

Effects of Past and Current undernutrition on Motor Skills of Senegalese Preschool Children.

E Bénéfice and T Fouéré

Objective: To study the effects of past and current undernutrition, expressed as a function of height-for-age, on the perceptual and motor abilities of 4.5-6.5 year-old rural Senegalese children.

Methods: Children's growth (n=54) was measured during infancy and then 4 years later. Motor tests included items from the McCarthy scale, the Charlop-Atwell scale for motor coordination, and 5 tests of physical fitness.

Results: Boys were better than girls in motor coordination and physical fitness. Nutritional status at the time of study, but not past nutritional status, was a significant predictor of fitness and motor coordination, but not of perceptual abilities. Environmental conditions are an important determinant of motor development and, in an attempt to partition the effects, these children were compared to a sample of 33 urban children from well-off households, of same age and sex distribution. The urban children performed better than the rural children in all tests. However, after removing the effects of nutritional status, urban origin remained as an indicator of better perceptual abilities, but not of most of motor coordination and physical fitness tests.

Conclusions: Environment and nutrition may have separate effects, but act together to slow growth and perceptual and motor development.

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ON MOTOR SKILLS OF SENEGALESE PRESCHOOL CHILDREN.

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Abstract

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Methods Children's growth (n=54) was measured during infancy and then 4 years later. Motor tests included items from the McCarthy scale, the Charlop-Atwell scale for motor coordination, and 5 tests of physical fitness.

Results Boys were better than girls in most of motor coordination and physical fitness tests. Nutritional status at the time of study, but not past nutritional status, was a significant predictor of fitness and motor coordination, but not of perceptual abilities. Environmental conditions are an important determinant of motor development and, in an attempt to examine its effects, rural children were compared to a sample of 33 urban children from well-off households, of same age and sex distribution. Urban children performed better than rural children in all tests. However, after removing the effects of nutritional status, urban origin remained as an indicator of better perceptual abilities, but not of most of motor coordination and physical fitness tests.

Conclusions Environment and nutrition may have separate effects, but act together to slow growth and perceptual and motor development.

Introduction

Refinement of motor skills is an integral part of motor development during preschool years. This process may be disrupted by undernutrition in different ways:

- by nutritional insult during the period of accelerated brain growth;**
- stunted growth size and muscle mass may influence motor development;**
- decrease of physical activity levels may alter early experiences and child behavior.**

Many studies stressed the negative impact of chronic undernutrition versus acute undernutrition on cognitive performances, but fewer focused on motor development (3). Additionally, environment *-lato sensu-* is a determinant of child development and should be considered (4).

Hence the objectives of this study are:

- to investigate the effects of past and current undernutrition on perceptual and motor development of a group of rural Senegalese children;**
- to determine the role of environment in child development. Performances of rural children were thus compared to performances of urban children sharing the same culture but reared under more favourable conditions.**

Methods

Sampling:

Rural children were drawn from an original sample of 105 children whose growth was monitored during their two first years of life. Eighty five children were relocated and 54 (32 boys and 22 girls) children less than 6 years of age selected for the survey. Almost all children had experienced an episode of malnutrition between 10 and 24 months of age, expressed by a decrease in nutritional indices at or below 2 standard deviations of the World Health Organization reference (6). This group represented the *undernourished index group*.

Urban children attended a Catholic kindergarten and were free from episode of undernutrition and disease during infancy. Thirty three children (16 boys and 17 girls) were selected. They represented the *well-nourished control group*.

Nutritional status:

Height-for-age (H/age) was retained as an overall indicator of nutritional status for the index group. Mean z-scores recorded during the growth study were chosen as an indicator of past nutritional status, and z-scores recorded during the present study as an indicator of current nutritional status.

Perceptual and motor tests:

Several items from the McCarthy scale of children's abilities (5) and from the Charlop-Atwell scale of motor coordination (2) were selected.

- perceptual performance: building blocks, tapping on a xylophone, classifying blocks;
- quantitative grouping: counting and sorting blocks;
- arm coordination: catching a ball and hitting a target;
- gross motor coordination was assessed through 5 items of the Charlop-Atwell scale: "jumping jacks", "jump and about face", "scarf twirl", hopping on one foot, tiptoe balance.

