# GROWTH, BEHAVIOR, DEVELOPMENT AND INTELLIGENCE IN RURAL CHILDREN BETWEEN 1-3 YEARS OF LIFE

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**ABSTRACT**

*In a rural cohort of 625 children registered from 1981 to 1983 in 10 villages of K.V. Block, Varanasi, 196 children were assessed for physical growth, development, intelligence and concept development between 1 and 3 years of age. Home environment was also assessed using Caldwell Home inventory. These rural children remained below 3rd centile of NCHS standard for weight, height, skull and mid-arm circumferences throughout the study. Malnourished children scored poorly in all the areas of development, i.e., motor, adaptive, language and personal social, 9% in Grade I and 16.6% children in Grade II + III had IQ <79 (inferior). Concept for color shape and size was poorly developed in malnourished children. Maternal involvement and stimulation was strongly associated with better behavior development and intelligence. Multiple regression analysis showed that the effect of home environment on development and intelligence was of a higher magnitude as compared to status and family variables and nutritional status during 1-3 years of age.*

**Key words:** *Growth, Development, Child, Rural.*

Over the past two decades a number of investigators have tried to explore the question whether childhood malnutrition affects intelligence and/or behavior development. This is further supported by studies demonstrating that babies born of undernourished mothers physiologically have poor brain development as demonstrated clinically and electrophysiologically(1,2). Studies in childhood on human malnutrition and mental development are limited on effects of severe malnutrition, *e.g.,* Kwashiorkor and marasmus mainly in hospitalized children(3-7). Further, besides nutrition, it is likely that environmental factors, *i.e.,* socioeconomic status, learning environment, stimulation at home, family size, recurrent infection, *etc.* may also be playing important role in mental development. These later confounding variables always make it difficult to visualize the role of mild to moderate degree of malnutrition on mental functions.

The present study is an attempt to observe children suffering from mild, moderate and severe degree of undernutrition from their first till third birth day and study the effect of nutrition and home environment on their behavior development and intelligence.

## Material and Methods

One hundred and ninety six children selected randomly from a cohort of 650

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*Received for publication March 18, 1991; Accepted October 23, 1991*

children born during November, 1981 to March, 1983 in 10 villages of Kashi Vidyapeeth block, district Varanasi were registered and followed for physical growth at monthly intervals during first year(8) and at quarterly intervals till 3 years of age. Besides studying the growth parameters, the children were divided into various grades of malnutrition at 18, 24, 30 and 36 months of age using NCHS(9) 50th centile weight for age as reference point (weight ≥/80% taken as normal, <80-70% Grade I, <70-60% Grade II and <60% Grade III malnutrition). Gesell's developmental schedule(10) was administered at 18, 24, 30 and 36 months to all the children.

A pretested interview schedule was used to collect the information on literacy and occupational status of the parents, per capita income, caste, birth order of children and family size. In order to assess the overall socio-economic status of the families of the study subjects, a linear composite score was obtained by combining the rank order scores of 6 variables, *viz.*, parents education and occupation, caste and per capita income. The linear sum of socio-economic status scores ranged from 6-33.

*Demographic Characteristics*

The general characteristics of these villages are almost representative of rural population of this part of the country. The block has 112 villages spread over an area of 147 sq. miles, with a population of 120,000 (1981 census). The male-female ratio in this block is 1,000: 939. The overall literacy rate is 31.4% (female 13.9%). Less than 4.0% women are educated beyond the primary level. The main occupation of 70% population is agriculture. In 40% of the households, per capita income is less than Rs. 60 p.m. An earlier survey carried out in 1982 has shown that infant and neonatal mortality rates are 133 and 64 per 1000 live births, respectively. Over 26% infants are born with weight less than 2,500 g, 13% pre-school children are suffering from severe and 50% mild to moderate forms of malnutrition(11).

*Home Observation for Measurement of Environment*

The Caldwell inventory (Part-I) for measuring Home environment(12) consisting of 45 items which were checked as present or absent in the home was employed.

This scale has six subcategories as described below:

1. Emotional and verbal responsivity of the mother.
2. Avoidance of restriction and punishment.
3. Organization of physical and temporal environment.
4. Provision of appropriate play materials.
5. Maternal involvement with the child.
6. Opportunity for variety in daily stimulation.

