

A brief review of risk-factors for growth and developmental delay among preschool children in developing countries

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Abstract

The purpose of this article is to provide an overview of the highly prevalent risk factors influencing growth and development among pre-school children in rural population of developing countries. A child's brain during the first 3 years of life is rapidly developing through generation of neurons, synaptogenesis, axonal, and dendritic growth and synaptic pruning each of which build upon each other. Any interruption in this process, such as trauma, stress, under-nutrition or lack of nutrients can have long-term effects on the brain's structure and on the child's socio-emotional development. Children's development is essentially cumulative in nature and hence, the early years of life are the foundation for later development. A Med-line search was done to review relevant articles in English literature on evaluation of risk factors influencing child development. Data were constructed and issues were reviewed from there. Influences upon children's development tend to be specific in nature and developmental influences rarely operate in isolation from each other. Developmental risk factors tend to cluster together thereby, interventions designed to facilitate development must be multifocal in nature, integrating influences from different domains.

Key Words: Child development, child growth, rural population, under-nutrition

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INTRODUCTION

Children are the touch-stone of a healthy sustainable society and hence, future of sustainable development begins with safe-guarding the health of every child.^[1,2] During the first 3 years of life, child development is dynamic and involves the maturation of interrelated functioning such as cognitive, physical and socio-emotional capabilities. It is a period marked

by rapid physical and neurological development and requires proper nutrition in order for the child to achieve those capabilities so that the child can reach their full potential not only in quality of life, but also in terms of educational achievement and earning potential.^[3]

We performed a Med-line search to review relevant articles in English literature on evaluation of highly prevalent risk factors influencing child development. Data were constructed and issues were reviewed. We have shared few issues from our research work on child development in rural population. Evaluation of children in their earliest age for development is of high concern in rural population with respect to the quality of life and future reproductive to the community and growth of the nation.

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Importance of child development

Addressing developmental issues are likely to increase given the growing focus on child development, the importance of early experience on brain development, and evidence that early identification of developmental problems and intervention will result in better developmental outcomes.^[4] Several health and socio-demographic predictors of delayed neurobehavioral development are common in the developing world and are likely to affect the neurobehavioral development of infants and young children. For example, research has shown effect of chronic malnutrition (i.e., stunting), iron-deficiency anemia and low-birth weight on delays in neurobehavioral development.^[5]

Growth assessment is an essential component of pediatric health surveillance because almost any problem within the physiologic, interpersonal, and social domains can adversely affect growth while development is multi-determined, varying as a function of nutritional, and biomedical status, genetic inheritance, and social and cultural context.^[6]

Determinants of child development Table 1 Principles influencing the competence of a child

The competent individual is one who can effectively adapt to and interact with his or her environment. In understanding what biological and psychosocial factors influence the development of individual differences in competence, four principles are critical.^[7]

First, most aspects of individual competence are multi-determined. This means that interventions designed to facilitate development must be multifocal in nature, integrating influences from different domains. Second, influences upon children's development tend to be specific in nature. This emphasizes the importance of targeting specific interventions to specific outcomes. Third, individual developmental influences rarely operate in isolation from each other.

Table 1: Examples of community or ecological risk factors and individual risk factors

Community or ecological risk	Individual
Poor sanitation	Repeated infections
Famine	Under-nutrition
Endemic violence	Abuse and neglect
Lack of accessible services: Pre-schools, schools, libraries, health services	Very low family income
Lack of commitment to child development	Low-birth weight
	Low maternal education
	Large family size
	Short spacing between births
	Low levels of developmentally enhancing parenting practices

Developmental risk factors tend to cluster together, as do developmentally protective influences. The extent of the impact of a given developmental risk factor will depend, in part, on the degree to which this risk factor covaries with other risk factors. Fourth, developmental risk and protective factors operate across time. Early exposure to developmental risks may increase the individual's susceptibility to later risk factors (sensitizing) or may limit the degree to which the individual is exposed.^[3]

Role of major factors affecting child development in developing countries

Influence of nutrition on child development

The prevalence of child under-nutrition in India is among the highest in the world; nearly double that of Sub-Saharan Africa, with dire consequences for morbidity, mortality, productivity, and economic growth. In India, child malnutrition is responsible for 22% of the country's burden of disease. Levels of malnutrition have declined modestly, with the prevalence of underweight among children under three falling by 11% between 1992/93 and 1998/99. Although, levels of under-nutrition in India declined modestly during the 1990s, the reductions lagged far behind that achieved by other countries with similar economic growth rates.^[8]

Under-nutrition, both protein-energy malnutrition and micronutrient deficiencies, directly affects many aspects of children's development. In particular, it retards their physical and cognitive growth and increases susceptibility to infection and disease, further increasing the probability of being malnourished. Under-nutrition also affects cognitive and motor development and undermines educational attainment; and ultimately impacts on productivity at work and at home, with adverse implications for income and economic growth. Micronutrient deficiencies alone may cost India US\$2.5 billion annually.^[8]

