

# Association between Hemoglobin Concentration and Cognitive Performance in School Children in Bangalore, India



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## Introduction

Nutritional deficiencies are a major public health issue in children, having adverse effects on their cognitive development, physical growth and immune function. Studies have shown that anaemic children have poorer scores on cognitive tests compared to non-anaemic children.

## Objectives

A clinical trial has been designed to investigate the efficacy of foods fortified with omega-3 fatty acids and/or a micronutrient mix on improving intellectual performance in Indian school children from a poor socio-economic background. Baseline data were used to assess the relationships between:

- Hemoglobin concentration and cognitive performance
- Height-for-age, weight-for-age and weight-for-height z-scores and cognitive performance

## Methodology & Statistics

Over a period of three months, 525 primary school children from India were assessed for a series of measurements including:

- Height and weight
- Blood sample to measure hemoglobin with an Act8 Counter
- Cognitive performance was assessed by six core tests of the Kaufman Assessment Battery for Children II and five additional tests (Fig 1, see sub-tests)
- Questionnaire to collect socio-demographic information as administered to the primary caretaker

A structural equation model was used to confirm the psychometric model of general intelligence by Carroll (1993). The outcomes were 4 factors representing broad cognitive abilities and the overall score representing Mental Processing Index (general intelligence) (see Fig 1).

Associations between the nutritional parameters (hemoglobin, height-for-age, weight-for-age and weight-for-height) and the 4 factor scores on cognitive abilities and the MPI score were analysed using multivariate analysis adjusted for age, gender, school and education level of the mother (ANOVA).

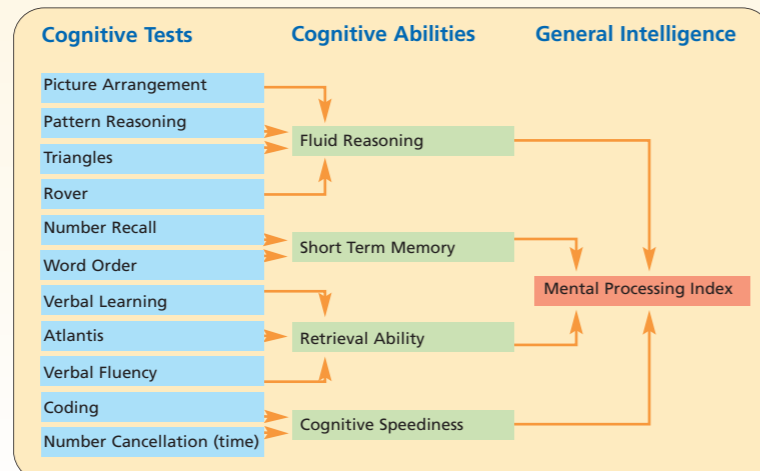


Figure 1. Structural Equation Modelling of cognitive tests

## Results

Baseline characteristics of the study population are presented in Table 1. Significant positive associations were found between hemoglobin concentration and the MPI ( $F_{8,516}=7.71$ ;  $p=0.006$ ;  $R^2=0.33$ ; see Fig 2) and three of the factors: short term memory ( $F_{8,516}=6.32$ ;  $p=0.01$ ;  $R^2=0.08$ ), cognitive speediness ( $F_{8,516}=5.81$ ;  $p=0.02$ ;  $R^2=0.34$ ), and retrieval ability ( $F_{8,516}=3.61$ ;  $p=0.06$ ). No relationships were detected between the anthropometric measurements and cognitive performance.

Table 1. Characteristics of the study population

N (% male)	525 (49)
Age (y)	8.7±1.2 <sup>1</sup>
Family income (\$/d)	2.1 (0.7, 3.5) <sup>2</sup>
Hemoglobin concentration (g/L)	12.9±0.9
Anemia (%)	8.6
Height (m)	122.9±7.8
Weight (kg)	21.4±3.8
Stunting (%)	22.2
Wasting (%)	14.1

<sup>1</sup>Mean±SD

<sup>2</sup>Median (25<sup>th</sup>, 75<sup>th</sup> percentiles)

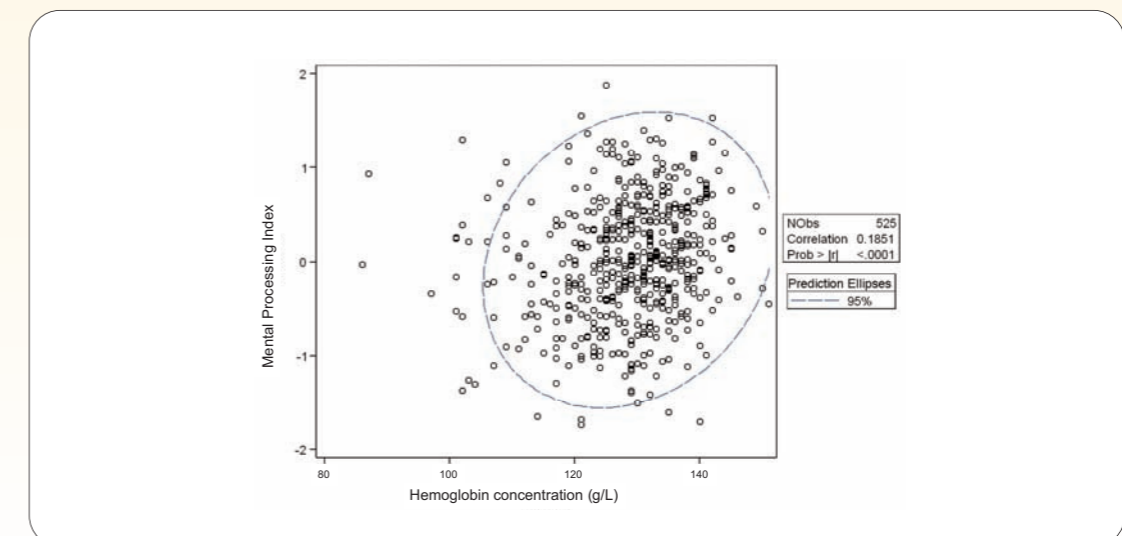


Figure 2. Scatter plot of association between hemoglobin concentration and MPI

## Conclusion

Results of this study suggest that higher hemoglobin concentrations are mildly but significantly associated with better intellectual performance in school children.