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Effect of decreased haemoglobin concentration on audio visual reaction time

Amrithaashri S[1], Sridevi G[*2], Archana Santhanam[3]

[1]Saveetha Dental College, Saveetha Institute of Medical and Technical Science, Saveetha University, Chennai, Tamil Nadu, India
[2]Department of Physiology, Saveetha Dental College, Saveetha University, Saveetha Institute of Medical and Technical Science, Chennai, Tamil Nadu, India
[3]Department of oral pathology, Saveetha Dental College, Saveetha Institute of medical and technical science, Saveetha University, Chennai, Tamil Nadu, India

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ABSTRACT

Anaemia is defined as the decrease in the blood with haemoglobin concentration and has also been a very important public health issue that extremely affects the middle-income countries. The present study was planned to investigate the association between haemoglobin concentration with audiovisual reaction time. The study was conducted among I year BDS female student population of saveetha dental college and hospital. Based on Haemoglobin values, the study population was divided into two categories. Group 1- Female subjects whose haemoglobin concentration was above 10 G %. Group 2(anaemic group)- Female subjects whose haemoglobin concentration was below 10 G%. Audiovisual reaction time was determined by the audio visual meter. The student's test was used to analyse the relationship between haemoglobin level and audiovisual reaction time The effect of age above and below 20 years also were analysed for haemoglobin and ART, VRT association. Pearson Chi square test was used to analyse the difference between normal and anaemic individuals in the age group above and below 20 years. The results of the analysis revealed that haemoglobin concentration was inversely proportional to Audio visual reaction time. The association analysis done between age groups with audiovisual reaction time in normal and anaemic participants did not show significant change. Thus, the present study concludes that haemoglobin concentration is inversely related to audio visual reaction time. This may be attributed to lower neural activity and impaired nerve conduction produced by anaemia.

*Corresponding Author

Name: Sridevi G
Phone: 9840325676
Email: sridevig.sdc@saveetha.com

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INTRODUCTION

The WHO defined anaemia as a level of haemoglobin lower than 13g% in males and less than 12g% in females. Anaemia is the condition which is characterized by the deficiency of the haemoglobin or decreased level of the red blood cells associated with the decreased oxygen-carrying capacity of the blood. In many, less and moderate-income countries, including India, anaemia is a common health issue among the public leading to morbidity in children and also in reproductive age women (Stoltzfus, 2001). The WHO reported that about 1.6 - 2 bil-

lion people worldwide are anaemic. According to the National Family Health Survey, more than 50% of the women in India have anaemia among them which 39% are mildly anaemic, 15% moderately anaemic and 2% severely anaemic that can lead to many deficiencies (Misra *et al.*, 1885).

Adolescent girls, who constitute a considerable segment of the Indian population, form a vulnerable group and are at a greater risk. Thus this is the most prone phase for developments of nutritional anaemia (Chaudhary and Dhage, 2008). They are particularly prone to iron deficiency anaemia because of their high demands of iron for the synthesis of haemoglobin. This is to make up for the loss of iron during menstruation (Beard, 2000). In addition, there is also a mismatch between their high metabolic demand and poor dietary intake. Abu Rayhan al- Biruni, a Persian scientist was first to explain that reaction time and measure it in a laboratory in 1868 (Chandra *et al.*, 2010). Normal auditory reaction time is 100-200 msec and normal visual reaction time is 200-400 msec (Ghuntla *et al.*, 2013).

Reaction time is a very important, simple and non - invasive test for nerve conduction in peripheral and central neural structures. It is a measure of the function of sensorimotor association (Botwinick and Thompson, 1966). The audio-visual reaction time is found to be prolonged with a decrease in haemoglobin levels, and the reason has been attributed to the decreased neuronal conduction caused due to decreased levels of iron in anaemia (Shenvi and Balasubramanian, 1994; Samuel and Devi, 2015; Fathima and Preetha, 2016). The lifestyle habits such as caffeine consumption and other dietary habits play a very important level not only in haemoglobin concentration, but the other blood counts as well. (Ilankizhai and Devi, 2016; Harsha *et al.*, 2015).