*Growth Assessment*

The anthropometric measurements were taken using standard techniques(13):

1. *Length/height (cm):* Crown heel length was measured with an infantometer and was taken to the nearest millimeter. The height was measured by calibrated anthropometric steel rod giving an accuracy of 0.1 cm.
2. *Body weight (kg):* Weight of the child was taken with minimal clothing

using a lever balance. Measurement was made accurately to the nearest 100 g for older subjects.

3. *Mid-arm circumference (cm):* It was measured with a fibre glass tape at the mid point of the left arm.
4. *Chest circumference (cm):* It was measured with a fibre glass tape, at the level of nipples in front and the inferior angle of the scapula on the back.
5. *Head circumference (cm):* It was measured with the same tape encircling the occipital protuberance on the back and the glabella in front.

*DQ, IQ and Concept Formation Assessment*

(*a*) Development quotient (DQ) for each area, *i.e.*, motor, adaptive, language and personal social as well as calculated by the formula given below: Gesell's development schedule(10)

$$DQ = \frac{\text{Developmental age}}{\text{Chronological age}} \times 100$$

(*b*) *Binet Kulshrestha Intelligence Scale*(14): which is an Indian adoption of Stanford Binet test from L-M was administered on each child at 36 months to assess the IQ. The basal age, mental age and IQ were calculated as per instructions given in the manual. After that each protocol was analysed separately for the following abilities.

1. Visual perception
2. Motor-eye coordination
3. Language development
4. Immediate recall
5. Concept formation
6. Reasoning

*Level of Cognitive Ability*

In all the above areas of cognitive functions, the number of correct items attempted, out of the total items given was noted down and the level of cognitive ability was calculated by the formula given below:

$$\text{Level} = \frac{\text{Number of correct items attempted}}{\text{Total number of items}}$$

(*c*) *Block-Sort Test*(15)

This test was used to study the concept development in children (2½-5 years age). It requires the subject to match or group blocks which differ in three dimensions, color, size and form. There are 26 blocks in various combinations of three colors (white, red and blue), three sizes (small, medium and large) and three forms (circle, square and equilateral triangle).

*Statistical Methods*

Percentiles were calculated for various anthropometric parameters at different age points. Mean and SDs and unweighted means of analysis of variance(16) were calculated to find out the differences for various attributes. Pearson product moment correlation and multiple regression analysis was done to find out the contribution made by nutrition, home environment and status and family variables in determining the development and intelligence of children.

## Results

*Growth*

*Figures 1 & 2* show that 50th and 97th centiles for weight and height of rural boys

