The development of 21 children, grossly undernourished during their first year of life, was con-
tраст with matched, better-nourished controls. Brain growth, as reflected by head circumference, 
and IQ of the undernourished group were signifi-
cantly lower than for controls, with no improve-
ment 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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January 2, 1985

This study is the outcome of a collaboration by two physicians with very different inter-
ests. Pat Smythe, a pediatrician and part-
time rancher, learned that calves fed a mod-
erate ration during their first year and a high 
ration during their second year did signifi-
cantly 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 dur-
ation of undernutrition relative to the total 
growth period. In human development, it seemed possible that the in-
fant 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 
these 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 extremely severe undernutrition af-
fected brain growth and subsequent cogni-
tive functioning and arrived at the follow-
ing conclusions. Compared with a control 
group, the originally undernourished in-
fants, now young adults, had significantly 
smaller head circumferences, defective 
visual-motor integration, and significantly 
less drive and initiative. Five had minor ab-
normal shadows on their brain CT scans, and 
four of these subjects were the most severely 
handicapped in their visual-motor integra-
tion. Interestingly, they have adapted well 
socially, and their children have not experi-
enced nutritional deprivation and are living in 
significantly better surroundings.

We suggest that this publication has been 
frequently cited because it was the first in 
the field. Our findings, which are highly signif-
ificant for millions of children growing up 
in the Third World, may have stimulated 
many studies over the following two de-
cades and may have highlighted the impor-
tance of intrauterine nutrition for subse-
quent brain growth and cognitive function. 
Recent school-age follow-up studies of pre-
nature infants show that they experience 
deficits in their visual-motor integration simi-
lar to our index subjects. 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 dif-
ferences.

Our biggest obstacle was maintaining the 
stability of the sample of 40 children over 20 
years. We improved the nutrition of the un-
dernourished group, but were still oftentimes 
challenged by their frustrated and angry par-
ents. 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 com-
pletion of our study.

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

1. Stock M B, Smythe P M, Moodie A D & Bradshaw D. Psychosocial outcome and CT findings after gross 
undersnurishment during infancy: a 20-year developmental study.
2. Handler L C, Stock M B & Smythe P M. CT brain scans: part of a 20-year development study following gross 
prematurity and functioning in the school-age child: the role of biological factors and environmental factors. 