



## A STUDY TO EVALUATE THE EFFECT OF IRON DEFICIENCY ANAEMIA ON COGNITIVE FUNCTION AMONG UNDERGRADUATE FEMALE STUDENTS OF PMCH

### Physiology

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### ABSTRACT

**Background:** Iron deficiency anaemia is a common health problem which affects overall body health and physical ability. Iron is an important key element for the brain function.

**Aims & Objective:** To analyze the cognitive function in anaemic young adult women.

**Materials and Methods:** A descriptive cross sectional study was conducted among normal and anaemic persons. Biochemical parameters such as haemoglobin, serum iron were assessed to identify the anaemia. Subjects were divided into two groups (n=30). Mini mental status examination (MMSE), Wechsler memory scale (WMS-IV), Digit symbol substitution test (DSST), Letter Digit Substitution Test (LDST) were used to assess the cognitive function.

**Results:** Though there was no significant changes in mean scores of 3 cognitive function tests between the groups, MMSE has shown significant decrease score in anaemic group when compared to control.

**Conclusion:** Mild iron deficiency anaemia in young adult women may have effect on cognitive function.

### KEYWORDS

Iron Deficiency Anaemia; Cognitive Function Test; Students, PMCH

### INTRODUCTION

Anaemia is a global public health problem which affects both the developing as well as developed countries. It is an indicator of poor nutrition and poor health as well as for the social and economic development of a population. Worldwide, at any given moment, more individuals have iron-deficiency anaemia (IDA) than any other health problem.<sup>[1]</sup>

In the World Health Organization (WHO)/World Bank rankings, IDA is the third leading cause of Disability Adjusted Life Years (DALYs) for females aged 15–44 years.<sup>[2]</sup> India is among the countries with high prevalence of anaemia. It is widely prevalent in all age groups, being particularly high among the most vulnerable nearly 58% among pregnant women, 50 % among non-pregnant non-lactating women, 56 % among adolescent girls.<sup>[3]</sup> Though anaemia is a major health problem for adults, it affects only 24 per cent of men.

Iron deficiency anaemia is a consequence of decreased iron intake, increased iron loss from the body and increased iron requirement. Above all three might be the reason, why non-pregnant non-lactating women are the second risk population for iron deficiency anaemia. The adverse effects of Iron deficiency anaemia among young adult women is enormous it is not only producing poor reproductive capabilities and also reduce the physical capabilities. Iron is a microelement which has significant influences on dynamic properties and special features of central nervous system.<sup>[4]</sup> IDA produces major cognitive impairments and supplementation of iron in early age could reverse the CNS changes.

Many studies have demonstrated the correlation between iron deficiency anaemia and cognitive dysfunction mainly in children. Prevalence of mild to moderate anaemia among young adult female medical and nursing students was found to be high.<sup>[5]</sup> Hence this current study was undertaken in order to assess the effects of iron deficiency anaemia on cognitive function in young adult women.

### MATERIAL AND METHODS

This study was conducted in the Department of Physiology, Patna Medical College Hospital, Patna, Bihar from April 2017 to March 2018. The targeted population was young adult women aging between 18-25 years. Students of PMCH were selected as subjects based on inclusion and exclusion criteria.

**Inclusion Criteria:** Unmarried young adult women

**Exclusion Criteria:** (i) Hearing and visual defects; (ii) Illiterate subjects; (iii) Known case of anemia already in treatment; (iv) Chronic disease like diabetes, hypertension, arthritis, renal disease or any gastrointestinal disease and those who were on some medication

A written informed consent was obtained from all subjects and they were divided into two groups. Group 1: (n=30) Non Anemic young adult women acting as control (Hemoglobin  $\geq 12$  gm %) Group 2: (n=30) Anemic young adult women (Hb < 12 gm %)

### Procedure:

Blood sample was collected by using aseptic technique uniformly from all the subjects at same time. Blood parameters like Hb, MCV, MCHC and serum iron were estimated to find out iron deficiency anaemia. The following tests were used to assess the cognitive function – Mini mental status examination (MMSE), Wechsler Memory Scale 4th edition (WMS-IV), Letter Digit Substitution Test (LDST), Digit Symbol Substitution Test.

Mini mental status examination (MMSE): It is an eleven question measure that tests the five areas of cognitive function: orientation, registration, attention, calculation, recall and language. The maximum score is 30. The MMSE takes only 5-10 minutes to administer and is therefore practical to use repeatedly and routinely.<sup>[6]</sup>

### Wechsler Memory Scale 4th edition (WMS-IV):

The examinee is shown a series of designs of increasing length for 5 seconds and a page with correct designs and foils. They must select the correct designs in the correct order. The examinee was awarded 2 points for getting the correct designs in the proper order and 1 point if they get the correct designs but in an incorrect order. There is only a forward condition as previous research indicated that examinees would study the stimuli from right to left.<sup>[7]</sup>

### The Letter Digit Substitution Test (LDST):

It is based on earlier developed substitution tests (e.g., Digit Symbol Substitution Test; Wechsler) but uses over-learned signs instead of the symbols used in other substitution tests. In this test sheet, the key gives the numbers 1 to 9, each paired with a different letter, the test items are printed beneath the key. Participants are required to replace the randomized letters with appropriate digits indicated by the key. The first 10 items are used as practice items, to ensure that participants understand the test instructions. After completion of these items, participants were instructed to replace the remaining items as quickly as possible. The numbers of correct substitutions made in 60 seconds were counted.<sup>[8]</sup>

### Digit Symbol Substitution Test (DSST):

It is same as Letter Digit Substitution Test but here the numbers are paired with different symbols.

