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Original Research Article

# Anemic and Non-Anemic Adolescent Girls towards Audio-Visual Reaction Time: Case Control Study

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**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 Saheli's Hemoglobinometer. Two groups were made. Group I (n= 40) with estimated haemoglobin concentration ≥12 gm%. Group II (n=40) with estimated haemoglobin concentration<12gm%. Auditory and visual reaction time has been measured using Reaction time analyzer. Recorded observations were analysed using Epi-info software.

**Results:** Delayed auditory and visual reaction time was observed in Group II. The mean hemoglobin level was 12.3± 0.48g/dl in group I and was 10±0.52 g/dl in group II. Significant difference ($p<0.05$) in auditory and visual reaction time was found between two groups. A significant negative correlation of hemoglobin with both Auditory and Visual reaction time was seen with Group -II.

**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.

**Keywords:** Anemia, Adolescent girls, Saheli's Hemoglobinometer, 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 anemic [1]. 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 requirements [2]. 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 processing stimuli, making choices, paying attention, and programming responses [3]. Although there is a substantial correlation between anemia and cognitive deficits based on observational data, there is little evidence of a causative relationship from interventional studies [4]. The nigrostriatal pathway is made up of A9 dopaminergic neurons, which play a role in controlling free will and postural reflexes. Haemoglobin's alpha and beta chains are represented by transcripts in gene expression analysis of A9 dopaminergic neurons. Movement control is hampered by the damage to these neurons [5].The goal of the study is to determine whether anemia and human reaction time among adolescent girls share a similar causal relationship.

## Materials and Method

It was a Prospective Case Control study conducted in LNCT Medical College & Sewakunj Hospital, Indore, M.P for the period of 6 months May 2022 to October 2022. Cases and controls were selected from first year MBBS girl students. The subjects belonged to adolescent age group between 17-19 years.

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 phase [6].

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 Saheli's hemoglobinometer using standard procedure protocol [7]. 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 <12gm%.

'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 millisecond [8]. 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 autodisplay [9]. 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 was 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±0.51 | 18±0.51 |
| Weight | 52.72±7.53 | 51.6±5.46 |
| Height | 1.59±0.063 | 1.57±0.19 |
| BMI | 20.35±1.87 | 19.71±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≥12 ) | Group- II (Hb<12) |
|---|---|---|
| Hb (gm %) | 12.3±0.48 | 10±0.52 |
| ART | 214.5±4.70 | 236.5±4.98* |
| VRT | 223.25±3.23 | 245.5±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± 0.48g/dl in group I and was 10±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-**

Decreased sensory-motor performance is indicated by an increase in reaction time. The early years of adolescence make serious dietary deficiencies more likely. Hemoglobin levels below 12 are considered anemia in women, according to the WHO. Anemia in females is mostly caused by low iron intake, poor iron absorption, and high iron needs during menstruation and growth spurts. The current study is centered on the impact of hemoglobin on adolescent cognitive development. This study discovered that iron deficiency anemia caused a delay in both auditory and visual reaction times.

Longitudinal studies show that iron deficiency in infancy is related to poorer cognition in childhood [10]. A more recent systematic review of iron supplementation in infants and children aged less than 5 years finding that supplementation led to improvements in cognition and motor development in anemic and iron deficient children [11]. 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 [12]. 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 [13]. Role of iron in neuronal functioning noted that the dopaminergic system is sensitive to iron status [14]. 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 function [15,16].

## Conclusion:

According to the findings of this study, anemic people may have longer auditory and visual reaction times because of reduced neuronal metabolic activity, lower nerve conduction velocity, altered neurotransmission systems, impaired cognition, and hypomyelination of neurons. The current study is a baseline investigation with a modest sample size. It requires a more thorough analysis.

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