A Comparative study Of Audio-Visual Reaction Time In Anemic And Non-Anemic Adolescent Girls.

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Abstract Background and objectives: Anemia is common and severe problem in adolescent girls in many developing countries including India. Decreased hemoglobin levels may lead to decreased attentiveness and low neuronal metabolic activity. The main aim of this study was to observe and compare the effects of hemoglobin level on auditory and visual reaction time in normal and anemic girls of same age group. **Method:** Adolescent girls of age group 17-19 years have been selected. Hemoglobin estimation was done using Sahali's Hemoglobinometer. After haemoglobin estimation two groups were made. Group I (n=30) with estimated haemoglobin concentration ≥12 gm%. Group II (n=30) with estimatedhaemoglobin concentration<12gm%.Auditory and visual reaction time have been measured using 'Reaction time analyser'.Observations have been statistically analysed .**Results:** The difference in auditory and visual reaction time between two groups was found to be significant (p<0.05).Interpretation and **Conclusion:** Both auditory and visual reaction time were found to be delayed in Group II having hemoglobin<12gm% as compared to those having hemoglobin ≥ 12gm%. Sensorimotor performance is affected in anemic individuals.

Key Words: Adolescent girls, Anemia, Reaction time.

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Introduction: Anemia is a major public health problem. Anemia is a common and severe problem in many developing countries including India. The WHO estimates that, worldwide 1.6 to 2 billion people are anemic[1.]. Anemia affects mainly the women in reproductive age group and adolescent girls. Adolescent girls are at greater risk of developing anemia because of their poor dietary intake compared to greater physiological requirements[2].

Decreased hemoglobin levels may lead to decreased attentiveness and low neuronal metabolic activity. While observational evidences suggest a strong link between anemia and cognitive deficit, the evidence of the causal link through interventional studies is limited[3].

Reaction time is an indicator of cognitive function. Reaction time is the time interval between the application of a stimulus and the appearance of appropriate voluntary response by a subject. It involves stimulus processing, decision making, attention mechanism and response programming[4].
 Some studies show infants who experience anemia during the first 6-12 months of life are likely to experience persistent effects of the deficiency that alter functioning in adulthood . It may be attributed to nerve conduction velocity in anemic infants[5].
A9 dopaminergic neurons form the nigrostriatal pathway and are involved in regulating voluntary movements and postural reflexes. Gene expression analyses of A9 dopaminergi neurons identifies transcripts for alpha and beta chains of haemoglobin.The loss of these neurons disrupts the ability to control movements[6].The rationale of the study is to find a similar causal link between anemia and human reaction time in adolescent girls .

Material and Method: The present study was conducted in department of physiology, GMC, Nagpur. It was approved by ethical committee.The study group and controls were selected from first year MBBS girl students. Simple random sampling method was followed.The subjects belonged to adolescent age group[7] between 17-19 years.

A written informed consent was obtained.1) Age was recorded from birthdate by calendar to the nearest of year (<6 months and >6 months). 2) Standing height was recorded without shoes and with light cloths on a wall mounted measuring tape in centimeters.3) Weight was recorded without shoes and with light cloths on a weighing machine with a least count of 500grams. 4) BMI was calculated using Quetelet's index i.e.weight (kg)/ (height in meter)^2.

Hemoglobin estimation was done with sahali'shemoglobinometer using standard procedure protocol[8]. After haemoglobin estimation two groups were made.Group I

consist of 30 subjects with estimated hemoglobin ≥12 gm%. Group II consist of 30 subjects with estimated hemoglobin<12gm%.Subjects in Group I as controls and Group II as cases.

Exclusion criteria includes neural disease ,muscle disease, hearing impairment and visual impairment.Girls receiving iron supplementation within 1 month were excluded from the study. The study was done during the post menstrual phase of the menstrual cycle to avoid any alteration in their values due to premenstrual phase[9].

The apparatus used to measure reaction time was 'Research reaction time apparatus' (Yantrashilp) manufactured by Anand agencies, Pune-2. It is a portable device with inbuilt fourdigit chronoscope with least count of 1/1000 sec i.e. 1 millisecond[10].Green light stimuli and high frequency beep stimuli were selected for recording visual reaction time and auditory reaction time respectively.Once the subject got familiarized with the instrument, the final readings were taken.

For auditory reaction time three readings of the high frequency beep stimuli were recorded.For visual reaction time three readings of the green light stimulus were recorded in milliseconds from autodisplay[11].The average of three readings was taken. While performing the test, all the subjects were made to sit comfortably in a chair. All the readings were taken between 9 to 10 am in the morning in a quite room.

As soon as the stimulus was perceived by the subject, she was asked to respond by pressing the response switch by index finger of the dominant hand. For each subject the lowest reading was taken as the value for the reaction time task.

Statistical analysis: - Student's t test was applied for the statistical analysis. Correlation between haemoglobin and reaction time was done using Pearson's correlation.

