ADOPTION EDUCATION LLC

MALNUTRITION

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MALNUTRITION

INTRODUCTION

Malnutrition afflicts more than 200 million children throughout the world and is responsible for 50% of deaths that occur before age 5. Malnutrition robs young children of good health, growth, and development. Many internationally adopted children are malnourished prior to adoption. Prenatal malnutrition is common: more than 25% of international adoptees are low birth weight. Postnatal malnutrition befalls children who reside with impoverished or neglectful birth families, in institutions, or in indifferent foster care. Some children suffer from prolonged, sever, and/or recurrent episodes of malnutrition. Others endure a single episode of malnutrition due to illness, food shortages, or loss of a beloved caregiver. Poor appetite, impaired oral-motor function, and improper feeding techniques (bottle-propping) all reduce food intake. Chronic undernutrition is much more common than malnutrition, and has long-lasting effects as well.

Although most international adoptees display remarkable growth recovery after adoption, the consequences of early malnutrition or undernutrition may still be observed in some children years later. Genetic factors, prenatal exposures, and neglect all amplify the effects of early malnutrition. This course describes the interactions of malnutrition and neglect, and the effects of malnutrition on growth, cognition, behavior and immunity. The effects of recovery from malnutrition on growth, cognition, and behavior are reviewed, along with practical considerations for internationally adopted children.

MALNUTRITION AND NEGLECT

Malnutrition often occurs in conjunction with neglect. The combination is far more devastating than malnutrition alone. Experimental animals exposed to both malnutrition and environmental isolation has more severe and persistent behavioral problems than after exposure to either one separately. Both malnutrition and neglect commonly result in behavioral withdrawal. These factors thus act synergistically to isolate the infant from the stimulation necessary for formal development. Malnutrition in the absence of neglect is less harmful. For example, among equally malnourished infants in Chile, developmental abilities were better among those who were the product of "wished-for pregnancies", "separated less from their mother's side," and received more stimulation from their mothers. Similarly, many Dutch children born during World War II suffered from pre- and postnatal malnutrition but had normal development and behavior (see exceptions below).

EFFECTS OF MALNUTRITION

Malnutrition has broad effects on growth, development, cognition, behavior, and immune function. All of these areas are linked and are subject to multiple other influences. Isolating the effects of malnutrition is impossible outside of experimental settings. Early malnutrition has effects throughout the lifespan. Adults malnourished as children are more likely to develop coronary artery disease, type 2 diabetes, and hypertension. Prenatal malnutrition also affects health in adult life. Dutch children born after the "Hunger Winter" imposed by the Nazi blockade were more than twice as likely to develop schizophrenia if their mothers were malnourished during the first trimester of pregnancy. Impaired glucose tolerance developed more frequently in those children whose mothers were malnourished during the last trimester of pregnancy. Infants born small for gestational age are more likely to develop insulin resistance, dyslipidemia (disorder of lipoprotein metabolism), and "syndrome X" (hypertension, type 2 diabetes, and obesity). Nutritional deprivation in early life may also impair cognitive function in old age.

MALNUTRITION AND GROWTH

The most obvious effect of malnutrition is on growth. The severity, timing, and duration of caloric deprivation determine the degree of growth inhibition. In growing children, height best reflects overall nutritional condition: body weight and amount of subcutaneous fat depend on recent intake rather than on the duration of undernutrition. In severe cases of malnutrition, growth ceases. In less extreme conditions, growth velocity is reduced. Young infants are more vulnerable to the effects of malnutrition on growth than older children. Children with chronic caloric undernutrition are short, have retarded bone ages, and normal dental ages. Although weight is below normal for age, weight for height is often normal (due to the reduction in height).

Like height and weight, head circumference may be reduced by malnutrition. Although height tends to catch up with time, head circumference in children who suffer early malnutrition becomes progressively more abnormal. Indeed, "suboptimal head circumference may be the most sensitive physical index of prolonged undernutrition during infancy." Sometimes, however, head circumference is relatively preserved.

In some children, the combination of neglect and malnutrition results in psychosocial dwarfism. Biochemical tests in these children are indistinguishable from those seen in idiopathic hypopituitarism (condition resulting from a deficiency in pituitary hormone), including abnormalities of growth hormone, ACTH (adrenocorticotropic hormone. which activates cortisol production), and thyroid function. The children are short, appear younger than their chronological age (immature facial features and body structure), and have delayed dental and bone ages. Some children have widened cranial sutures (sutures between the bones of the skull). In extreme cases, children exhibit bizarre eating and drinking behavior, sleep disturbances with nighttime roaming, and foraging (beyond the usual post-adoption arrival behaviors).

