International Journal of Research in Social Sciences
Vol. 8, Issue 8, August 2018,
ISSN: 2249-2496 Impact Factor: 7.081
Journal Homepage: http://www.ijmra.us, Email: editorijmie@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gate as well as in Cabell's Directories of Publishing Opportunities, U.S.A

SUPPLEMENTING NUTRITION IN THE EARLY YEARS: THE ROLE OF EARLY CHILDHOOD STIMULATION

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ABSTRACT

Child development has multiple dimensions, including physical, sensorimotor, social, emotional, language and cognitive. Children develop rapidly during the first five years of life from being unable to speak and walk to having fairly advanced motor, social and cognitive skills. The importance of the first 1,000 days (from gestation to two years) in helping a child develop healthy growth is well established. The brain grows very rapidly during the same period; between three and five years of age its development continues with new abilities building on those already acquired. Early childhood is a critical time for cognitive, social, and physical development. For children under the age of five, good nutrition and psychosocial stimulation—physical and emotional engagement—may be especially important for physical and neurological growth. Unfortunately, many children under five fail to reach their developmental potential, due to poverty and the often associated poor nutrition and lack of psychosocial stimulation. Previous research has shown that nutritional supplements early in life can increase a child's income as an adult[1] and that encouraging parents to play with their children more can promote greater emotional and intellectual development.

Keyword:Early child development, Child nutrition, Integrated Interventions, Care, Behavior change

INTRODUCTION

Providing every child with the best start in life is not only essential for the child's individual well-being but is a necessary investment to protect human capital and achieve national development objectives. Chronic malnutrition (or stunting, low height-for-age) affects an estimated 165 million children worldwide, a majority of whom live in developing countries.1 Most of these children are also not achieving their development potential due in large part to chronic malnutrition. In fact, it is estimated that more than 200 million children under 5 years of age in developing countries are not achieving their development potential due to both chronic malnutrition and poverty. Adequate nutrition is critical for brain development and plays an

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important role in a child's physical, social, emotional, and cognitive development—the four domains of early childhood development (ECD) in which children need to develop to reach their potential. Aside from adequate nutrition, children also need a stimulating environment and social interaction with attentive caregivers to develop sufficiently in all four domains. Adequate nutrition is critical to a child's optimal development, particularly during the first 1,000 days (pregnancy through the child's second birthday), a period of rapid growth where nutrient deficiencies can have long-term consequences.

THE CAUSES OF UNDERDEVELOPMENT

Why is underdevelopment so bad in India? Childhood development is the product of a hugely complex array of overlapping factors that fall into three broad areas: nutrition, health and care. The drivers of inadequate nutrition, health and care are therefore the ultimate determinants of underdevelopment. NutritionChild development proceeds normally where there is enough protein and energy, and where there are adequate supplies of micronutrients for growth and development. Box 3 highlights key indicators.In India, poor feeding practices, low dietary intakes and failure to prevent or adequately treat communicable diseases cause widespread undernutrition.1More than one in five babies in India (22%) is born with low birthweight, putting them at risk of undernutrition and illness even before birth.This reflects poor attention to maternal health and nutrition before and during pregnancy. Also, 36% of Indian women are too thin for their height, and 55% are anaemic.

HEALTH

Health relates closely to nutrition, with young children vulnerable to diarrhoea, intestinal worms and pneumonia as well as infectious diseases like measles, malaria and TB. These obviously have a direct impact on children's well-being, but they also affect well-being indirectly through damaging children's ability to absorb nutrients.Around a tenth of children in India suffer from diarrhoea, and almost a sixth suffer from fever. More than half of under-threes are deprived of full immunisation, with children often beginning but infrequently completing vaccination courses. Of course, breastfeeding rates also drop off in developed countries like the UK. The difference is that the practice is particularly important in less wealthy places: both because the alternatives are generally worse in poorer countries, and because children start from a lower base (eg, on birthweight).Underpinning this is lack of prevention—particularly adequate sanitation. Only half of the urban population and 18% of the rural population have access to adequate sanitation ('improved toilets'). Only in 21% of households are children's stools disposed of safely.Good health also requires carers not to do the wrong things. A range of harmful cultural practices are prevalent in India, including denying newborns the first milk (anti-body rich 'colostrum'), keeping babies too cool and, in some areas, not feeding children during illness. More than a quarter of children with diarrhoea get no treatment; 41% have their fluid intake cut and 45% have food levels cut. Lack of timely and sensible management of childhood illness is at the heart of underdevelopment.