Result: There was no statistically significant difference in the anthropometric parameters between group I and group II. Hence they were comparable for the study (Table I).

Table I. Table showing anthropometric parameters Groupwise.

Parameters	GroupI (Hb≥12)	Group II (Hb<12)
Age	18.25±0.51	18±0.51
Weight	52.75±7.54	51.5±5.36
Height	1.6±0.065	1.57±0.118
BMI	20.31±1.88	19.78±1.89

The mean hemoglobin level was 12± 0.52g/dl in group I (Hb≥12) and was 10±0.68 g/dl in group II (Hb<12).Observation shows delayed auditory and visual reaction time in Group II (Table II).

Table II. Table showing Hemoglobin level, Auditory reaction time and Visual reaction time Groupwise.

Parameters	Group I(Hb≥12)	Group II (Hb<12)
Hb (gm %)	12±0.52	10±0.68
ART	204.5±4.80	226.5±4.58
VRT	213.25±3.13	235.5±4.86

A significant negative correlation of hemoglobin with both Auditory and Visual reaction time was seen. (Table III and IV).

Table III. Correlation of Hemoglobin with Auditory reaction time.

Parameter	Group I (Hb ≥12)		Group II (Hb<12)	
	r value	p value	r value	p value
Hemoglobin	-0.2469	0.1884	-0.3402*	0.0659

*p<0.05-significant.

Table IV. Correlation of Hemoglobin with Visual reaction time.

parameter	Group I (Hb ≥12)		Group II (Hb<12)	
	r value	pvalue	r value	p value
Hemoglobin	-0.2719	0.1461	-0.2350*	0.2113

*p<0.05- Significant.

Discussion: The increase in reaction time indicates an impaired sensory-motor performance. According to WHO, Anemia in women is defined as hemoglobin concentration less than 12. Lower concentration of hemoglobin results in a number of symptoms such as weakness and general fatigue and adverse effects on immune system[2]. Adolescence being formative years in life is more prone to major nutritional deficiency.Many factors contribute to anemia in girls –e.g. Low iron intake, poor iron absorption and high iron demands during

menstruation and growth spurts. And the results are higher risk of anemia during adolescence.

Longitudinal studies show that iron deficiency in infancy is related to poorer cognition in childhood[12]. A more recent systematic review of iron supplementation in infants and children aged under 5 years finding that supplementation led to improvements in cognition and motor development in anemic and iron deficient children[13].

Rodent models show that iron deficiency during gestation/lactation alters neurometabolism, neurotransmitters, myelination in the developing brain. Human infants with iron deficiency anemia test lower in cognitive, motor, social, emotional and neurophysiologic development than comparison group infants. Poorer outcome has also been shown in human and monkey infants with neonatal iron deficiency. Iron deficiency is associated with hypomyelination of neurons, effects on the dopaminergic system and a deficiency of enzymes involve in the development of parts of the brain important for cognitive function such as memory[14].

The present study is based on effect of haemoglobin on cognitive functions in adolescence.In this study, auditory reaction time and visual reaction time were found delayed due to iron deficiency anemia.

Some studies shows that iron supplementation improve attention and concentration in females. Lucca et al, suggested an independent association of anemia with attention performance in elderly persons[15].

The central conduction time was found to be prolonged in 6 months old children with anemia compared with nonanemic children.The investigators speculated that the prolonged central conduction time was due to changes in myelination that have been reported in iron deficient animals.Thus in anemic children central conduction time was found to be prolonged and longer latencies in visual evoked potentials[16].

School aged children who had chronic iron deficiency anemia during infancy but were treated with iron performed more poorly on tests of attention (specifically selective attention) than their nonanemic peers 10years later[16].Information processing tasks includes speed and discrimination. The ability to discriminate may be sensitive to anemia[16]. Anemia can lead to altered cognition.Changes due to anemia is reflected in structural and functional changes in central nervous system that manifest as altered cognition.

Two frequently discussed mechanisms are effects on the dopaminergic system and effects on myelination[12] . Role of iron in neuronal functioning noted that the dopaminergic system is sensitive to iron status[17] . Process of attention to environmental information is dependent on rates of dopamine clearance from the interstitial space and that this suggests that iron status may affect behavior through dopamine metabolism[11] .

There are positive association between hemoglobin levels; somatic iron levels and performance in tests of cognitive function[18].Children who were anemic in early childhood continue to have poor cognitive, motor development and school achievement into middle childhood. There are many studies about effects of haemoglobin in infants and elderly. But very few studies about the effects of haemoglobin in adolescent and young age group.Present study is a baseline study, with small sample done on small scale.It needs to be evaluated on a larger scale.

Conclusion: With this study we conclude that low neuronal metabolic activity, decreased nerve conduction velocity, alteration of neurotransmission systems, altered cognition, and hypomyelination of neurons might be responsible for prolongation in auditory and visual reaction time in anemic individuals. These mechanisms might act synergistically to induce altered function.

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