GROWTH DELAYS AND INTERNATIONAL ADOPTEES

Growth delays are common among international adoptees. Many have low birth weights, although these are difficult to interpret in the absence of (reliable) information about gestational age. Malnutrition may develop or worsen during institutional life. Small size at birth, intercurrent medical problems (recurrent infections, for example), insufficient calories, and lack of nurturing physical contact all contribute to ongoing malnutrition. Many international adoptees are malnourished at arrival.

Multiple factors contribute to malnutrition among institutionalized children. Duration of orphanage confinement is an important variable. In three distinct populations of adoptees (Romanian, Chinese, Russian), length of institutionalization related directly to linear growth lags.

MALNUTRITION AND COGNITION

In addition to reducing growth, malnutrition also impairs cognitive ability. Malnutrition during the period of most rapid brain growth (last trimester of pregnancy through the first 9-12 months of postnatal life) diminishes brain size, brain DNA content, myelinization (formation of the myelin sheath around a nerve fiber), cortical dendritic growth, and neurotransmitter content (chemicals that allow the movement of information from one neuron across the gap between it and the adjacent neuron). Some of these changes may be ameliorated by environmental enrichment.

A linear correlation between growth and developmental delays has been identified in children with protein-energy malnutrition. Similarly, malnourished international adoptees are more likely to be developmentally delayed than are better nourished children.

Numerous studies (but not all) find permanent reductions in cognitive ability after significant malnutrition in early childhood. Studies in Jamaica and South Africa show reduced IQ as long as 20 years after recovery from malnutrition. One study found that children sustain a loss of approximately 12.5 IQ points as long as 10 years after a single episode of malnutrition.

Malnutrition also alters subtle neurocognitive function. Memory and attention appear to be particularly vulnerable to early malnutrition. Visuo-motor and perceptual abilities were impaired in South Africans diagnosed with malnutrition 20 years previously, unrelated to their IQ scores. Fine motor delays are found in some children at least through 18 years of age, years after malnutrition has resolved. Even children with temporary malnutrition have impaired auditory and visual memory at age 5-14 years, especially if their weight deficit reached 11% or more. These children also have lower scores on the Parental Estimate of Development Scale. Other studies show sensory integration disorder, learning disabilities, abnormal auditory evoked responses, and impaired school performance long after a single episode of malnutrition. Researchers in South Africa state that the "association of a small head and impaired visuo-motor functioning may be the most reliable indicator of children at a cognitive disadvantage after undernutrition in infancy."

Maternal or other environmental factors that frequently coexist with malnutrition are also important and contribute to outcome. Mothers of malnourished children have higher maternal depression scores; maternal depression correlated with the behavioral and cognitive functioning of the child during the school years, regardless of the child's IQ. Thus maternal depression or conditions leading to it -- hospitalization, lack of bonding -- may be an independent factor contributing to behavioral and cognitive deficits in children with an early history of malnutrition. Malnourished infants are more likely to be described by their mothers as "difficult". It is not known if these findings can be extrapolated to foster mothers or orphanage caregivers. In all settings, malnutrition is usually complicated by concurrent exposures to social and economic disadvantage, poor housing, ill health, and family disruption or disorganization, all factors capable of influencing intellectual development.

The timing of malnutrition markedly influences its effects on neurocognitive outcome. The risks are greatest when the malnutrition coincides with periods of rapid brain growth. Production of brain DNA is two-thirds complete by birth then ceases at 1 year of age; brain growth is largely complete by 3 years of age. Low-birth weight infants generally have inferior cognitive outcomes. When evaluated in early childhood and during school-age and teenage years, these children tend to have difficulties in coordination, lateralization (localization of function attributed to either the right or left side of the brain), spatial and graphomotor (handwriting) skills, attention, and cognition. Smaller head circumferences are strongly linked to worse outcome.

In children without prenatal growth retardation, malnutrition anytime within the first 3 years of life is more likely to result in impaired intellectual development than if it occurs later during childhood. Cognitive outcome may be worse in children who experience malnutrition within the first 6 months of life, although other studies demonstrate no difference in outcome after malnutrition at any time within the first 2 years. Cognitive recovery may only be possible during the period of rapid brain growth, although some believe it may occur at any time. Varied outcomes likely result from the testing measures used and characteristics of the study population.