Physical fitness:

Several components of physical fitness were explored:

- cardiorespiratory endurance: 3-min run;
- static strength measured with a manometer;
- power and coordination: tennis ball throw for distance;
- speed and agility: 4x10 m shuttle run;
- explosive power: standing long jump.

Results

Age and sex differences: Perceptual and motor performances improve significantly with age in most of the items. To take into account these differences and to use the same scale with each tests, comparisons were made after standardization of variables according to age. Boys had better scores than girls in most of motor coordination tests (significant for catching a ball, scarf twirl and tapping sequence) and in physical fitness tests (see figure 1), but not in perceptual performances.

Nutritional status effect: To remove the age effect all scores were regressed on age and residuals instead of absolute values were used in a second regression with z-score of H/age during past (HAZP) and present value of H/age (HAZ) as independent variables (table 1). There was no effect of HAZP on any of the perceptual and motor items measured except for a small effect on endurance run. In contrast, HAZ had a significant effect on the remaining variance of motor coordination and physical fitness tests but not on perceptual performances.

Environmental influences: After standardization of variables, comparisons between urban and rural children were done: Urban children were better than rural children in all tests except for endurance run and hitting a target (figure 2 and 3). However urban children were heavier and taller than rural children. In view of these effects, motor performances were regressed on age and H/age and residuals instead of absolute value used in a logistic regression with origin (rural or urban) as independent variable (table2). Origin then, correctly classified the children in all perceptual tests but not in most of motor coordination and physical fitness tests.

Conclusions

- Boys were more performant than girls in motor coordination and physical fitness. Such differences have already been reported in this area (1).
- The lack of an effect of H/age during infancy, in contrast with the impact of present nutritional status, could be explained by the persistence of malnutrition throughout childhood in rural children and the lack of recovery. In fact there were no differences between nutritional indices recorded in the past and during the present study. This finding suggests that prolonged chronic undernutrition during childhood have long lasting negative consequences on motor coordination and performances.
- Comparisons between urban and rural children indicate that, in contrast with nutritional effect, environmental conditions influenced perceptual abilities.

Environment and nutrition may have separate effect but act together to slow down growth and motor developement.

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Table 1 Regression analysis of the residuals of perceptual and motor scores on age with current (HAZ) and past (HAZP) H/age z-scores in rural Senegalese children.

variables	HAZ R ¹	p ²	HAZP R	p	R ²	F(1,53)	p
Building blocks	0.35	0.02	-0.02	ns	0.11	3.3	0.04
Conceptual grouping	-	-	-	-	0.002	0.06	ns
Counting & sorting	-	-	-	-	0.02	0.75	ns
Tapping	-	-	-	-	0.06	1.8	ns
Catching	-	-	-	-	0.03	0.9	ns
Hitting target	-	-	-	-	0.03	0.8	ns
"Jumping Jacks"	-	-	-	-	0.03	0.7	ns
"Jump and about face"	-	-	-	-	0.08	2.3	ns
Hopping	0.48	0.002	-0.12	ns	0.18	5.7	0.005
Scarf twirl	0.38	0.02	-0.25	ns	0.10	2.9	0.06
Tiptoe	0.35	0.02	-0.22	ns	0.09	2.5	0.08
Endurance run	0.72	0.00	-0.27	0.04	0.38	16.0	0.00
Throw	0.61	0.00	-0.17	ns	0.29	10.4	0.00
Jump	0.41	0.01	-0.30	0.07	0.11	3.0	0.05
Agility	-0.73	0.00	0.20	ns	0.42	18.1	0.00
Grip strength	0.51	0.002	-0.05	ns	0.22	7.1	0.003

¹ standardized regression coefficient of independent variables

² p value; ns=not significant

Table 2 Logistic regression analysis of origin of rural and urban Senegalese children on residuals of perceptual and motor scores on age and H/age z-score.

