinc—Zinc, like iron, is an important micronutrient that is essential for normal growth and development in children. Iron and zinc share common food sources; studies have shown that zinc deficiency is more prevalent among low-income, minority children, and that zinc levels are correlated with iron levels, both of which are added risk factors for foster children (Schneider et al., 2005; Cole et al., 2010). Toddlers may be especially vulnerable to zinc deficiency due to greater growth velocities (Briefel et al., 2000). Zinc deficiency is thought to be uncommon in developed countries like the U.S., because the consumption of zinc-rich foods is usually common in these countries. However, in a study conducted in California, 43% of 12- to 36- month-old children from low-income families (enrolled in the Special Supplemental Nutrition program for Women, Infants, and Children program) had low serum zinc levels (<70 μg/dL [<10.7 μmol/L]) (Schneider, Fujii, Lamp, Lönnerdal, & Zidenberg-Cherr, 2007). Similarly, in Atlanta, the prevalence of zinc deficiency (and anemia)was high in a population of low-income minority children, especially among African Americans (Cole et al., 2010).

Zinc is essential for cognitive development; presynaptic boutons in the brain depend on zinc for delivery of neurotransmitters, and it plays a central role in neurogenesis, neuronal migration, and synaptogenesis (Bhatnagar & Taneja, 2001). Zinc has been studied in post-institutionalized internationally adopted children and in supplementation studies. Recent results from a study of micronutrient status in international adoptees ages 8–18 months found that zinc deficiency during the early adoption period was associated with compromised memory functioning (Fuglestad et al., 2016). A study of zinc supplementation in Peruvian infants ages 6 to 18 months found that only micronutrient supplements containing zinc supported the normative development of information processing and active attention profiles in the year following commencement of supplementation (Colombo et al., 2014). Given the importance of zinc during critical times of growth and development, further investigation is warranted to ascertain the prevalence of zinc deficiency and its relation to iron deficiency in children in foster care.

4.3.2. Choline—Children often enter the foster care system because of unfavorable circumstances that increase the odds of prenatal alcohol exposure, and thus this population can be regarded as high risk for fetal alcohol spectrum disorders (FASD). FASD is associated with physical anomalies, brain damage, and neurocognitive abnormalities and is likely to have lifelong implications. In the U.S., the prevalence of FASD in the foster care population was reported to be 5 to 15 times higher than in the general pediatric population (Astley, Stachowiak, Clarren, & Clausen, 2002; Lange, shield, Rehm, & Popova, 2013)

Unfortunately, there are currently no comprehensive treatments for children with FASD. However, studies are underway to examine whether nutritional interventions involving choline can reduce the severity of cognitive deficits associated with FASD. Choline is an essential nutrient, necessary for brain and behavioral development. Specifically, it is involved in attentional systems and hippocampal development, and a deficiency may decrease neuron proliferation (Zeisel, 2004; Niculescu, Craciunescu, & Zeisel, 2005). Choline supplementation has been shown to improve memory functioning in children aged 2.5 to 5 years with FASD, with the strongest treatment effect visible in children under age 4 (Wozniak et al., 2013, 2015). One preliminary study of choline levels in post-institutionalized adoptees found that choline status at adoption predicted cognitive and motor development (Fuglestad, Innis, et al., 2013). However, in this study the authors could not rule out the possibility that choline status was simply an indicator of general malnutrition.

Neither choline nor zinc has been well studied or assessed as deficient in the foster care population, but given the detrimental cognitive and health outcomes that could result from their respective deficiencies and the potential utility of supplementation, the adequacy of their intake in foster children is well worth attending to.

5. Conclusions

Micronutrient deficiencies have a sizable impact on cognitive and behavioral development in children. Given the prevalence of poor nutrition among children in foster care and similar at-risk populations, opportunities must be taken to address this issue and improve outcomes for this population. Some of the negative psychological, developmental, and behavioral outcomes seen in foster children could be mitigated by screening for deficiencies prior to placement or implementing nutritional interventions during placement.