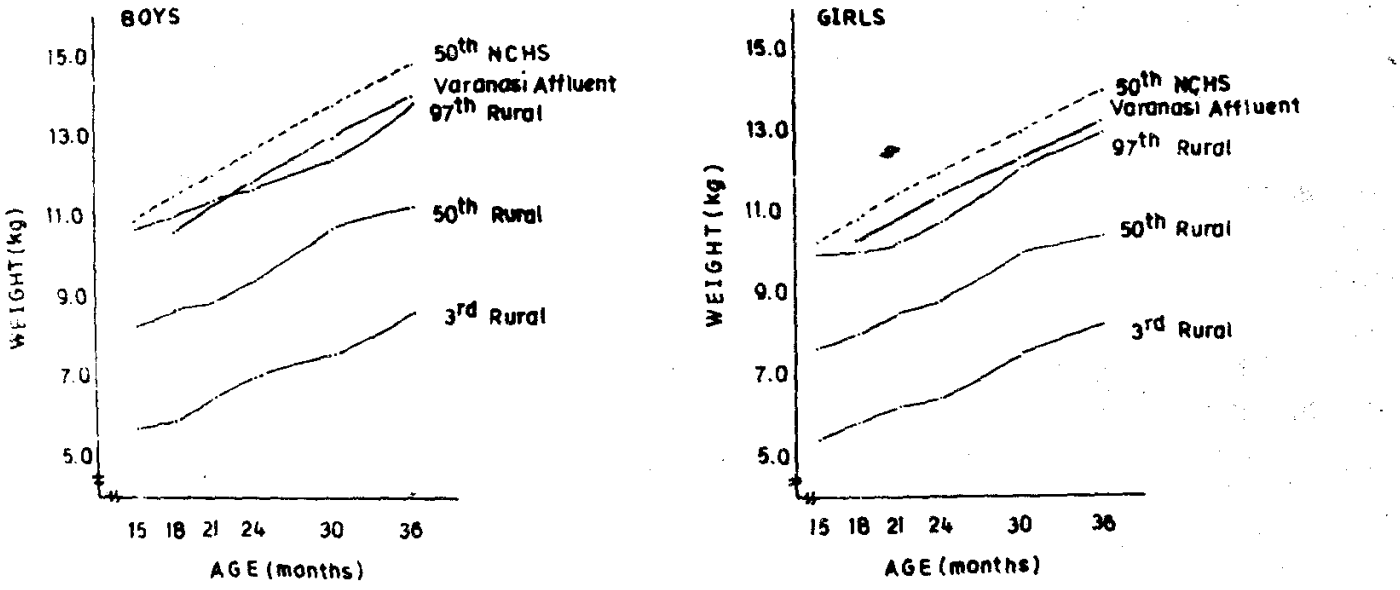


*Fig. 1. Weight Percentiles for Rural Boys and Girls*
*Scale: X-axis 1 cm² = 3 months of age. Y-axis 1 cm² = 1.0 kg of weight.*

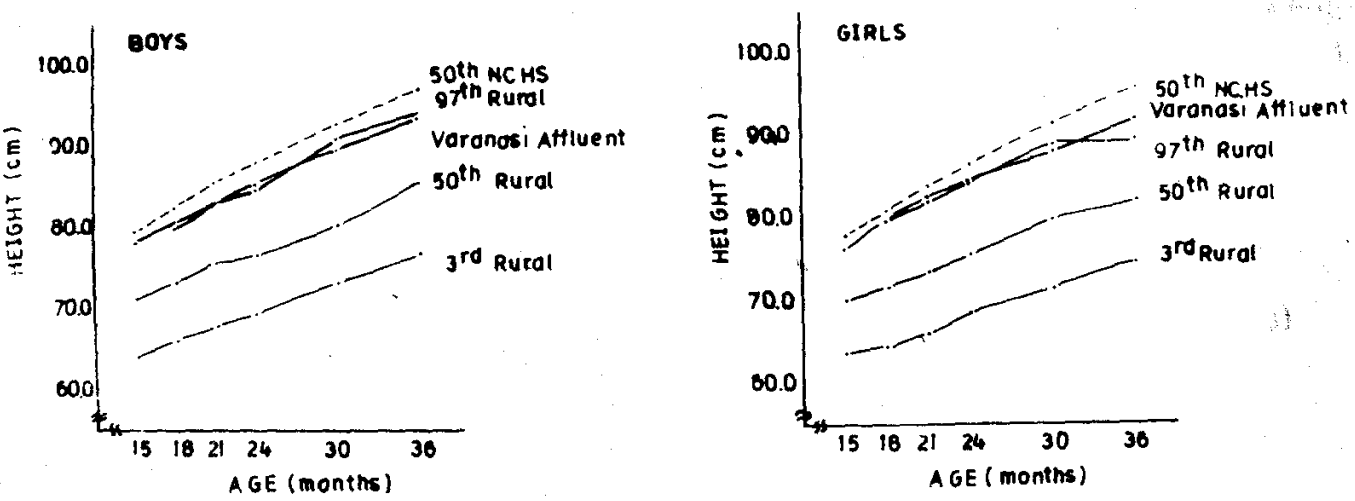


*Fig. 2. Height Percentiles for Rural Boys and Girls.*
*Scale : X-axis 1 cm² = 3 months of age. Y-axis 1 cm² = 20 cm of height.*

and girls remained below 3rd centile of NCHS and Varanasi affluent children at all the age points. The mean values for head and chest circumferences (rural) were lower when compared to those of affluent Varanasi children at 18, 24, 30 and 36 months. The differences were found to be statistically significant for both boys and girls (*Table I*). The mean mid-arm circumference of rural children was below 3rd centile of affluent urban Varanasi children and ranged between 12.1 ± 1.2 and 13.4 ± 1.0 cm indicating moderate to severe degree of undernutrition.