After administration of above 4 cognitive tests scoring was done and compared between two groups.

**Statistical Analysis:**

Data are presented as mean  $\pm$  standard deviation. Analysis was done by using graph pad prism 6<sup>th</sup> version. Students unpaired t test was used to compare the two groups.

**RESULTS****Following observations was found :****Table 1 : Blood parameters of control and anaemic groups**

Blood Parameters	Non anaemic Group I	Anaemic Group II	t-value	p-value
Hb (gm%)	12.61 $\pm$ 0.10	10.37 $\pm$ 0.12	14.27	<0.0001****
MCV (fl)	90.39 $\pm$ 0.78	81.15 $\pm$ 0.96	7.48	<0.0001****
MCH (pgm)	28.78 $\pm$ 0.34	25.76 $\pm$ 0.50	5.16	<0.0001****
MCHC (%)	31.74 $\pm$ 0.19	30.29 $\pm$ 0.40	3.24	0.002****
Serum Iron (ug/dl)	169.7 $\pm$ 10.08	124.4 $\pm$ 6.68	3.75	0.004****

\*\*\*\* p < 0.0001: highly significant; \*\*\* p < 0.001: significant

**Table 2 : Scores of cognitive function tests in control and anaemic groups**

Test	Non anaemic Group I	Anaemic Group II	t-value	p-value
MMSV	27.83 $\pm$ 0.43	26.23 $\pm$ 0.54	2.31	0.02*
LDST	43.70 $\pm$ 3.65	38.80 $\pm$ 2.55	1.10	0.26
DSST	41.40 $\pm$ 1.90	41.60 $\pm$ 1.63	0.08	0.94
WMS-IV	4.80 $\pm$ 0.25	4.73 $\pm$ 0.18	0.02	0.83

\* p < 0.05: significant

**DISCUSSION**

In this study mean haemoglobin in anaemic population was 10.37  $\pm$  0.12 i.e. means they were mild anaemic. Blood parameters like Hb, MCV, MCHC, serum iron were significantly lower in anaemic group when compared to normal group.

Iron deficiency anaemia is a common health problem which produces bad consequences in overall body health. Iron is the key component of the main enzymes that involve essential oxidation and reduction reactions, synthesis of neurotransmitters, catabolism of neurotransmitters and synthetic processes such as the production of myelin. By discussing the functions of iron on CNS we surely can expect the cognitive dysfunction in IDA. Iron needs of the brain vary with the stage of the life cycle. Iron uptake into the brain is maximal during the period of rapid brain growth, which coincides with the peak of myelinogenesis.<sup>[9]</sup> Jean- Luc Jougleux et al. (2011) mentioned that mild maternal IDA during gestation and altered the nervous system development of offspring.<sup>[10]</sup> Previous research showed that iron deficiency can exert a direct deleterious effect on learning and on the brain. Effects of iron deficiency in infancy lay ground for the problems in cognitive and behavioural functioning.<sup>9</sup> Longitudinal studies have found that children who were anaemic in the first 2 years of life continued to function poorly in later childhood.<sup>[11]</sup>

Our question to start this study was whether the need of iron is important only for the young developing brain? In current study mean scores of all 4 cognitive function tests were less in anaemic group than normal individuals though they were not significant but MMSE showed significant decrease of cognitive score in anaemic group this finding concurs with the study done by Khedr E et al. He demonstrated low score of cognitive function test (MMSE, WMS) in anaemic adults when compared to control group (2008).<sup>[12]</sup> Halterman JS et al. demonstrated lower standardized math scores not only among iron deficient school aged children and also in adolescents, with iron deficiency anaemia.<sup>[13]</sup>

Correlation of cognitive impairment with IDA can be explained by three main mechanisms. Systemic effects of anemia lead to low oxygen delivery to the brain-cerebral hypoxia (Lena Hulthen et al. (2003).<sup>[8]</sup> Iron dependant enzyme aldehyde oxidase activity is reduced which may interfere with the degradation of serotonin (Lozoff B et al. (1996).<sup>[12]</sup> Decreased iron content resulting from IDA may decrease the activity of neurotransmitters such as dopamine, serotonin and noradrenalin by interfering with the iron dependant enzymes (Youdim MB et al. (1990).<sup>[14]</sup> In this study above mechanisms would be taken as reason for less cognitive performance in anaemic group when compared to control group.

**CONCLUSION**

Iron deficiency anaemia even in young adult can affect the cognitive performance. So screening of anaemia and early treatment is needed not only to reduce maternal mortality, physical health and also to

improve mental capacity. Limitations behind this study are only mild anaemia was taken for analysis and inadequate sample size. Further studies are needed to compare cognitive performance with severity of anaemia.

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