The global community has designated halving the prevalence of underweight children by 2015 as a key indicator of progress towards the Millennium Development Goal of eradicating extreme poverty and hunger. Economic growth alone, though impressive, will not reduce malnutrition sufficiently to meet the nutrition target. If this is to be achieved, difficult choices about how to scale up and reform existing nutrition programs or introduce new ones have to be made by the Government of India and other agencies involved in nutrition in India.^[8]

Influence of iron deficiency on child development

Nutritional anemia is a recognized public health problem throughout the world. An estimated 30% of the

world's population is anemic, with the global prevalence of anemia among 6-12 year-old children to be 36% and 77% in developing regions respectively. Iron deficiency anemia (IDA) was found to be the commonest followed by vitamin B12 and folic acid deficiencies.^[9]

The literature regarding the possible effects of iron deficiency on cognitive function and psycho-affective development was critically reviewed in 1976.^[10] Despite serious shortcomings in research design and measures of independent and outcome variables, considered as a group these studies suggested that iron deficiency might have adverse effects on attention, intelligence test performance, and school achievement. During the intervening years, the relevant study designs and measurements have been significantly improved.^[11]

IDA is common across all age groups, but highest among children and pregnant, and lactating women, and affects about 2 billion people in developing countries. The consequences of IDA in pregnant women include increased risk of low-birth weight or premature delivery, perinatal, and neonatal mortality, inadequate iron stores for the newborn, lowered physical activity, fatigue and increased risk of maternal morbidity. It is also responsible for almost a quarter of maternal deaths. Inadequate iron stores as a newborn child, coupled with insufficient iron intake during the weaning period, have been shown to impair intellectual development by adversely affecting language, cognitive, and motor development. Infants with iron-deficiency anemia or other indications of chronic, severe iron deficiency have shown lower cognitive test scores than infants with good iron status.^[9,12]

Influence of poverty on child development

Despite heightened international efforts to bring more attention to poverty and human development, the most vulnerable children are still the most invisible. These children, aged zero to three, do not show up in mortality records, but poverty and hunger are negatively affecting their development. They survive while living in poverty during the most critical stages of cognitive, social and emotional development. Any sustained interruption to their nutrition or to their care, if not treated early, can result in irreversible damage to their development. As impoverished young children grow, they will be less likely to succeed in school and more likely to provide inadequate parenting. This will perpetuate the cycle of poverty and poor human development. The result is the perpetuation of another generation in poverty.^[1]

Undernourished and poorly developed children who are at risk in those first 3 years of life are at the heart of the grinding social inequalities that drive poverty

and truncate human development. Beyond nutritional deficiencies, high rates of infectious and diarrheal diseases due to poor sanitation and toxins in water supplies have devastating effects on the development of young children. Some infections such as malaria can directly cause neurological and cognitive damage, while others have indirect effects through poor nutrition, where loss of nutrients can lead to apathy, poor absorption, and less uptake of micronutrients.

The relationship between poverty and child development is not only dramatic in developing nations, it is also a major concern in developed nations where there are pockets poverty, and health disparities related to race/ethnicity, gender, income, and education.^[3,13]

Influence of literacy of parents on child development

In one of the study conducted in rural population, it's found that poor maternal education is one of the variables most often cited as having a predictive value for poor developmental outcome in children. In this study, among the fathers, majority had completed minimum 10 years of education. The results indicated that higher education among the parents had a positive effect on child development. Since, the literacy of the father and family income are interrelated, most of the families which were involved in this study were from low socio-economic class and majority of the mothers were unemployed.^[14,15]

Covariance among developmental influences

Development is multi-determined, varying as a function of nutritional and biomedical status, genetic inheritance, and social and cultural context.^[16] In understanding, the effect of specific influences upon individual behavioral–developmental variability, behavioral geneticists emphasize genetic contributions, nutritionists emphasize nutritional contributions, psychologists emphasize environmental contributions, and anthropologists emphasize cultural contributions. The traditional goal within each discipline is to isolate the unique contributions to development of influences from one's chosen field of study.^[5]

Potentially, relevant influences from other fields often tend to be regarded as nuisance variables that hinder our ability to isolate the unique contributions of what we are focusing on. However, parsimony notwithstanding, the factors that influence individual developmental variability rarely operate in isolation from each other, and most aspects of individual behavioral development are multi-determined. The contribution of multiple influences to individual behavioral developmental variability can be illustrated by the nature of genetic contributions to development.^[5]

As shown in Figure 1, the path from genes to outcomes is indirect, circuitous, and complex. Genes themselves directly affect only microbiological processes – essentially the transmission of DNA to RNA. Thereafter, we have a complex multilevel pathway, including contributions from both biological variables (e.g., nutrition, teratogens) and environmental stressors and supports. Not only is this pathway complex, but it is also bi-directional. Thus, whether structural genes are actually expressed or not depends on the action of regulatory genes, which are directly sensitive to a variety of non-genetic influences such as hormonal levels or nutritional status.^[5]