**TABLE I**—*Head, Chest and Mid Arm Circumference of Rural Children in Relation to Urban Affluent Class Varanasi Children*

| Age | Sex (Mo) | Skull circumference (cm.) | Chest circumference (cm.) | Midarm circumference (cm.) |
|---|---|---|---|---|
| 15 | B | 44.7 ±1.3 | 43.9 ±2.5 | 12.4 ±0.8 |
| | G | 44.2 ±1.7 | 44.4 ±3.5 | 12.1 ±1.2 |
| 18 | B | 45.6 ±1.5 (20th) | 45.2 ±1.9 (10-20th) | 12.6 ±1.2 (below 3rd) |
| | G | 44.6 ±1.2 (10th) | 43.9 ±1.9 (10-20th) | 12.8 ±1.7 (below 3rd) |
| 21 | B | 45.6 ±1.5 | 45.9 ±3.0 | 12.6 ±1.6 |
| | G | 44.9 ±1.2 | 44.3 ±2.1 | 12.4 ±1.8 |
| 24 | B | 46.4 ±1.8 (20th) | 46.9 ±2.2 (20-25th) | 12.9 ±1.5 (below 3rd) |
| | G | 45.4 ±1.3 (10-20th) | 45.6 ±2.1 (10-20th) | 12.6 ±1.2 (below 3rd) |
| 30 | B | 46.8 ±2.0 (10-20th) | 47.1 ±2.6 (10-20th) | 13.4 ±1.0 (3-5th) |
| | G | 46.1 ±1.6 (10-20th) | 46.8 ±2.0 (20-25th) | 13.2 ±1.0 (below 3rd) |
| 36 | B | 47.8 ±1.3 (25th) | 48.3 ±2.3 (10-20th) | 13.4 ±1.0 (3rd) |
| | G | 45.7 ±4.3 (3-5th) | 47.1 ±2.2 (10-20th) | 13.1 ±1.0 (below 3rd) |

* Figures in parentheses indicate percentile levels in relation to affluent class urban Varanasi children.

From *Table II* it was observed that the percentage of children in Grade II and III malnutrition was around 50-60 and did not vary with age. Between 18 and 24 months, there is considerable reduction in the percentage of normal nourished children with corresponding increase in Grade I.

*Nutritional Status, Development and Intelligence*

The overall developmental quotient progressively decreased with the severity of malnutrition at 18, 24, 30 and 36 months of age and the scores were below average in children having grade III malnutrition except personal social development (*Table III*). The difference were significant between the normally nourished and those having Grade II and III malnutrition.

For motor development the decrease in scores from normal to Grade II malnutrition ranged between 7 and 12 points and it was maximum at the age of 24 and 30 months. Similarly, for adaptive, language and personal-social behavior, there was a progressive decrease in scores with the severity of malnutrition. At the age of 36 months there was a catch-up in scores for motor, language and personal social behavior of those having Grade III malnu-

**TABLE II**—*Per cent Distribution of Children in Different Nutritional Grades*

| Age | n | Normal | Nutritional status | | |
|---|---|---|---|---|---|
| | | | Grade I | Grade II | Grade III |
| 12 | 166 | 8.61 (14)* | 38.41 (64) | 47.02 (78) | 5.96 (10) |
| 18 | 152 | 14.75 (22) | 33.61 (52) | 40.98 (62) | 10.65 (16) |
| 24 | 146 | 5.51 (8) | 42.52 (62) | 44.88 (66) | 7.09 (10) |
| 30 | 141 | 8.73 (13) | 42.06 (59) | 41.26 (58) | 7.95 (11) |
| 36 | 194 | 10.48 (20) | 34.29 (66) | 46.66 (91) | 8.57 (17) |

*Figures in parentheses indicate number of children.

**TABLE III**—*Mean Scores for Overall, Motor Adaptive, Language and Personal Social Development in Relation to Nutritional Status*

