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Original Research Article

CORRELATION OF HEMOGLOBIN LEVEL WITH ECG CHANGES, IN FEMALE HOSTEL BOARDERS OF JMCH OF AGE GROUP 18 -30 YEARS

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ABSTRACT

Background: Anaemia is one of the most common nutritional burdens of world. Anaemia is one of the common most leading causes of disabilities and death. Anaemia is a global public health concern affecting individuals across all age groups, genders and socioeconomic backgrounds. AIM of the study: Correlation of hemoglobin level with ECG changes, in female hostel boarders of JMCH, of age group 18 -30 years. **Materials and Methods:** An institution-based cross-sectional study was conducted in the Department of Physiology, Jorhat Medical College. A total of 195 participants, aged between 18 and 30 years, studying in Jorhat Medical College, were included by a random sampling method. According to inclusion and exclusion criteria, 195 female participants were enrolled in the study. Hemoglobin was calculated by cyanmethemoglobin method using a colorimeter and ECG was taken. Statistical analysis was done by using Chi square statistics. **Results:** ECG alterations were more prevalent in individuals with lower hemoglobin levels, indicating a potential impact of anaemia on cardiac function. **Conclusion:** The results of this study help to assess the impact of anaemia on the cardiovascular system. Routine ECG monitoring in anaemic patients can serve as a valuable tool for early detection of cardiac involvement.

INTRODUCTION

Anaemia is one of the most common nutritional burdens of world as well as one of the common most leading causes of disabilities and death.[1]

Anaemia is a condition marked by a decreased number of circulating red blood cells (RBCs). It can also be defined as a lower hemoglobin concentration or RBC count relative to age-matched reference values. In laboratory assessments, normal value refers to a statistical range that includes 95% of the population's values.[2] The World Health Organization (WHO) classifies anaemia as a hemoglobin level below 13 g/dL in adult men and below 12 g/dL in non-pregnant adult women.[3]

Anaemia decreases the oxygen-carrying capacity of the blood, reducing the amount of oxygen delivered to tissues and resulting in tissue hypoxia. Most clinical symptoms of anaemia stem from this impaired oxygen transport as well as the compensatory cardiovascular and respiratory adjustments made to counteract the reduced red blood cell mass.[4]

Anaemia affects multiple organs, with the heart being one of the most significantly impacted. It is among the most common causes of a hyperdynamic cardiac state at rest,5 where the heart is forced to work harder to compensate for reduced oxygen availability. This occurs because anaemia impairs the delivery of oxygen to the myocardium,[6] leading to an imbalance between oxygen supply and metabolic demands of the heart. If this imbalance persists, it can result in myocardial ischemia, where the heart muscle receives inadequate oxygen, or in more severe cases, myocardial infarction.[7] To counteract the diminished oxygen transport, the heart initiates compensatory mechanisms such as increasing cardiac output and reducing circulation time to enhance oxygen delivery to tissues.8 However, these adjustments remain in effect as long as anaemia persists, placing continuous strain on the cardiovascular system. These changes in heart cause cardiac disturbances. One of the important and

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International Journal of Academic Medicine and Pharmacy (www.academicmed.org)
ISSN (O): 2687-5365; ISSN (P): 2753-6556

simplest tools for the diagnosis of cardiac disturbances is recording electrocardiogram. Electrocardiography (ECG) is a vital diagnostic tool that assesses cardiac electrical activity and can reveal changes associated with anaemia. Since anaemia reduces oxygen supply to the myocardium, it may lead to alterations in heart rate, repolarization abnormalities and even ischemic-like changes in severe cases.

The reported incidence of electrocardiographic abnormalities in anaemia varies widely across different studies, ranging from 10% to 80%, leading to inconsistent conclusions regarding ECG changes associated with the condition.9,10 Earlier research suggested that anaemia could lead to a decrease in QRS amplitude, T wave flattening, and mild atrioventricular (AV) conduction disturbances.[11] However, more recent studies have not consistently confirmed these findings. Instead, later research has reported frequent nonspecific ST-T wave changes in anaemic individuals.[12]

Hence, in the present study, we have decided to study the electrocardiographic changes in female anaemic population. We have decided to correlate ECG changes with severity of anaemia. Understanding the correlation between anaemia and ECG changes is crucial for early detection of cardiac involvement in anaemic patients. This study aims to explore these relationships, providing insights into how severity of anaemia can influence ECG parameters.

Aim: Correlation of hemoglobin level with ECG changes, in female hostel boarders of JMCH, of age group 18 -30 years.