Prior research has demonstrated that foster children are already at risk for deficits in executive function and prefrontal activity (Bruce, McDermott, Fisher, & Fox, 2009; Pears, Fisher, Bruce, Kim, & Yoerger, 2010). Addressing the effects of micronutrient deficiencies and poor nutrition early could reduce the size and impact of these deficits. The insufficient intake of macronutrients has an unmistakably detrimental effect on cognitive development, as do micronutrient deficiencies in certain domains and gains in cognitive function from nutritional interventions may serve as a protective factor for foster children above and beyond the beneficial effect on their health. It is as yet unclear which micronutrient deficiencies should be of greatest concern to address in foster children; as such, research in this area should be a high priority. There is a notable lack of recent research on the nutritional status of foster children both at intake and during care, despite the multiple factors that may place this population at risk for malnutrition.

If one recommendation is to be made from the existing scientific knowledge base, it is that every foster child should have a comprehensive assessment of nutritional status at intake to the foster care system. Because this population is highly mobile, visits with a primary care practitioner should occur either at intake or within 30 days of placement, and they should include screening for nutritional deficiencies. Current recommendations regarding screening are highly variable from one state system to another, and there may now be sufficient scientific knowledge developing to establish standards of care. Just as previous researchers have called for developmental screenings at intake, we now call for a complementary focus on nutritional screenings (Leslie et al., 2003).

On the basis of the literature about similar populations and extensive research linking micronutrient status to early cognitive development in the general pediatric population, we can make informed hypotheses about which micronutrient deficiencies should be the focus of attention. The compounding effects of ID, including IDA, and lead poisoning suggest that the two should be examined and addressed in conjunction rather than in parallel; mandatory screening for both ID and IDA prior to placement could play a critical role in a comprehensive medical assessment.

One of the most noteworthy and relevant findings is that the demands of catch-up growth may lead to micronutrient deficiencies even in children who have begun to consume sufficient nutrients. This finding has particularly important implications for public policy and practice: foster children, particularly those who have been neglected and are likely to experience rapid catch-up growth, may be most at risk when growth has begun but intake is not sufficient to meet developmental demands (Oliván, 2003). In the case of iron, screening should continue longitudinally at regular intervals, ideally every 6 months, to account for the demands of catch-up growth that may lead to ID or IDA. The U.S. Preventive Services Task Force recommends routine iron supplementation for children ages 6 to 12 months who are at increased risk for IDA (U.S. Preventative Task Force, 2006), which may also be advisable for young children in foster care.

These screening and preventative recommendations for iron should be accompanied by a complementary focus on lead poisoning. Screening for blood lead concentration should be prioritized when the health of foster children is assessed, and for children in care who are found to be iron deficient or children who have been removed from environments where lead exposure is a risk, attention to even subclinical blood lead concentrations (<5 μg/dL) should be part of the initial medical assessment.

Additional research with the potential for far-reaching results would involve the lesser-studied nutrients such as choline. As noted, novel supplementation studies with animals and with humans have provided preliminary evidence that the effects of prenatal teratogens on neural development can be mitigated with such supplementation (Wozniak et al., 2015). Given the prevalence of FASD and other prenatal exposure in foster children, this may be a highly productive area of research to pursue.

Addressing poor nutrition in foster children early may eliminate possible negative influences on development and may significantly alter children's trajectories, placing them on a more positive path. Comprehensive studies assessing the nutritional status of foster children would provide a basis of research from which to address the critical influence of nutrition on foster children's development. The relative cost of micronutrient supplementation is low, the benefits are high, and the implications of failing to provide supplementation can pose significant challenges to these children's overall health across the lifespan. As such, although the scientific knowledge base specific to the ramifications of foster children's compromised nutrition is still emerging, the empirical evidence is sufficient to justify changes to policy and programming related to their nutritional needs.

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