| Age (mo) | Nutritional status | n | Overall | Developmental areas | | | |
|---|---|---|---|---|---|---|---|
| | | | | Motor | Adaptive | Language | Personal-social |
| 18 | Normal | 23 | 97.9 ±7.5 | 103.6 ± 10.8 | 100.8 ±8.0 | 89.9 ±10.4 | 96.9 ±8.9 |
| | Grade I | 51 | 93.0 ±7.9 | 95.5 ± 10.9 | 96.5 ±7.9 | 86.4 ±9.6 | 95.0 ±8.7 |
| | Grade II | 62 | 87.6 ±8.8 | 85.2 ± 13.1 | 94.4 ±5.9 | 80.7 ±11.4 | 89.5 ±10.5 |
| | Grade III | 16 | 86.7 ±6.3 | 82.4 ± 7.5 | 88.7 ±7.3 | 80.3 ±9.6 | 90.7 ±8.0 |
| 24 | Normal | 8 | 93.9 ±8.7 | 98.6 ± 10.2 | 97.0 ±8.8 | 84.5 ±10.4 | 96.1 ±10.6 |
| | Grade I | 60 | 90.6 ±7.4 | 93.5 ± 7.5 | 93.9 ±7.8 | 82.3 ±9.9 | 92.6 ±10.0 |
| | Grade II | 61 | 82.8 ±10.2 | 87.1 ± 12.8 | 88.2 ±10.9 | 74.0 ±10.0 | 81.5 ±11.5 |
| | Grade III | 9 | 86.0 ±8.8 | 84.9 ± 10.2 | 89.1 ±4.6 | 70.8 ±8.7 | 90.1 ±10.8 |
| 30 | Normal | 13 | 95.6 ±9.9 | 98.2 ± 10.0 | 94.3 ±8.9 | 86.7 ±12.9 | 104.3 ±13.6 |
| | Grade I | 59 | 92.1 ±9.4 | 95.6 ± 9.1 | 91.9 ±8.8 | 80.1 ±12.1 | 98.6 ±13.8 |
| | Grade II | 58 | 89.2 ±6.8 | 91.1 ± 8.6 | 90.2 ±7.0 | 74.5 ±10.0 | 91.5 ±8.4 |
| | Grade III | 11 | 83.5 ±14.7 | 84.5 ± 17.9 | 84.3 ±14.1 | 70.5 ±11.8 | 84.3 ±15.2 |
| 36 | Normal | 20 | 98.9 ±8.3 | 102.3 ± 6.8 | 97.5 ±7.3 | 93.2 ±11.7 | 104.3 ±10.0 |
| | Grade I | 67 | 95.1 ±8.8 | 99.2 ± 8.0 | 94.3 ±7.7 | 87.0 ±13.0 | 100.1 ±11.0 |
| | Grade II | 90 | 90.6 ±6.8 | 93.3 ± 7.4 | 90.4 ±6.9 | 81.0 ±8.2 | 92.8 ±7.4 |
| | Grade III | 17 | 88.4 ±6.7 | 88.6 ± 8.0 | 87.6 ±7.1 | 80.2 ±9.2 | 94.4 ±3.5 |

* n = Number of children.

trition, however, the difference in scores (10-13 points) from those having normal nutrition was significant. The differences between the scores of normal + Grade I and those having Grades II + III malnutrition were significant ($p<0.001$ for all excepting adaptive behavior at 24 and 30 months $p<0.05$) at all the age points for motor, adaptive, language and personal social behavior.

The percentage distribution of children in different ranges of IQ in nutritional status (*Table IV*) showed that 9.0% and 16.6% children had IQ <79 (inferior) in Grade I and II + III malnutrition, respectively. Further, percentage of children having average IQ (90-109) and above average IQ range >109 decreased progressively with the severity of malnutrition ($\chi^2 = 35.4$; $p<0.001$). The mean scores decreased progressively with the increase in the degree of malnutrition. Further, the difference between the scores of normal, Grade I and Grade II + III children were significant ($F = 13.27$, $df = 2,191$, $p <0.001$; *Table V*).

*Table V* presents the mean scores for various abilities. There was progressive fall in scores with severity of malnutrition as measured on Intelligence test. The scores were significantly lower in Grade II + III malnutrition for all the tasks as compared to normal and Grade I children. In Grade I nutritional status, language development and reasoning were affected. One way analysis of variance showed that F-values were significant for all the abilities, except visual perception.

