

**Stoch M B & Smythe P M.** Does undernutrition during infancy inhibit brain growth and subsequent intellectual development? *Arch. Dis. Child.* 38:546-52, 1963.  
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The development of 21 children, grossly undernourished during their first year of life, was contrasted with matched, better-nourished controls. Brain growth, as reflected by head circumference, and IQ of the undernourished group were significantly lower than for controls, with no improvement over seven years. [The *Science Citation Index*® (SCI®) and the *Social Sciences Citation Index*® (SSCI®) indicate that this paper has been cited in over 225 publications, one of the top 10 for this journal.]

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This study is the outcome of a collaboration by two physicians with very different interests. Pat Smythe, a pediatrician and part-time rancher, learned that calves fed a moderate ration during their first year and a high ration during their second year did significantly worse than those fed high in the first year and moderately in the second year. This suggested that the effects of undernutrition would be most marked during the greatest growth period and would vary with the duration of undernutrition relative to the total growth period. When applied to human development, it seemed possible that the infant brain, which has its maximum postnatal growth during the first two years and is almost complete by the third year, may be most vulnerable to early undernutrition. Smythe wanted to study the development of those infants who had experienced severe undernutrition during this critical growth period.

In 1955, we began our study in Cape Town, South Africa. I had completed my pediatric internship and was interested in an academic career but needed a flexible schedule for my young and growing family. Longitudinal developmental research met both our needs and thus we began our long association.

For 20 years, we investigated the question of whether early severe undernutrition affected brain growth and subsequent cogni-

tive functioning and arrived at the following conclusions. Compared with a control group, the originally undernourished infants, now young adults, had significantly smaller head circumferences, defective visual-motor integration, and significantly less drive and initiative.<sup>1</sup> Five had minor abnormal shadows on their brain CT scans, and four of these subjects were the most severely handicapped in their visual-motor integration.<sup>2</sup> Interestingly, they have adapted well socially, and their children have not experienced nutritional deprivation and are living in significantly better surroundings.<sup>1</sup>

We suggest that this publication has been frequently cited because it was the first in the field. Our findings, which are highly significant for millions of children growing up in the Third World, may have stimulated many studies over the following two decades and may have highlighted the importance of intrauterine nutrition for subsequent brain growth and cognitive function. Recent school-age follow-up studies of premature infants show that they experience deficits in their visual-motor integration similar to our index subjects.<sup>3</sup> Methodological problems in our study stimulated extensive critical discussion, and some of the still-topical issues include the effect on later cognitive functioning of different patterns of early mothering, illegitimacy, nursery school attendance, and socioeconomic differences.<sup>4</sup>

Our biggest obstacle was maintaining the stability of the sample of 40 children over 20 years. We improved the nutrition of the undernourished group, but were still oftentimes challenged by their frustrated and angry parents. With time, we enjoyed technological advances as the simple calculator gave way to sophisticated computers. The acquisition of CT brain scan equipment by Groote Schuur Hospital, in 1978, facilitated the completion of our study.

On a personal level, this research allowed me to resolve a dilemma facing many women physicians, namely, combining family and career. It also stimulated my further study in developmental psychology and, later, in psychiatry.

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