



A CASE CONTROL STUDY AMONG ANEMIC AND NON-ANEMIC ADOLESCENT GIRLS TOWARDS AUDIO-VISUAL REACTION TIME.

Physiology

Dr. Hemlata Gupta Assistant Professor, Department of Physiology, Lakhiram Agrawal Medical College, Raigarh, Chhattisgarh

Dr. Ram Krishna Gupta* Associate Professor, Department of Plastic Surgery, Cancer Hospital and Research Institute, Gwalior, M.P. *Corresponding Author

ABSTRACT

BACKGROUND: Anemia is common problem in adolescent girls in many developing countries including India. Low hemoglobin levels may lead to decreased attentiveness and low neuronal metabolic action.

OBJECTIVES: To observe and compare the effects of hemoglobin level on auditory and visual reaction time in Non-Anemic and anemic girls of same age group.

MATERIAL AND METHODS: Adolescent girls of age group 17-19 years were included in the study. Hemoglobin estimation was done using Sahali's Hemoglobinometer. Two groups were made. Group I (n=40) with estimated haemoglobin concentration ≥ 12 gm%. Group II (n=40) with estimated haemoglobin concentration < 12 gm%. Auditory and visual reaction time have been measured using Reaction time analyzer. Recorded observations were analysed using Epi-info software.

RESULTS: Significant difference ($p < 0.05$) in auditory and visual reaction time was found between two groups.

CONCLUSION: Both auditory and visual reaction time were found to be delayed in Group II having hemoglobin < 12 gm% as compared to those having hemoglobin ≥ 12 gm%. Sensorimotor performance is affected in anemic individuals.

KEYWORDS

Anemia, Adolescent girls, Reaction time.

INTRODUCTION: 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 anemic¹. Anemia disturbs mainly the women in reproductive age group and adolescent girls. Adolescent girls are at greater jeopardy of developing anemia because of their poor dietary intake compared to greater physiological requirements². Decreased hemoglobin levels may lead to decreased attentiveness and low neuronal metabolic activity. 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 programming³. While observational indications suggest a strong link between anemia and cognitive deficit, the evidence of the causal link through interventional studies is limited⁴. A9 dopaminergic neurons form the nigrostriatal pathway and are involved in regulating voluntary movements and postural reflexes. Gene expression analyses of A9 dopaminergic neurons identifies transcripts for alpha and beta chains of haemoglobin. The injury of these neurons disrupts the ability to control movements⁵. The rationale of the study is to find a similar contributory link between anemia and human reaction time among adolescent girls.

MATERIAL AND METHOD:

Study Design- Prospective Case Control study

Study settings- The present study was conducted in department of physiology, Lakhiram Agrawal Medical College, Raigarh.

Study period- The study was done for the period of 6 months (March 2018 to August 2018)

Study Population- Cases and controls were selected from first year MBBS girl students. The subjects belonged to adolescent age group between 17-19 years.

Sampling Technique- Simple random sampling method was used.

Exclusion criteria- any girl suffering from neural disease, muscle disease, hearing impairment and visual impairment were excluded from the study. 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 phase⁶.

A written informed consent was obtained. Parameters like age was

recorded from birthdate by calendar to the nearest of year (< 6 months and > 6 months), height was recorded without shoes and with light cloths on a wall mounted measuring tape in centimeters, weight was recorded without shoes and with light cloths on a weighing machine with a least count of 500grams and finally BMI was calculated using Quetelet's index i.e. weight (kg)/ (height in meter)². Approval from Institutional Ethics Committee was obtained before conducting the study.

METHODOLOGY- Hemoglobin estimation was done with Sahali's hemoglobinometer using standard procedure protocol⁷. Two groups were formed after Hemoglobin estimation. Group I are controls which consist of 40 subjects with estimated hemoglobin ≥ 12 gm% and Group II are cases which consist of 40 subjects with estimated hemoglobin < 12 gm%.

'Research reaction time apparatus' (Yantrashilp) manufactured by Anand agencies, Pune-2 was used to measure reaction time. It is a portable device with inbuilt four-digit chronoscope with least count of 1/1000 sec i.e. 1 millisecond⁸. Green light stimuli and high frequency beep stimuli were selected for recording visual reaction time and auditory reaction time respectively. 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 autodisplay⁹. The average of three readings was taken. All the subjects were made to sit comfortably on a chair while performing the procedure. All the readings were taken between 10 to 11 am in the morning in a quiet room. As soon as the stimulus was professed by the subject it was responded 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: - The recorded observation were studied in Epi-info software for analysis. Student's t test was used to test the significance. Pearson's correlation was used to determine the Correlation between haemoglobin and reaction time. $P < 0.05$ is considered statistically significant.

Results-

Table 1- Anthropometric Parameters in Cases and Controls

Parameters	Group-I (Hb ≥ 12)	Group-II (Hb < 12)
Age	18.15 \pm 0.51	18 \pm 0.51
Weight	52.72 \pm 7.53	51.6 \pm 5.46
Height	1.59 \pm 0.063	1.57 \pm 0.19
BMI	20.35 \pm 1.87	19.71 \pm 1.88

According to Table 1 nearly all the anthropometric parameters were similar in both the groups. Hence, they were comparable for the study.

Table 2- Group wise comparison of Hemoglobin level, Auditory and Visual reaction time

Parameters	Group- I(Hb \geq 12)	Group- II (Hb<12)
Hb (gm %)	12.3 \pm 0.48	10 \pm 0.52
ART	214.5 \pm 4.70	236.5 \pm 4.98*
VRT	223.25 \pm 3.23	245.5 \pm 4.96*

*p<0.05-significant.

According to Table 2 delayed auditory and visual reaction time were observed in Group II. The mean hemoglobin level was 12.3 \pm 0.48g/dl in group I and was 10 \pm 0.52 g/dl in group II.

Table 3- Correlation of Hemoglobin with Auditory and Visual reaction time

Parameters	Auditory Reaction Time		Visual Reaction Time	
	Group -I	Group -II	Group-I	Group-II
Hb (gm%)	r= -0.256	r= -0.342*	r= -0.27	r= -0.25*

*p<0.05-significant.

r= Correlation coefficient

as per table 3 a significant negative correlation of hemoglobin with both Auditory and Visual reaction time was seen with Group -II.

DISCUSSION- The increase in reaction time specifies diminished sensory-motor performance. Adolescence being formative years in life is more prone to major nutritional deficiency. According to WHO, Anemia in women is defined as hemoglobin concentration less than 12. Low iron intake, poor iron absorption and high iron demands during menstruation and growth spurts are the major factors contribute to anemia in girls. 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.

Longitudinal studies show that iron deficiency in infancy is related to poorer cognition in childhood¹⁰. 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 children¹¹. 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 memory¹². 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 potentials¹³. Role of iron in neuronal functioning noted that the dopaminergic system is sensitive to iron status¹⁴. 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. There are positive association between hemoglobin levels; somatic iron levels and performance in tests of cognitive function¹⁵.

CONCLUSION: This study concludes 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. Present study is a baseline study, with small sample done on small scale. It needs to be evaluated on a larger scale.

Conflict of Interest- None declared.

Source of Funding- None.

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