Emotional stress can either precipitate or provoke both acute and chronic anaemia (Dave and Preetha, 2016; Abigail *et al.*, 2019). The primary remedy lies in practices of physical fitness that help in making the body fit and purify the blood (Shruthi and Preetha, 2018). Fitness in the form of physical exercises not only prevents anaemia but also enhances circulation and stimulates the bone marrow (Iyer *et al.*, 2019; Devi and Sethu, 2018). The effect of acupuncture can also improve the concentration of haemoglobin (Swathy and Sethu, 2015). The stem cell therapy, which repairs heart muscles after acute myocardial infarction, also provides new circulation with right haemoglobin concentration (Renuka and Sethu, 2015). Also, deficiencies play a role in anaemia, physiologically pregnancy also results in anaemia (Renuka and Sethu, 2015; Swathy and Sethu, 2015; Timothy *et al.*, 2019).

MATERIALS AND METHODS

30 Female students of I year BDS students in the group between (15 - 25 years) from Saveetha Dental College and Hospital, were taken as participants for the students. The study was conducted in the Department of Physiology, Saveetha Dental College and Hospital in February 2020. Exclusion criteria of neural diseases and muscle disease involved in hearing impairment and visual impairment. Students are receiving iron supplementation before one month, which is excluded from the study. The study is done during the post-menstrual phase of the menstrual cycle to avoid alteration in India values in the pre-menstrual phase.

As a routine part of I-BDS practical, haemoglobin estimation was done by SAHLI's method., the study population was divided into two categories on the basis of haemoglobin values.

Group 1

Female subjects whose haemoglobin concentration was above 10 G %

Group 2

Anemic group- Female subjects whose haemoglobin concentration was below 10 G%

The visual reaction time (ART) and auditory reaction time (VRT) was determined by the audio visual meter.

Reaction time is the time elapse that occurs between the application of sensory stimulation and the subsequent behavioural response. An instrument was used to record audiovisual reactions. A portable device which is built with a chronoscope that counts least 1/1000 seconds. A recording of visual reaction time with Greenlight stimuli. On the other hand, auditory reaction time with frequency beep stimuli was done respectively. While performing a test, the subjects are made very comfortably in chairs. The readings were taken in the morning in a silent room. The auditory reaction time readings were done in triplicate with high-frequency beep stimuli and similarly, the visual reaction time readings were also taken triplicate with the green light stimulus in Milliseconds through the auto display. As the person perceives the stimulus, she/he is asked to respond by pressing in the response with their index finger using the dominant hand. Three readings were taken, and the average was taken.

Statistical analysis

Table 1: The haemoglobin with the visual reaction time

Groups	Haemoglobin Concentration (GM%)	Visual Reaction Time
Group1 (G1)	10.75+0.77	0.291+ 0.20
Group 2 (G2)	8.26+ 0.59*	0.361 + 0.17#

signifies that haemoglobin is significantly decreased in G2; # signifies that visual reaction time is increased in G2

Table 2: The haemoglobin with the auditory reaction time

Groups	Haemoglobin Concentration (GM%)	Auditory Reaction Time
Group1 (G1)	10.75 + 0.77	0.258 + 0.12
Group 2 (G2)	8.26+0.59*	0.444+0.13#

signifies haemoglobin is significantly decreased in G2; # signifies auditory reaction time is significantly increased in G2

The obtained data were presented as mean + STD. The student's test was applied to analyse the differences in haemoglobin concentration and audiovisual reaction time. The changes in haemoglobin and audiovisual reaction time among the two age groups of the study above 20 years and below 20 years was analysed using Pearson chi square test, and the significance level was fixed at p< 0.001.

RESULTS AND DISCUSSION

Table 1 Comparing the Haemoglobin concentration and visual reaction time.

Table 2 Comparing the haemoglobin concentration and auditory reaction time.

The haemoglobin concentration in the graph is inversely proportional to Audio visual reaction time.

Association analysis between age groups and audiovisual reaction time

The association analysis did not reveal significant changes among the two age groups (GI- Age above 20 years) and (G2- Age group below 20 years) with audio visual reaction time as in Figures 1 and 2.

Anaemia is a common public health issue affecting low and middle-income countries. The common causes of Anemia are nutritional deficiency of folate, vitamin A, vitamin, B12), inherited or acquired disorders, parasitic infections etc. These have an effect on haemoglobin synthesis, red blood cell production, but the most significant and essential contributor globally is iron deficiency. Studies done on adolescent girls revealed that low haemoglobin could be diagnosed with symptoms like fatigue, weakness, low immune power (Stevens *et al.*, 2013; Renuka and Sethu, 2015). Anaemia is also reported to develop cognitively and motor-impaired along with fatigue and low productivity (Balarajan *et al.*, 2011; Iyer *et al.*, 2019). The findings of this study indicate that the decrease in haemoglobin levels have