Objectives

- To study the pattern of ECG changes in apparently healthy female boarders with different levels of hemoglobin
- To compare the ECG changes of the group of females with normal hemoglobin percentage and low hemoglobin percentage
- To correlate the ECG changes with severity of anaemia

MATERIALS AND METHODS

Research/Study Design
For any successful research, research design plays an important role where it decides the outcome of the study. The study design depends on the purpose of the research and the findings of the data collection. The present study was an institution-based cross-sectional study.

Sample Size: A total no. of 195 female hostel boarders, aged 18-30 years were selected.

Inclusion Criteria

- Boarders who provided consent as well as detailed history, participated in the study
- Boarders who were within the age group of 18 to 30 years.
- Boarders who were available during both blood sample collection and ECG recording.

Exclusion Criteria

- Boarders who did not provide consent for the study
- Pregnancy
- Hypertension
- Diabetes
- Established renal, liver, lung disease
- Alcoholism/smokin
- Structural heart disease (Valvular heart diseases, Ischemic heart disease, Cardiomyopathy etc)

Place of the Study
The study was conducted at the Department of Physiology.

He Parameters Studied Are:
1. Hemoglobin percentage
2. ECG
1. Hemoglobin was measured by Cyanmethemoglobin method using a colorimeter. These methods are based on the conversion of haemoglobin to cyanmethemoglobin.

- Procedure of Hb estimation by colorimeter,[13]
- Venous blood was collected from the participants in EDTA vial under aseptic conditions.
- Three clean, dry test tubes were labelled as Blank (B), Standard (S), and Test (T).
- Pipetted as follows

	Blank	Standard	Test
Drabkin's Reagent	5 ml	5 ml	5 ml
Hemoglobin standard	–	20 µl	–
Sample	–	–	1

- The mixture was stirred well and allowed to stand at room temperature (250C) for 5 minutes.
- The absorbance of the standard and test sample was measured at 540 nm (green filter) against the blank in a colorimeter.
- The hemoglobin concentration was calculated using the following formula

$$\text{Conc. of Hemoglobin in the specimen (g/dl)} = \frac{\text{Absorbance of Test}}{\text{Absorbance of Standard}} \times \text{Conc. of Standard}$$

2. In this study, a digital 3-channel ECG machine was used in all the 12 leads and analyzed for the specific changes such as Tachycardia, T inversion, tall T wave and ST depression

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International Journal of Academic Medicine and Pharmacy (www.academicmed.org)
ISSN (O): 2687-5365; ISSN (P): 2753-6556

RESULTS

This study was carried out on 195 no. of female hostel boarders within the age group 18 to 30 years. The results were then analysed by using Microsoft Excel. Statistical analysis was done by using Chi square test (X2). If X2 is greater than or equal to the critical value, the result is considered significant. A 'P value' <0.05 is considered as statistically significant. Table 1 and fig 1 shows the prevalence of different grades of anaemia depending upon the Hb % in the study population where 49.23% has normal hemoglobin, 34.35% has mild anemia,16.41% has moderate anaemia and 0% severe anaemia cases. Table 2 and fig 2 shows association of sinus tachycardia with different grades of anaemia (p<0.001) indicating the presence of strong association between severity of anaemia and sinus tachycardia among the

participants. Table 3 and figure 3 shows association of T wave inversion with different grades of anaemia indicating presence of strong association between severity of anaemia and T wave inversion among the participants (P<0.0001). Table 4 and fig 4 shows association between Tall T wave with different grades of anaemia indicating presence of strong association between severity of anaemia and T wave inversion among the participants (p< 0.0001). Table 5 and fig 5 shows association between ST depression with different grades of anaemia indicating strong association between severity of anaemia and ST depression among the participants (p=0.0002). Table 6 and fig 6 shows A statistically significant 'p-value' in all categories showing the presence of strong association between different ECG changes in anaemic participants than in participants with normal Hb.

Table 1: Prevalence of different grades of anaemia depending upon the HB% in the study popolation

Hb (gm %)	FREQUENCY	PERCENTAGE (%)
Severe anaemia (<7)	0	0
Moderate anaemia (7-9.9)	32	16.41
Mild anaemia (10-11.9)	67	34.35
Normal (≥12)	96	49.23
Total	195	

Table 2: Sinus tachycardia with different grades of anaemia

		SINUS TACHYCARDIA		Total	
		PRESENT	NORMAL		P VALUE <0.0001
	Severe anaemia	0	0	0	
	Moderate anaemia	20	12	32	
	Mild anaemia	17	50	67	
	Normal	4	92	96	
TOTAL		41	154	195	