Independent variables	R ²	Chi ² (df=1) ¹	p ²	% subjects correctly classified (N=87)
Building blocks	0.16	16.2	0.00	66.6
Conceptual grouping	0.15	15.7	0.00	72.4
Counting & sorting	0.09	8.5	0.003	66.6
Tapping	0.07	7.4	0.006	63.2
Catching	0.15	16.1	0.00	70.1
Hitting target	0.003	0.2	ns	
"Jumping Jacks"	0.07	6.7	0.009	63.2
"Jump and about face"	0.02	2.3	ns	
Hopping	0.01	1.0	ns	
Scarf twirl	0.02	2.0	ns	
Tiptoe	0.01	1.2	ns	
Endurance run	0.07	7.1	0.007	68.9
Throw	0.007	0.6	ns	
Jump	0.08	7.2	0.007	69.4
Agility	0.01	1.5	ns	
Grip strength	0.0005	0.05	ns	

¹ Chi² significance for the predictive value of the model

² p value; ns=not significant

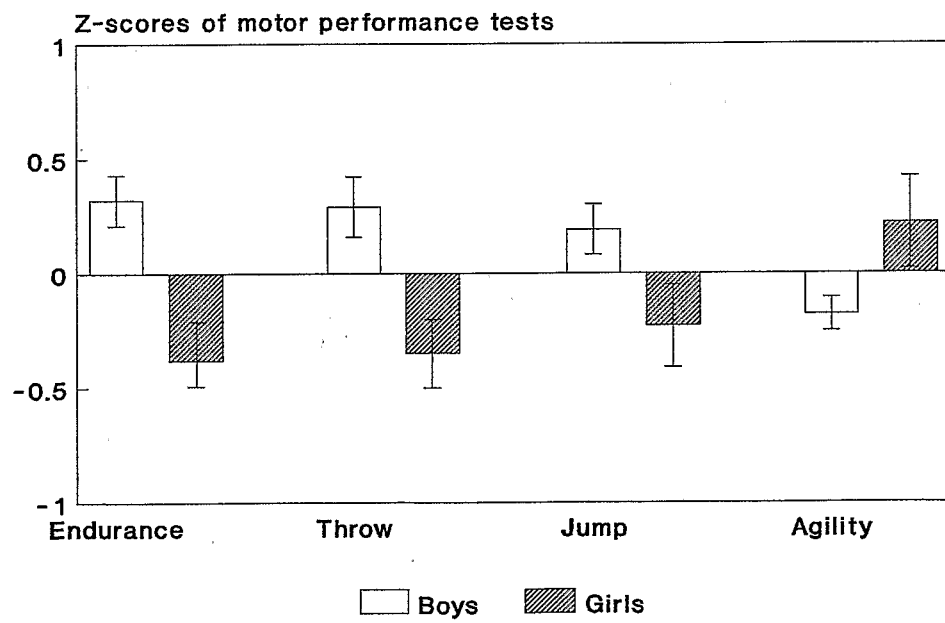
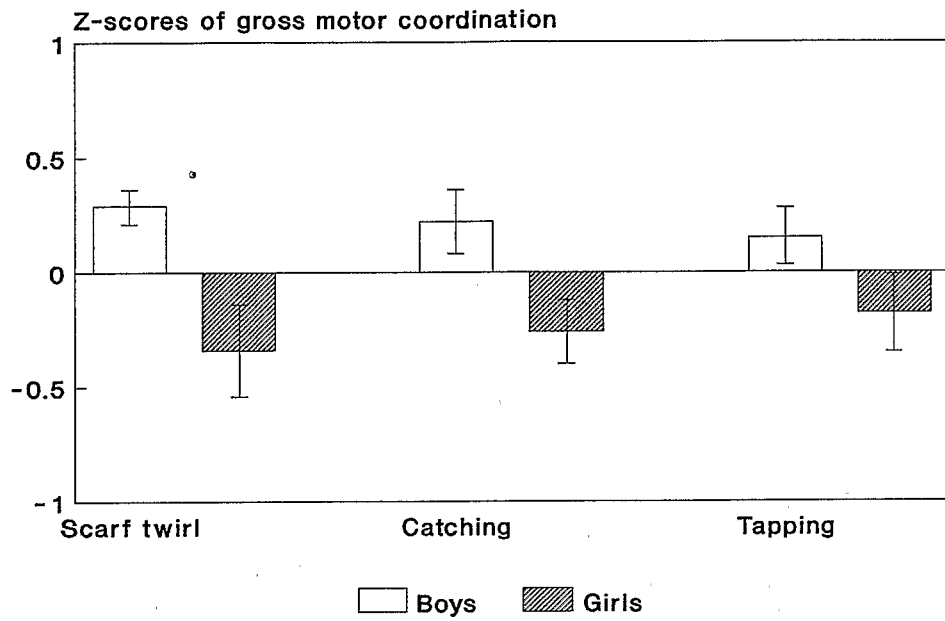