*Nutritional Status and Concept Development*

For Block-sort test the mean scores for total test performance as well as for placing, matching and sorting of blocks were significantly higher in normal nourished children as compared to those having moderate to severe degree of malnutrition (Grade II + III; *Table VI*). Further, normal and Grade I children showed significant difference in the mean total scores,

**TABLE IV**—*Percentage Distribution of Children in Different Ranges of IQ and Mean ± SD in Relation to Nutritional Status at 36 months of Age*

| Nutritional status | >110 (slightly above average) | 90-109 (Average) | 85-89 (Slightly below) average | 80-84 (Definitely below average | <79 (Inferior) | Mean ± SD |
|---|---|---|---|---|---|---|
| Normal | 5.8 (4)* | 62.2 (40) | 21.7 (14) | 7.3 (5) | – | 95.5 ±7.9 |
| Grade I | 1.1 (3) | 57.3 (140) | 18.0 (44) | 14.6 (36) | 9.0 (22) | 91.9 ±8.6 |
| Grade II + III | – | 39.0 (126) | 19.4 (63) | 35.0 (81) | 16.6 (54) | 86.8 ±7.7 |

* Figures in parentheses indicate number of children
Normal *vs* Grade I t-value 2.70 $p < 0.01$
Normal *vs* Grade II 5.38 <0.001
$\chi^2 = 35.14$, $p <0.001$ ($df = 8$).

**TABLE V**– *Mean ± SD and t Values for Various Abilities in Relation to Nutritional Status at 36 Months*

| Nutritional status | n | Visual perception | Motor coordination | Language development & comprehen. | Immediate recall | Concept formation | Reasoning |
|---|---|---|---|---|---|---|---|
| Normal | (64) | 1.14 ±0.19 | 1.16 ±0.14 | 0.90 ±0.14 | 0.66 ±0.51 | 1.38 ±0.37 | 1.43 ±0.89 |
| Grade I | (245) | 1.11 ±0.20 | 1.13 ±0.22 | 0.85 ±0.14 | 0.53 ±0.50 | 1.32 ±0.43 | 1.15 ±0.79 |
| Grade II + III | (324) | 1.04 ±0.23 | 0.97 ±0.27 | 0.78 ±0.11 | 0.32 ±0.39 | 1.07 ±0.54 | 0.75 ±0.79 |
| t values Normal *vs* Grade I | | 0.001 | 0.94 | 2.23* | 1.62 | 0.94 | 2.06* |
| Normal *vs* Grade II + III | | 2.24** | 3.80*** | 4.82*** | 3.84*** | 3.09** | 4.01*** |
| Grade I *vs* Grade II + III | | 1.60 | 3.16** | 2.97** | 2.50* | 2.48* | 2.56 |
| Anova | | | | | | | |
| F-values | | 2.8489 | 10.5253*** | 9.3081*** | 5.7369** | 6.2345** | 7.7739*** |
| df | | 2,191 | 2,191 | 2,191 | 2,191 | 2,191 | 2,191 |

*Figures in parentheses indicate number of children.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

and scores for placing of blocks. The calculated F-ratio was found to be significant for total test performance as well as placing, matching and sorting of blocks.

### *Home Environment, Development and Intelligence at 36 Months*

Pearson product moment and multiple correlations between home environment scores at 36 months with motor, adaptive, language, personal social and overall development are presented in *Table VII*. Correlations between total HOME scores and different developmental areas were moderate to high ranging between 0.43 and 0.58 ($p<0.001$). The five HOME subscales also showed significant association with motor, adaptive, language, personal social and overall development at 36 months. The magnitude of correlations was higher for responsivity of mother, maternal involvement and variety of stimulation ('r' ranged between 0.34 and 0.49) when compared to restriction and punishment and organization of environment ('r' ranged between 0.19 and 0.35). The value of correlation was of a lower magnitude for motor as compared to other areas of development. The values of multiple correlation showed that when family variables and home environment were combined together and regressed against overall DQ, it explained 36.8% variation in the scores. However, family variables alone explained 15.5% variance, which was of a lower magnitude as compared to home environment