CARE

The final key component that supports childhood development is care, understood here in the broad sense of social and emotional care, including stimulation, affection, securityand love. For babies and young children, this includes engaging with them through look, touch and speech, and responding to them positively. For older infants, it means quality preschool education and daycare. For all children, care requires positives such as parental involvement, spending time together and being listened to, as well as avoiding negatives such as exposure to stress and violence.

NUTRITION'S IMPACT ON EARLY CHILDHOOD

Development during the First 1,000 DaysNutrition impacts ECD both directly and indirectly. Nutrition has a direct impact on brain development during the first 1,000 days, a period of rapid brain growth and development where sufficient quantities of key nutrients are needed in differing amounts at critical periods to ensure the brain is developing properly. This is because regions of the brain (e.g., the hippocampus) and brain processes (e.g., synapse formation) require different nutrients at different times and amounts to develop. For example, the brain's demand for zinc, which is necessary for cell division among other neurodevelopmental processes, is particularly high during the last four months of gestation and from 6 months to 10 years of age. Children's nutritional status can also influence their behavior, indirectly impacting their development through two key pathways—childhood exploration and caregiver interaction. Without proper nutrition, children may not have the energy or interest to explore their environment, limiting their interaction with new situations, senses, and experiences. In addition, children who are adequately nourished may be more active and demand greater attention and responsiveness from their caregiver, while malnourished children may be frequently ill and therefore more irritable, eliciting negative and less stimulating responses from a caregiver. Malnourished children may also be harder to feed, leading caregivers to provide less food and use a non-responsive and less stimulating manner of feeding. Finally, since malnourished children may appear younger than they actually are (either due to reduced weight or height), they may receive stimulation that is not appropriate for their actual age, further stunting their development.

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DEGREE OF NUTRIENT DEFICIENCY

Much evidence shows that brain development may be compromised when nutrient deficiency is severe to moderate but spared when deficiency is mild to moderate. A number of homeostatic mechanisms protect the developing fetus and the developing brain from nutrient deficiency to a certain degree. For example, in the case of placental insufficiency, when insufficient nutrients and oxygen are available, fetal cardiac output is redistributed such that blood flow to the peripheral tissues decreases and blood flow to the brain, adrenal glands, and heart increases. This leads to brain sparing, or the sparing of brain growth even when overall fetal growth is reduced. Another mechanism that protects the fetus from iron deficiency to a certain degree is the increased transfer of iron across the placenta as maternal levels decrease. For each nutrient, there is likely to be a threshold at which deficiency results in impairment for the child. Exactly where this line is drawn is an important question which must be answered for each nutrient individually. Several studies have shown that the effect of nutritional supplementation on brain development depend son initial nutritional status. For example, in Bangladesh and Indonesia, a positive effect of maternal multiple micronutrient supplementation during pregnancy and postpartum on child motor and cognitive development was found only in children of undernourishedmothers.[70,71]Similarly, in Chile, infants with low hemoglobin concentration at age 6 months showed improved cognition at age 10 years if they had been fed iron-fortified formula (compared to low-iron formula) during infancy, whereas children with high hemoglobin concentration at age 6 months performed better in cognitive tasks at age 10 years if they had received low-ironformula.[72]In summary, greater severity of nutritional deficiency increases both the likelihood of negative effect son brain development and the likelihood of positively responding to nutritional supplementation.

NUTRITION

The development of many organs, including the brain, is dependent upon adequate nutrients. Deficiencies in micronutrients that have been associated with brain development are common in children under age 5, with the prevalence of iodine deficiency (40% in Africa and 31.6% in Asia), zinc deficiency (23.9% in Africa and 19.4% in Asia),and anemia (hemoglobin<110g/L, mostly dueto iron deficiency: 20.2% in Africa and 19.0%in Asia).Deficiencies in macronutrients (energy, protein, and fat) can lead to poor weight gain followed by stunting,22and certain macronutrients (e.g., essential fatty acids) are also associated with brain development. Although the number of stunted children under 5 years of age has decreased from 253 million in 1990 to