Figure 1

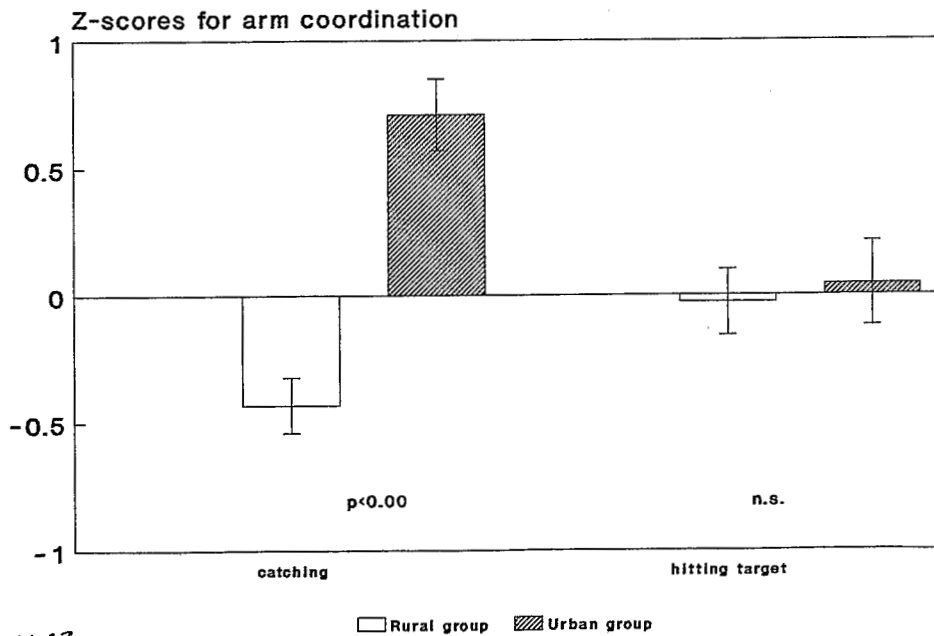
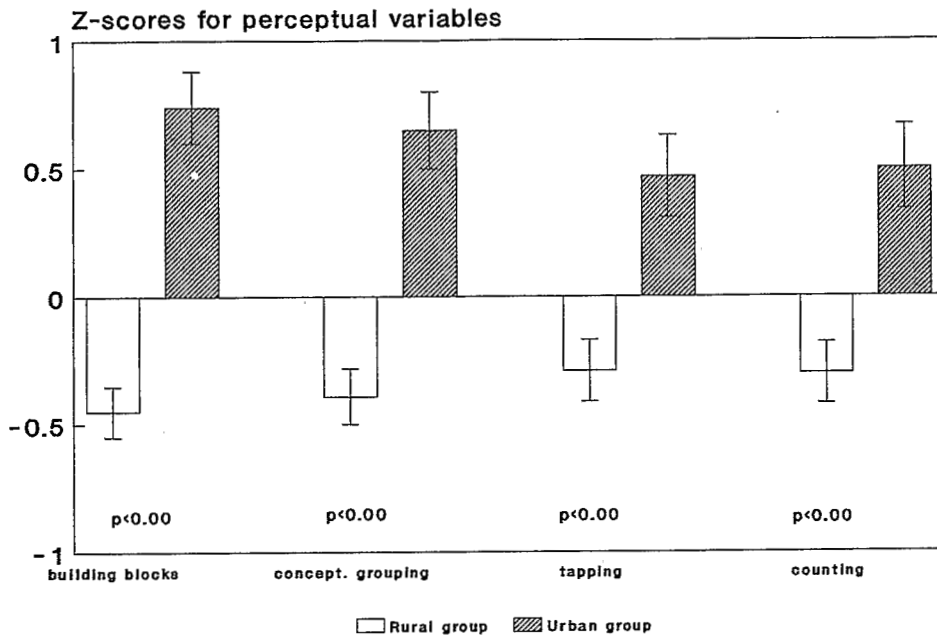