Even in adequately nourished children, specific dietary deficiencies (protein, cholesterol, polyunsaturated fatty acids) may reduce speech and language, gross motor function, and perception and visual motor skills. Neuroanatomic abnormalities found in infants with severe protein-calorie malnutrition suggest a possible basis for their neuropsychological deficits.

MALNUTRITION AND BEHAVIOR

In addition to its effects on growth and cognition, malnutrition also affects behavior. Malnutrition rarely occurs in isolation; it is usually accompanied by deprivation of social, sensory, and environmental stimulation. Thus it is difficult to ascribe behavioral problems seen after malnutrition to that factor alone. Malnourished individuals are apathetic and tend to avoid new experiences, show overly emotional responses to aversive or stressful stimuli, and exhibit less locomotor activity. Malnourished infants are lethargic and suck poorly, which further contributes to poor nutrition. These children are classified as "ineffectual, immature, and dependent" when assessed in nursery school. Animal studies suggest that malnutrition "functionally isolates" the individual, limiting enriched experiences needed for optimal cognitive development. Malnutrition reduces curiosity, the major impetus for learning in young infants.

Even a single episode of malnutrition in early life can result in long-lasting behavioral changes. Jamaican boys with a period of malnutrition before age 2 years had poor attention span, poor memories, more distractibility, less cooperation with teachers, more isolation from peers, fewer positive peer relationships, and more frequent behavior or conduct problems at ages 5-10 years than their well-nourished siblings and classmates. There was no relation to the timing of the malnutrition within the first 2 years of life and behavioral outcome. Those children in whom onset of starvation was between 21 and 30 days of life have more difficulties than children with later onset of starvation. The authors of this study concluded that "even a brief period of severe starvation in early infancy, uncontaminated by socioeconomic conditions, has a long-lasting effect on learning abilities and general adjustment as measured at 5-14 years of age."

Similarly, Barbadian children with a single episode of malnutrition in infancy had short attention spans, poor memories, distractibility, restlessness, poorer social interaction with teachers and peers, low self-esteem, and more emotional liability years later. These behavioral problems were unrelated to IQ. There was a four-fold increase in the frequency of attention deficit hyperactivity disorder at age 15 years (60% of previously malnourished children vs. 15% of control children). The attention-deficit behaviors persisted to at least age 9 to 15 years. Finally, although previously malnourished South African children were well integrated into their communities 20 years later, many individuals showed lack of drive, initiative, enterprise, and social maturity.

MALNUTRITION AND IMMUNE FUNCTION

Malnutrition is the most common cause of immunodeficiency in the world. Malnutrition and undernutrition clearly increase susceptibility to infection. Pneumonia and measles are among the most common acute infections in malnourished children and contribute to the deaths of many. Other infections are also more common among malnourished children. In one study, hepatitis B surface antigenemia was more common among Thai children with malnutrition than in well-nourished children (29% vs. 7.4%).

Many components of the immune system are affected by malnutrition. One of the most striking findings in malnutrition is a generalized increase in serum immunoglobulins, likely a response to increased antigen exposure (via chronic dermatitis, increased intestinal permeability, which enhances systemic absorption of food antigens and microbial toxins, and more frequent intestinal parasites). Undernutrition or malnutrition may impair responses to vaccines. Children with severe malnutrition may harbor severe infections without the usual clinical signs of infection.

Many of these changes in the immune system reverse with improved nutrition. However, improvement in immune function lags considerably behind nutritional rehabilitation. Recovery of some immune functions, especially cell-mediated immunity, may be incomplete. Ongoing micronutrient deficiency, chronic exposure to infectious diseases, or other environmental factors may impede complete restitution of the immune system. Thus, the malnourished international adoptee may be more susceptible to infection for some time even after nutritional rehabilitation is complete.

RECOVERY FROM MALNUTRITION

PHYSICAL EFFECTS

Supplemental calories and a nurturing environment are both needed for optimal physical recovery from malnutrition. When both components are provided, most children demonstrate remarkable growth catch-up after malnutrition. Adequate dietary amino acids, phosphorus, and sulfur are particularly important to promote growth recovery. The velocity and amount of catch-up vary depending on many factors: the age of the child, the severity, duration, and cause of the malnutrition, and concurrent health problems.