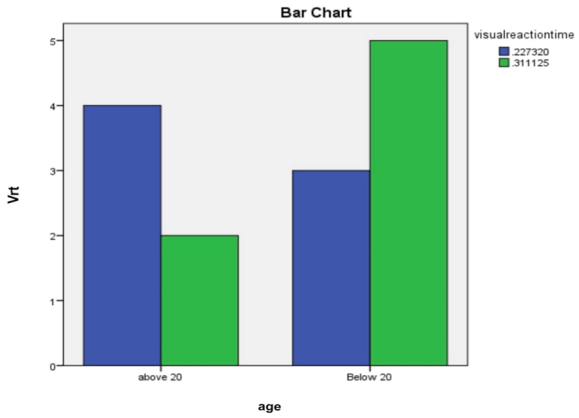

Figure 1: Bar chart represents the association between age and visual reaction time

an important and significant impact on the audiovisual reaction time; this is in accordance with the result in (Misra *et al.*, 1885) study. A detailed review written by Sachdev HPS and Gera T with iron supplementation in infants and children with age less than five years led to an improvement in their cognition and motor development (Sachdev *et al.*, 2006; Choudhari and Jothipriya, 2016). Adolescence has been the determining growing phase in life and is more prone to major nutritional deficiency. Many factors contribute to anaemia in adolescent girls like low iron intake, poor iron absorption, high metabolic demand for iron during menstruation and growth spurts. Due to this, the pubescent girls are at a higher risk of developing anaemia.

Figure 1, There is no significant difference in the VRT among the two age groups. Pearson chi square test value=1.167;p=0.280;

Figure 2, There is no significant difference in ART among the two age groups. Pearson chi square test value=1.167; p=0.280; p < 0.05;

Children diagnosed with iron deficiency anaemia

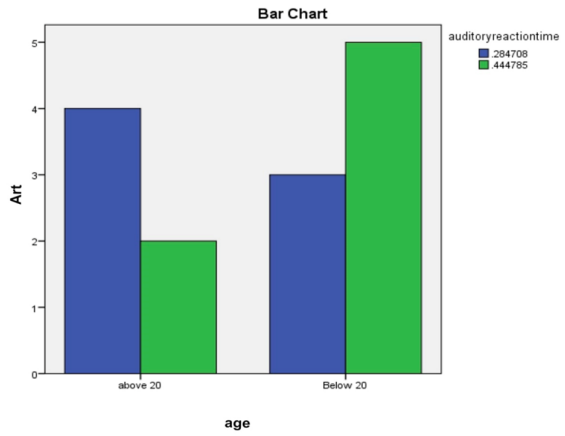

Figure 2: Bar chart represents the association between age and auditory reaction time

have been reported to have lower cognitive, social, emotional and motor neurophysiological development when compared to infants with normal haemoglobin concentration. Humans with neonatal iron deficiency have shown poorer outcomes with respect to physical and mental growth in the early developmental years. Reports revealed that CNS iron deficiency is associated with 1) Decreased myelination of the neurons, 2) impaired activity of the dopaminergic system and 3) deficiency of enzymes involved cognitive function and memory (Lozoff and Georgieff, 2006; Abbas *et al.*, 2020). In context to reaction time, the central conduction time was increased. The study states that the high central conduction time can be caused by changes in myelination of neurons in iron-deficient infants. This is anaemic children central conduction time was prolonged, and also longer latencies in visual evoked potential were recorded (Metallinos-Katsaras *et al.*, 2004; Timothy *et al.*, 2019). The Supporting article of our study reveals that when haemoglobin values were decreased, there was a rise in Visual Reaction. Time(VRT) indicating that lower Hb levels cause prolonged VRT (Rashmi and Kumar, 2010; Kumar *et al.*, 2018). In the Opposing article it is given that Visual reaction time is greater than Auditory reaction time – (Solanki *et al.*, 2012).

Limitations of the study

The present study involves a limited population, and the parameters were taken in subjects within a particular geographical area. Further biochemical and haematological parameters like blood in disease and serum iron levels were not determined.

Implications of the study

Deficiency of iron results in infant nerve conduction and transmission of nerve impulses so awareness of proper dietary intake of iron and nutritional factors can help to prevent anaemia and changes in visual and auditory reaction time.

CONCLUSION

The present study concludes that haemoglobin concentration is inversely related to audio visual reaction time. This results in decreased transmission of neuronal impulses, that causes changes in the transmission of impulses in the central nervous system. There were no significant groups between age groups with ART and VRT.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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