165 million in 2011,there are striking inequities in the prevalence of stunting between the poorest and richest quintiles within countries. Stunting early in life has been associated with consequences that threaten equity throughout the life span, including delayed school entry, early school termination, and poor school performance, resulting in reduced work capacityandhumancapital.25–Early stunting has been usedas an indicator, along with poverty, to estimate the number of children worldwide who do not reach their developmental potential. The reduction of nutritional deficiencies and the prevention of stunt-ing during the first 1000 days are major priorities in promoting children's development and preventing inequalities. In addition to growth faltering, overweight and obesity have emerged as serious problems among young children throughout the world. In LMIC, rates of childhood overweight and obesity have in-creased from 4.2% in 1990 to 6.7% in 2010 (representing over 35 million children), with an expected increase to 9.1% in 2020 (12.7% in Africa).Unlike other health and nutritional conditions that differentially affect children in the lowest wealth quin-tile, in LMIC obesity often occurs in the highest wealth quintiles, illustrating the complexities of the nutrition transition. The consequences of child-hood obesity often begin with psychosocial problems and extend to health-related problems. Although the strategies that help families promote healthy growth among their young children (to pre-vent underweight and stunting) often apply to the prevention of obesity, this issue focuses primarily on the prevention of under nutrition and stunting. Nutritional guidelines often focus on nutrition specific interventions regarding the availability, accessibility, and acceptability of food and nutrients, beginning before conception and extending to breastfeeding promotion, the timing of complementary feeding, and dietary adequacy during childhood. Nutrition sensitive interventions have emerged from the recognition that nutritional status is affected by factors that extend from societal conditions, such as poverty alleviation and women's empowerment, to household considerations, such as mealtime organization and family feeding interactions. Since many of these nutrition-sensitive factors affect not only nutritional status, but also children's development, they could be incorporated into integrated interventions, thereby potentially strengthening both nutritional status and child development.

POOR MATERNAL NUTRITION

Poor maternal nutrition can contribute to low birth weight (LBW)—when an infant weighs less than 2,500 g (5.5 lbs) at birth—which is associated with poor developmental outcomes. LBW is an outcome of intrauterine growth restriction and/or preterm birth.10 Maternal stunting (height <145 cm) and underweight (low body mass index) during early pregnancy are associated with increased risk of poor fetal growth. In addition, maternal obesity and deficiencies in calcium and zinc during pregnancy are associated with preterm birth, while iron deficiency anemia during pregnancy is associated with LBW.11 The 2007 and 2016 Lancet series on child development in developing countries found that LBW infants with intrauterine growth restriction are at significant developmental risk—including lower cognitive scores, poorer problem-solving skills, and behavioral issues. Small-for-gestational-age and preterm births are also important contributors to stunting in children, a risk factor for poor ECD that is discussed below.

IODINE DEFICIENCY

Iodine, which is required for the production of thyroid hormones, is also critical for brain development and cognition. Global evidence identifies iodine deficiency as one of the key risk factors for poor ECD. Iodine deficiency during pregnancy, the main cause of preventable brain damage worldwide, can lead to irreversible brain damage of various degrees in the infant.16 While the most severe manifestation is cretinism—an irreversible disorder characterized by mental retardation, deaf-mutism, facial deformations, and severely stunted growth—even milder iodine deficiency can have an impact on ECD by reducing intelligence and cognitive ability. On average, iodine deficiency can lead to a reduction in IQ of up to 13.5 points.

Early Childhood (0–23 months)

IRON DEFICIENCY

Iron deficiency during infancy can have both short- and long-term consequences, including impaired mental and motor development, poorer socio-emotional behavior, and reduced school achievement. The fetal/neonatal and infancy/toddlerhood (6 months to 3 years) period is a time of particularly high vulnerability to iron deficiency but is also a period when children's needs are greatest.Numerous longitudinal studies have consistently demonstrated that children who had iron deficiency anemia in the first 2 years of life continue to show deficits in cognition and school achievement later in life. Longitudinal studies also demonstrate that despite treatment with iron, children who were severely iron deficient before 2 years of age continue to show signs of reduced cognitive ability at 4–19 years of age, indicating that iron deficiency anemia, especially early in life, appears to have long-term impacts. Studies on supplementation during pregnancy have yielded inconsistent results, indicating that maternal supplementation alone may not be enough to prevent the negative cognitive consequences of iron deficiency during early infancy.

CONCLUSION

In summary, integrated approaches that include a focus on the child (stimulation and nutrition), the parent (maternal depression), and the parent-child relationship (knowledge and responsive care skills for feeding, play, and communication) may well be more effective and sustainable than approaches that consider the child with little attention to the family care context. However, to optimize the effectiveness of integrated interventions, more research is necessary to understand both the combined effect and the effect of individual interventions on a broad range of outcomes related to the delivery of care for children's nutrition and development (e.g., reduction in maternal depressive symptoms and enhancement in responsive care and feeding behaviors) and how these variables might mediate young children's nutrition and development outcomes. For example, research is needed to understand how theoretical frameworks of care that combine varying nutrition and development messages might be best aligned and delivered. These messages and delivery strategies have to be reflected in common curricula, training materials, supervision, behavioral change techniques, and delivery practices.

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