Interrelationship between Growth and Development in Low- and Middle-Income Countries

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Early childhood growth failure is a significant public health problem in developing countries where 11% of term newborns are low birthweight (LBW) and 32% of children <5 years of age are stunted [1]. It leads to varied adverse consequences including increased morbidity and mortality in childhood and, among survivors, delayed cognitive development and reduced schooling [2]. We review studies that examined relationships between term LBW and stunting with child development. We also review studies that assessed the relative importance of prenatal vs. postnatal growth for developmental outcomes.

Compared to children born with normal birthweight (NBW), term LBW children have poorer cognitive and schooling later in life. Differences between LBW and NBW children were substantial and, in standard deviation units of cognitive outcomes, ranged from –0.98 to –0.14. Each additional kilogram of birthweight was associated with 0.3 more years of schooling.

Linear growth failure leading to stunting mostly occurs before 2 years of age, with stunting in older children reflecting growth failure in early life [3]. There is a substantial literature showing that stunting is associated with poor mental and motor development in preschool children, and with low scores in cognitive tests, increased frequency of behavioral problems and poor school achievement in older children [4]. Stunted children had cognitive scores that were –1.05 to –0.4 standard deviations lower than in non-stunted children. Schooling was reduced by 0.5 years for each z score lower in height.

Very few studies have assessed the relative importance for development of prenatal vs. postnatal growth failure using appropriate statistical techniques such as Multiple Stage Least Square analysis. The limited evidence to date suggests that growth during the first 2 years of life is more important than growth at any other time, including the
The relationship between child growth retardation and child development is confounded by poverty. Poverty leads to both growth failure and to delayed child development. Therefore, analyses of the relationship between growth failure and child development must control for poverty indicators. The two most commonly used indicators of poverty in the child growth and development literature are family socioeconomic status (SES) and parental educational level. Most studies used at least some proxy of poverty and some used very detailed measures. Controlling for confounding leads to modest attenuation of associations, but in many cases the associations remain statistically significant. While this suggests an independent true association, researchers must be concerned with residual confounding. It is possible that the measures of SES and education used were not perfect and that better measures of confounding would have attenuated the associations even more.

Various mechanisms, none mutually exclusive, have been proposed to explain the interrelationship between malnutrition (or its indicator, growth failure) and poor development. The long-standing

**Fig. 1.** Possible mechanisms related to malnutrition, growth retardation and poor mental development. From Brown and Pollitt [1996].
idea posits that the relationship is mediated through changes in the structure or biochemistry of the brain that impair the functioning of the central nervous system but there are several plausible mechanisms of a more subtle nature (fig. 1). For example malnutrition may influence development by delaying motor development and by increasing susceptibility to infections, which cause lethargy and withdrawal and thus interfere with exploration of the environment and learning.

References