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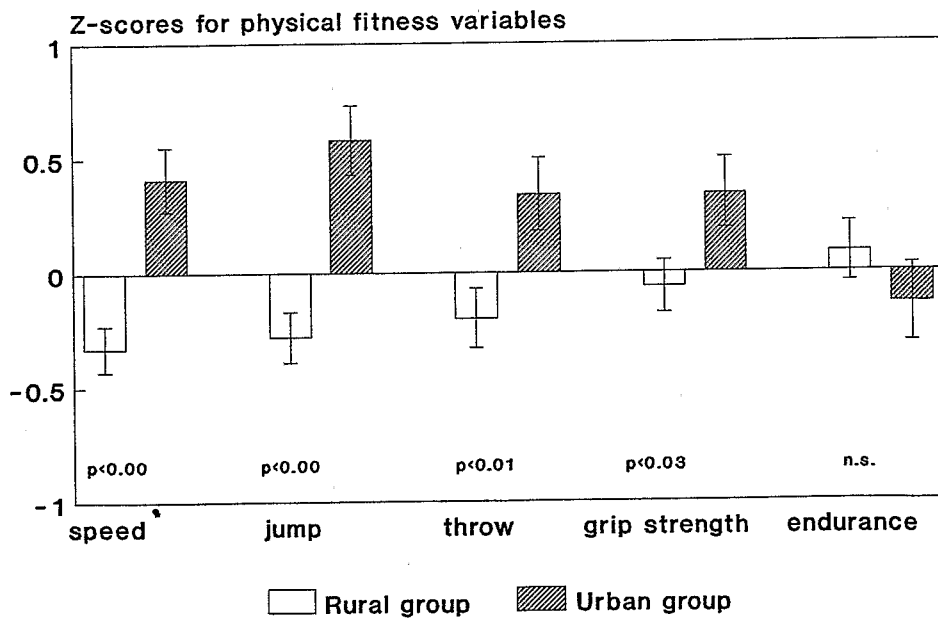
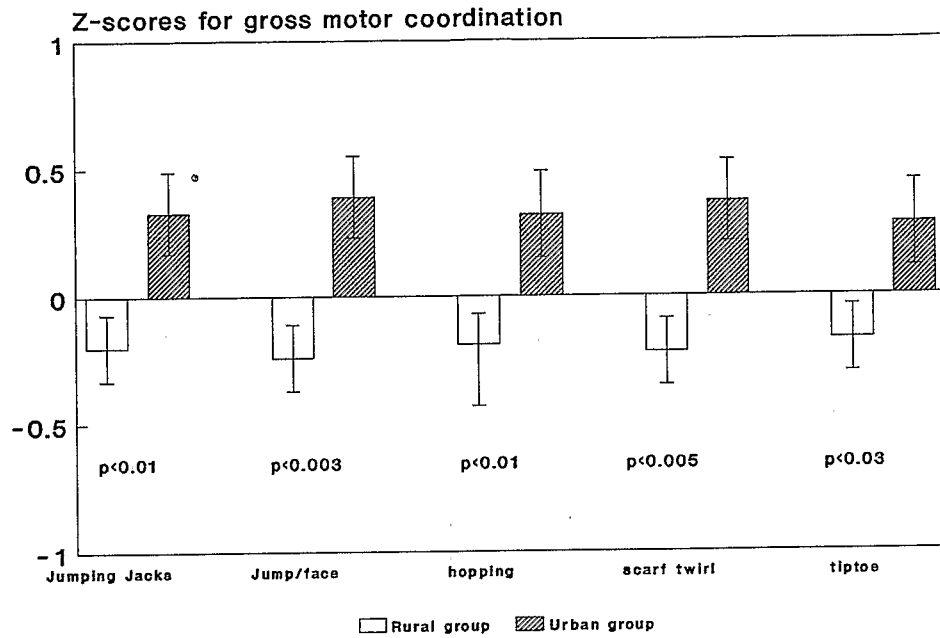


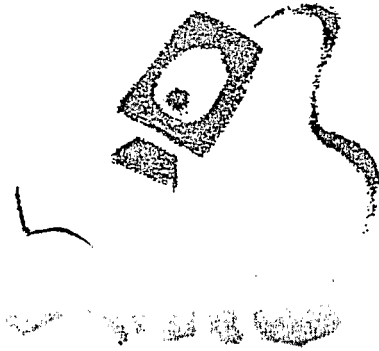
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This workshop will be held in co-operation with the
Dept. of Obstetrics and Gynaecology,
and the Dept. of Paediatrics,
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**and will be of interest to
Obstetricians, Paediatricians, Paediatric Neurologists,
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