DISCUSSION

Development of the central nervous system (CNS) is a dynamic process that occurs as a cascade of events, with each step dependent on the completion of the previous step. The most rapid periods of CNS maturity in humans occur in utero, during infancy, and at puberty.^[17] It has been shown by medical and educational research that mental growth i.e., the development of intelligence, personality, and social behavior, occurs most rapidly in humans during their earliest years and hence are at heightened susceptibility to the adverse effects of environmental toxins and other negative factors such as chronic malnutrition, nutrient deficiencies, and lack of developmental stimulation leading to neurological and behavioral disorders such as learning disabilities and mental retardation in later life.^[17,18]

According to results of animal research and clinical studies, several nutrients, and other components present in breast milk could contribute to the enhancement of mental development. Long-chain polyunsaturated fatty acids in human milk have an effect on the chemical composition of the brain and enhance retinal and cortical function. These agents can act directly, influencing brain biochemistry and functional development, or indirectly, modifying sensory systems that affect brain development.^[19]

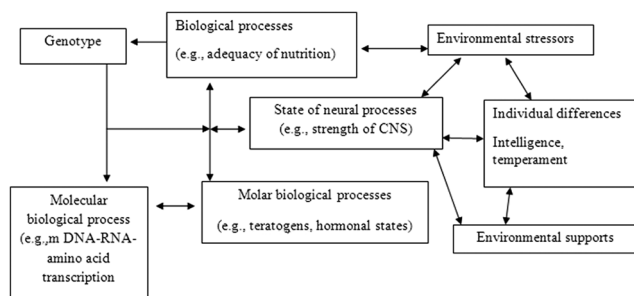


Figure 1: Pathway from gene to development

Child development is multi-dimensional. These dimensions, which are interdependent, include social, emotional, cognitive, and motor performance, as well as patterns of behavior and health and nutritional status. Covariance refers to the fact that in nature, individual developmental influences rarely operate in isolation. Rather, combinations of two or more developmental influences often co-occur at a greater than chance probability.^[3]

It has been recently estimated that in developing nations, 200 million children (roughly 39%) under age five are not reaching their developmental potential because of poverty, malnutrition, high rates of infection, lack of stimulation, and education and instability in the home and thereby detrimentally affect their cognitive, motor, and social-emotional development.^[20]

Nutritional inequalities across different states, socio-economic and demographic groups are large and in general, are increasing. Here, child malnutrition is mostly the result of high levels of exposure to infection and inappropriate infant and young child feeding and caring practices, and has its origins almost entirely during the first 2-3 years of life.^[9] Children who suffer from growth retardation as a result of poor diets and/or recurrent infections tend to have increased numbers of severe diarrheal episodes and a heightened susceptibility to certain infectious diseases, e.g., malaria, meningitis and pneumonia.^[1]

Growth retardation in early childhood is also associated with significant functional impairment in adult life and reduced work capacity, thus affecting economic productivity.^[1] Strong evidence exists that poor growth is associated with delayed mental development and that there is a relationship between impaired growth status and both poor school performance and reduced intellectual achievement.^[1]

Maternal and paternal education have been found to be moderate to strong predictors of children's cognitive ability.^[21] In one of the study, it was found that Socio-economic status, education, occupation and income of parents are positively associated with child development. They are considered to measure different aspects of children's environment. Family income is thought to impact more on the availability of material resources available to a child, whereas parental education is linked with nonmaterial resources such as attitude towards education and understanding of child development.^[14,15]

A cause and effect relationship has not been established between malnutrition and psychosocial development,

even after more than two decades of research efforts. This is due to the fact that malnutrition and other deprivations always coexist in an environment of poverty.^[1] It is extremely difficult to disentangle individual environmental effects as measurable impact variables causing delay in mental development. The role of multiple influences that is of particular relevance to children at risk in both developed and less developed countries is school failure and drop-out rates.^[5,22]

CONCLUSION

Child development depends on the synergistic effects of environment, nutrition, responsive stimulation, and social structures that work to nurture proper child development. Development depends on adequate access, quality, preparation and consumption of healthy foods, interactive bonding and emotional and intellectual nurturance from caregivers, supportive social and educational structures and community, economic and political support.^[3]

Though, development is dependent on multiple factors beyond food and micronutrients, yet we cannot ignore the centrality of good nutrition. Nutrition by providing the building blocks for brain development has a strong influence on cognitive, fine and gross motor skill development, educational attainment and psychosocial behavior along with linguistic and social development and self-regulation.^[3] Hence, evaluation of all these risk factors while screening for child development will give us the exact picture of burden of disease among children from rural population rather than screening for any of these individual factors.

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