**TABLE VI**—*Mean ± SD and t Values of Block-Sort Test in Different Nutritional Status at 36 Months*

| Nutritional test | Block-Sort test (Concept test) | | | |
|---|---|---|---|---|
| | Total | Placing of blocks | Matching of blocks | Sorting in blocks |
| Normal | 10.0 ±3.6 | 5.1 ±0.35 | 3.6 ±2.0 | 1.4 ± 1.2 |
| Grade I | 9.3 ±3.7 | 5.0 ±0.42 | 3.2 ±2.2 | 1.1 ± 0.97 |
| Grade II + III | 7.8 ±3.3 | 4.7 ±0.67 | 2.4 ±2.1 | 0.9 ± 0.78 |
| t values | | | | |
| Normal *vs* Grade I | 1.20 | 1.14 | 1.28 | 1.69 |
| Normal *vs* Grade II + III | 3.21** | 3.35** | 2.77** | 2.21* |
| Grade I *vs* Grade II + III | 2.28* | 2.74** | 1.77 | 0.78 |
| ANOVA | | | | |
| F-values | 4.3711* | 9.1227*** | 3.7595* | 3.1262* |
| df | 2,191 | 2,191 | 2,191 | 2,191 |

n = Number of children; *p < 0.05, **p < 0.01, ***p < 0.001.

(21.3%). Similarly, when nutritional status and family environment were taken together as predictor variables they explained 26.0% variation in developmental scores; however contribution of home environment alone was 21.3%, *i.e.,* almost double the contribution made by nutrition.

*Table VIII* presents 'r' values between HOME scores and Binet IQ as well as different abilities in 36 months. The total HOME scores correlated significantly with IQ and other abilities, 'r' ranging between 0.37 and 0.67. Further, correlation between HOME scores, visual perception and motor coordination was of a lower order compared to language development, immediate recall, concept formation and reasoning. Similarly the magnitude of correlation between HOME subscales and visual perception as well as motor coordination was also low compared to other abilities and global IQ.

Avoidance of restriction and punishment was weakly associated with IQ as well as with other cognitive abilities. The results of multiple regression analysis show that home environment was the most important variable predicting intelligence (variation in scores 26.2%) as compared to nutrition (7.6%) and status and family variables (14.4%).

## Discussion

In the present study 5.5% children at 24 months of age were in normal nutrition, 42.5% in Grade I, and 52.0% in Grade II + III malnutrition. The corresponding figures were 5.9, 38.2 and 55.8% for the year 1989-90. These findings suggest that the profile of early childhood malnutrition in rural areas has not changed much in the last 7-8 years. Further, majority of the children are stunted as well as wasted (height and

**TABLE VII**– *Correlation Coefficients and Multiple Correlation Between Developmental Scores and Measures of Status and Family Variables* and Home Environment*

| | Overall DQ | Motor | Adaptive | Language | Personal-social |
|---|---|---|---|---|---|
| Socio-economic status | 0.38** | 0.28** | 0.35** | 0.40** | 0.37** |
| Family size | 0.25** | 0.24** | 0.20** | 0.21** | 0.26** |
| *Home Observation* | | | | | |
| A. Responsivity of mother | 0.49** | 0.36** | 0.49** | 0.48** | 0.41** |
| B. Avoidance of restriction and punishment | 0.23** | 0.24** | 0.23** | 0.19** | 0.21** |
| C. Organization of the environment | 0.31** | 0.21** | 0.35** | 0.28** | 0.32** |
| D. Maternal involvement | 0.48** | 0.34** | 0.49** | 0.48** | 0.42** |
| E. Variety of stimulation | 0.48** | 0.41** | 0.48** | 0.45** | 0.47** |
| *Multiple Correlations:* | *Multiple R* | *% of total variation for overall DQ ($R^2 \times 100$)* | | | |
| Status & family variables | 0.39* | 15.48* | | | |
| Status & family variable + nutrition | 0.51*** | 26.03*** | | | |
| Status & family variables + home environment | 0.61*** | 36.81*** | | | |
| Nutrition | | 10.55*** | | | |
| Home environment | | 21.33*** | | | |

Family variables are birth order, family size, father's education, father's occupation.
* $p<0.05$; *** $p<0.001$.

weight both being <3rd percentile), in the Grade II and III malnutrition.

The overall developmental scores of those having moderate to severe malnutrition were below average (≤89) at all the age points. When specific areas of development were analysed those having Grade II and III malnutrition were at risk of developmental delay particularly for language development as the mean developmental quotient was ≤80 at the all age points. The deterioration was more marked at the age of 24 and 36 months.

Further, children having Grade II and III malnutrition scored significantly lower for motor adaptive and personal social behavior but their scores fell either in average or borderline category (DQ between 81-89 and 90-110).

