Trial using Multiple micronutrient food supplement and its effect on cognition in children.

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Background

- Multiple micronutrient deficiencies occur in poorer sections of populations in developing countries.
- Current methods is to treat micronutrient deficiencies in isolation – iron tablets to pregnant women, vitaminA supplementation to children.
- Need to tackle multiple micronutrient deficiencies in entire families .
- The multiple micronutrient fortified food supplement was developed to fulfill these concepts. It is a powder enriched with many vitamins and minerals and is added to food during cooking.

Composition of the multiple micronutrient food supplement

Ingredient	Nutrient quantity
Vitamin A IU/g	1500
Vitamin B2 mg/g	1
Calcium pantothenate mg/g	1
Niacin mg/g	15
Vitamin B6 mg/g	1
Folic Acid mcg/gm	100
Vitamin B12 mcg/gm	1
Vitamin E IU/g	30
Vitamin C mg/g	30
Iron mg/g	10
Lysine mg/g	250
Calcium %	15.63

Dosage of the above supplement 1 gram per person per day

Aims

To test the efficacy of the multiple micronutrient fortified food supplement (MMFS) on the iron status and cognition of school children in the age group 7-11 years.

Methods

- The Research Design was a pretest post test design with experimental and control groups.
- A school was selected for the study.
- The children residing in the residential school in the age group 7-11yrs constituted the experimental group (n=51)
- The children who lived in communities nearby and attended the day school constituted the control group.
- The MMFS was used in the kitchen of the experimental residential school for a period of one year.
- The MMFS provided about 1 RDA of the micronutrients to the children of the experimental group per day.
- The children in both the experimental and control groups were dewormed with 400 mgs Albendazole every 6 months
- No intervention other than deworming was done in the control group children (n=72)
- The experimental and control groups of children were selected after establishing their homogeneity in terms of age, intelligence and socioeconomic status.
- **Ethical issues**: Children whose baseline hemoglobin was less than 8 gms/dl were therapeutically treated with iron tablets and excluded from the study.

Tests for cognition: Children's memory tests developed & standardized by NIMHANS, India.

- **Personal information**: This test is a measure of remote memory which constitutes recall of past events of personal life. This is adopted from Wechsler memory scale and PGI memory scale
- **Digit span**: This subtest is taken from Wechsler memory scale. This comprises of span for digits forward and backward. The maximum number of digits used in the series is limited to 9.This test is a measure of attention and concentration .
- **Delayed response learning** :This essentially requires the ability to delay the previous response in order to arrive at a final solution. There are 4 sets of fairly simple arithmetical problems. Each problem consists of 2 parts presented one after the other .In the first part a simple arithmetical problem is given, the child solves it and keeps the result in mind and then solves the second part of the problem 10 seconds later incorporating the result from the previous part.

- **Mann-Suiter Visual memory screen for objects (picture recall test):** This is designed to assess the ability to revisualise pictures of common objects presented in groups. There are 4 cards. On the first card there are 2 pictures and it was exposed for 2 seconds. The second picture has 3 pictures and it was exposed for 3 seconds, the 3rd card had 4 pictures and the 4th card had 5 pictures and it was exposed for 4 seconds and 5 seconds respectively. The child was expected to recall the pictures in the same sequence. This test measures short term visual memory.
- **Benton Visual Retention Test (BVRT) :**This test is designed to assess visual perception, Visual memory and visuo-constructive abilities. There are 10 cards. Each card is exposed for 10 seconds and the child is asked to reproduce the design from memory. This test measures the visuo spatial perception, visual and verbal conceptualization and immediate memory span.
- **Cattells Retentivity Test:**
  It consists of complex and unfamiliar designs of irregular geometric figures which cannot elicit any verbal associations. On a card 10 geometrical figures are presented for 30 seconds ,after a 2 minute pause and from the second card the child has to recognize the geometrical figures which he has already seen in the first card. This measures the visual recall for irregular geometrical designs.
- **Letter cancellation test :**
  This test is a measure of concentration .The children are given the test which has many alphabets typed out in rows and the children are instructed to score out the A's and E's within a period of 2 minutes. If the child has omitted to score a letter or if she has scored a letter which is not A or E ,it is considered as a wrong. If the child has correctly struck out an A or E it is considered as right. The final score is obtained by subtracting the total of wrongs from the totals of rights.
- **Ravens coloured progressive matrices:**
  This is an IQ test to measure intelligence in children.

The same tests were administered before the intervention program and repeated after one year of nutrition intervention.

Blood collection, storage and laboratory analysis

- 3 ml of venous blood was drawn from each child
- Hemoglobin was estimated by cyanamethemoglobin method.
- Hematocrit was estimated by centrifuging blood in wintrobe tubes.
- Red blood cell count was done by counting the cells using the neubauer counting chamber
- Above tests done in the lab within few hours of blood collection.

Blood analysis of those children who took the memory tests

	Experimental group n=51		Control group n=72	
	Base line	Endline after one year	Base line	Endline after one year
Hemoglobin gms/dl	9.98 +-0.75[a]	10.23 +-0.60 [a]	10.43 +-0.83 [b]	10.13 +-0.74 [b]
Hematocrit l/l	0.2872 +- 0.018 [a]	0.3000 +- 0.021 [a]	0.3062 +- 0.022	0.3013 +- 0.023
Red blood cells million/cmm	3.24 +- 0.22 [a]	3.43 +- 0.27 [a]	3.62 +- 0.49 [b]	3.47 +- 0.28 [b]

a: significant improvement($P<0.05$) from baseline to endpoint
b: significant decrease($P<0.05$) from baseline to endpoint
Data given as mean+-Sd

Results cognition: Change in scores

Name of the test	Test measures	Experiment n=51 mean	Control n=72 mean
Benton Visual Retention Test (BVRT)	memory	13.73 +-31.45a	3.61 +-18.00 a
Cattells retentivity test	memory	6.28 +-22.18 a	-0.83 +-23.89 a
Mann-Suiter Visual memory screen for objects (picture recall test)	memory	15.29 +-27.37 a	5.62 +-18.85 a
Delayed Response Learning test	memory	14.51 +-26.18 a	5.49 +-18.29 a
Personal Information test	memory	20.59 +-48.22	15.35 +-29.41
Digit Forward test	memory	3.14 +-15.68 a	-2.11 +-14.82 a
Digit Backward test	memory	0.39 +-22.26	-0.85 +-25.56
Letter cancellation test	Attention and concentration	11.78 +-10.34 a	5.50 +-9.15 a
Ravens coloured progressive matrices	intelligence	11.58 +-22.29	11.08 +-21.74

a: significant improvement of the experimental group ($P<0.05$) over the control.
Data given as mean+-SD

Discussion

- Significant increase ($P<0.05$) in hemoglobin, hematocrit and red cells in experimental group
- Significant decrease ($P<0.05$) in red cells and hemoglobin the control group.
- In 5 out of 7 memory tests and letter cancellation test the change in scores significantly more ($P<0.05$) in experimental group than control group showing significant improvement in memory in experimental group children.

Conclusion

- The multiple micronutrients present in the multiple micronutrient food supplement especially iron has resulted in significant improvement in hemoglobin, hematocrit and red cell count and a concomitant improvement in memory and attention in the children.