Children who suffer substantial malnutrition in early childhood likely end up shorter and lighter (and with smaller head circumferences) than their genetic potential indicates (similar to most studies of intrauterine growth-retarded infants). In some circumstances, children may achieve their full growth potential or nearly so. If the height deficit is less than 5-8%, chances for a complete recovery are good. If the height deficit is equal to or greater than 15%, the possibility of achieving normal height is less. Weight usually recovers prior to height.

Onset of puberty may be affected by malnutrition. Girls with a history of malnutrition often have significant delays in onset of menarche (first occurrence of menstruation), although precocious puberty may occur in children after recovery from malnutrition. Twelve-year-old children born small for gestational age have increased adrenocortical and adrenomedullary hormones; some have elevated cortisol and cholesterol levels.

COGNITION AND BEHAVIOR

Environmental stimulation can remediate the behavioral and cognitive effects of malnutrition and is probably more effective than achieving optimal nutrition. Environmental stimulation long after an acute period of malnutrition may modify or diminish some behavioral changes. Home visitors and other low-cost enrichment programs improve the developmental scores of children after malnutrition, although the sustainability of these benefits is controversial. Although low-birth weight children are more likely to experience learning difficulties and attentional problems as adolescents, recent work demonstrates that cognitive function improves over time (years) in very low-birth weight infants; this may provide a model for other high-risk conditions in early life. Adequacy of catch-up growth determines neurodevelopmental outcome in very low-birth weight infants; similar studies have not yet been reported after early malnutrition.

Adoption is the most dramatic intervention after malnutrition. Adoption provides a total and permanent improvement of the environment, optimizing both nutrition and surroundings. Studies of Indian, Korean, and Chilean adoptees all address this question. Indian children adopted in Sweden achieved normal psychomotor scores within two years, although milestones were initially delayed in approximately 30% of the children, especially those who were stunted or underweight. Average age at follow-up was 39 months.

In another study, Korean children in the United States were evaluated 6 or more years after adoption; all were in grades 1-8. The nutritional status of the children at the time of entry into pre-adoptive (foster) care (less than 2 years of age) predicted IQ scores. All 138 children adopted before age 3 years had above average IQ scores. Nutritional status of Korean children adopted at older ages (between age 2 and 5 years) also predicted IQ. Those with severe malnutrition at entry did not achieve average IQ scores, but moderately malnourished and well-nourished children scored above average.

Finally, Chilean children with malnutrition in infancy achieved higher IQ scores after adoption than those consigned to institutions or those who returned to their biologic families. These studies are all testaments to the special stimulatory character of the adoptive home.

MALNUTRITION AND INTERNATIONAL ADOPTION: PRACTICAL CONSIDERATIONS

When caring for the malnourished or under-nourished new arrival, the pediatrician should explicitly discuss feeding practices with the family. Voracious or ravenous children should be allowed to eat freely. Rapid weight gain allows a quicker return to normal body composition in malnourished children, and free access to food is important psychologically for the hungry child. Vitamin and mineral supplements should be discussed with the child's pediatrician.

Rapid growth recovery is the rule in malnourished children after adoption. If substantial physical catch-up does not occur within the first 6 months, medical or behavioral causes preventing recovery should be sought. The number of possibilities is substantial, and a comprehensive approach must be taken. Curiously, some children with growth retardation from malnutrition and neglect become accustomed to low-caloric intakes, and do not appear to be hungry even if presented with adequate amounts of food. This may reflect disordered regulation of the complex pathways that determine appetite and satiety. However, until these pathways are more clearly elucidated, a behavioral approach to nutritional rehabilitation is necessary for these children.

SUMMARY

In conclusion, many international adoptees are malnourished to some degree at arrival to the United States. Others have endured unrecorded episodes of malnutrition prior to adoption. Even children with measurements greater than the fifth percentile may be undernourished, as demonstrated by the rapid catch-up growth to an appropriate percentile curve. Most children quickly recover weight; height and head circumference growth recovery usually follow. Micronutrient deficiencies and immune function impairments may outlast growth deficits. Long-term, many factors influence whether previously malnourished international adoptees reach their full potential for growth and cognitive development. Those without rapid physical recovery should be evaluated more fully. Some children likely have permanent behavioral or neurocognitive effects from early episodes of malnutrition.

KEY POINTS FOR INTERNATIONALLY ADOPTED CHILDREN

- Malnutrition is common in new arrivals.
- Most children exhibit rapid catch-up in growth measurements.
- Early malnutrition may have long-term effects on growth, cognition, behavior, immunity, and health.
- Malnourished children who do not have rapid growth recovery after arrival should be carefully evaluated.