The motor development scores were most affected at one year of age(8) and remained low by 10-12 points till the age of 36 months. Observations of the present study on Gesell's test for motor development are also in conformity with those of Chavez and Martinez(17) indicating that

**TABLE VIII**— *Correlation Coefficients and Multiple Correlation Between IQ and Various Availabilities with Measures of Status and Family Variable and Home Environment*

| | IQ | Visual perception | Motor co-ordination | Language development & comprehension | Immediate recall | Concept formation | Reasoning |
|---|---|---|---|---|---|---|---|
| Socio-economic status | 0.33** | 0.18** | 0.18** | 0.36** | 0.28** | 0.17** | 0.26** |
| Family size | 0.22** | -0.20** | -0.21** | -0.16* | -0.20** | -0.22** | -0.20** |
| *Home Observation:* | | | | | | | |
| A. Responsivity of mother | 0.54** | 0.33** | 0.27** | 0.50** | 0.44** | 0.36** | 0.45** |
| B. Avoidance of Restriction and punishment | 0.25* | 0.17* | 0.16* | 0.19** | 0.26** | 0.15* | 0.20** |
| C. Organization of the environment | 0.27** | 0.20** | 0.28** | 0.34** | 0.32** | 0.27** | 0.40** |
| D. Maternal involvement | 0.49** | 0.29** | 0.28** | 0.46** | 0.44** | 0.32** | 0.42** |
| E. Variety of stimulation | 0.50** | 0.35** | 0.35** | 0.43** | 0.46** | 0.35** | 0.46** |
| *Multiple Correlations* | *Multiple R* | | *% of total variance for IQ ($R^2$x 100)* | | | | |
| Status & family variables | 0.38* | | 14.37* | | | | |
| Status & family variables + Nutrition | 0.47*** | | 21.96*** | | | | |
| Status & family variables + Home environment | 0.64*** | | 40.59*** | | | | |
| Nutrition | | | 7.59*** | | | | |
| Home environment | | | 26.22*** | | | | |

Family variables are birth order, family size, father's education and occupation.
*p<0.05; **p<0.01; ***p<0.001.

retardation in cerebral maturation becomes more evident during the peak period of nutritional deficiency, *i.e.*, around 1-2 years of life. The impairment observed in motor and adaptive development in the early school period has also been reported by several other workers(18-20).

For language development, the deterioration in scores was more marked, from 40 weeks onwards(8) and it continued till the age of 3 years (present study). Chavez and Martinez(17) have reported that language development was affected most between 10 and 20 months of life, and malnourished children recuperate during the 3rd year of their life, however, those differences reappeared again.

Thus these observations indicate that the age of 10-12 months is the most crucial period in rural child's life when environment vitally influences his physical growth and development.

The results of the present study also indicated that although the overall development as well as the scores in the four major areas in malnourished children were low yet it did not reach abnormality. Their averages were within the lower limit to that of mental retardation. These observations indicate that malnourished children display delayed behavior development although the expected behavior does eventually appear in these chronically malnourished children.

The results of the present study on Binet-Kulshreshtha Intelligence scale demonstrated that the percentage of children having IQ <79 (inferior) and 80-84 (definitely below average) increased with the severity of undernutrition. There were only 7.3% children in normal nutrition having IQ<84, while the number became 23.6% in Grade I, and 41.0% in Grade II. Thus the relative risk of having poor IQ increased with the severity of undernutrition. Therefore, the findings of poor adaptive development on Gesell test between 12-36 months in undernourhsed children corroborates that these children have higher risk to have poor intelligence in situation of endemic undernutrition.

After considering the environmental factors in relation to DQ and IQ, the analysis demonstrates that home environment is the most important variable followed by status and family characteristics and nutritional status. Further, all the areas of home scale were significantly related to the overall DQ, scores in four areas of development, intelligence and various abilities. Items related to maternal involvement, verbal and emotional stimulation were more strongly associated with these functions as compared to physical and temporal environment and measures of discipline. These observations indicate importance of maternal involvement and stimulation in early child development. These observations also find support from the studies reported by others(21-33). Rehabilitation studies carried out in malnourished children have also shown that nutrition intervention along with increased stimulation is more beneficial than nutrition intervention alone in improving the mental test performance(24-27).

**Acknowledgement**

The study was supported by a grant from the Indian Council of Medical Research.

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## NOTES AND NEWS

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**Guest Editor: Dr. Vimlesh Seth**

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