Chi-square value (X2): 50.3, Degrees of freedom (df): 2

Table 3: T wave inversion with different grades of anaemia

		T WAVE		TOTAL	P VALUE
		INVERSION	NORMAL		
Hb value (gm %)	Severe anaemia	0	0	0	<0.0001
	Moderate anaemia	12	20	32	
	Mild anaemia	10	57	67	
	Normal	1	95	96	
TOTAL		23	172	195	

Chi-square value (X2): 31.62, Degrees of freedom (df): 2

Table 4: Tall t wave with different grades of anaemia

		T WAVE		TOTAL	
		TALL	NORMAL		P VALUE <0.0001
Hb value (gm %)	Severe anaemia	0	0	0	
	Moderate anaemia	9	23	32	
	Mild anaemia	8	59	67	
	Normal	1	95	96	
TOTAL		18	177	195	

Chi-square value (X2): 21.90, Degrees of freedom (df): 2

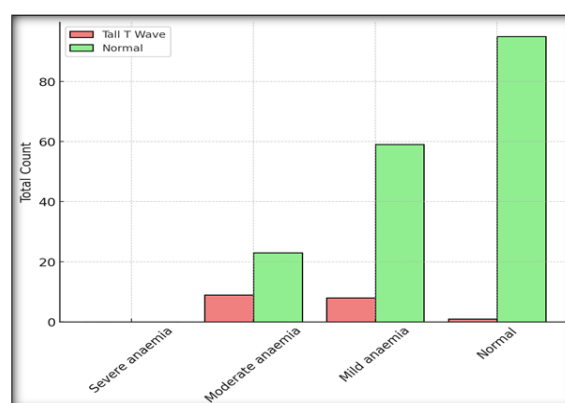**Table 5: ST segment change with different grades of anaemia**

		ST SEGMENT		TOTAL	P VALUE
		DEPRESSION	NORMAL		
Hb value (gm %)	Severe anaemia	0	0	0	P=0.0002 (<0.05)
	Moderate anaemia	5	27	32	
	Mild anaemia	2	65	67	
	Normal	0	96	96	
TOTAL		7	188	195	

Chi-square value (X2):17.04, Degree of freedom (df): 2

Table 6: different ECG changes with normal HB and anemia

ECG CHANGES	FEMALES WITH NORMAL Hb % (≥12gm%)	FEMALES WITH LOW Hb % (≥12gm%)	X² VALUE P VALUE
SINUS TACHYCARDIA	4	37	X^2=20.3, P<0.0001
ST DEPRESSION	0	7	X^2=4.74, P=0.029
TALL T WAVE	1	17	X^2=10.97, P=0.0009
T WAVE INVERSION	1	22	X^2=15.01, P=0.0001

Degree of freedom (df): 3
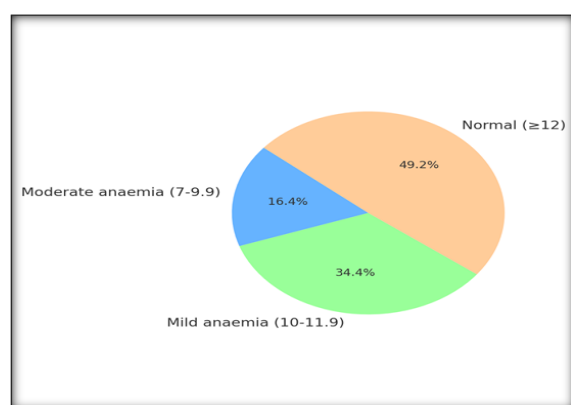
Figure 1: Prevalence of different types of anaemia depending upon the Hb % in the study population
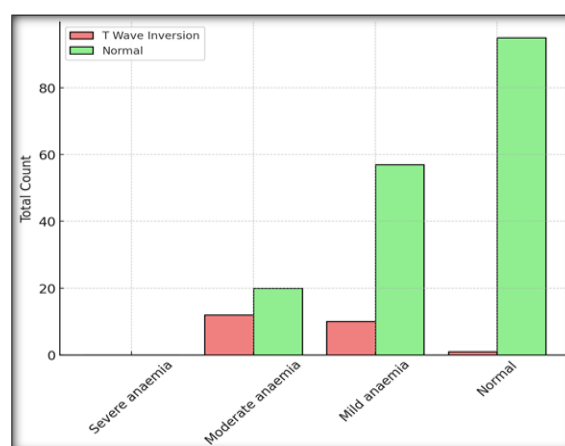
Figure 4: Prevalence of tall T wave among different grades of anaemia
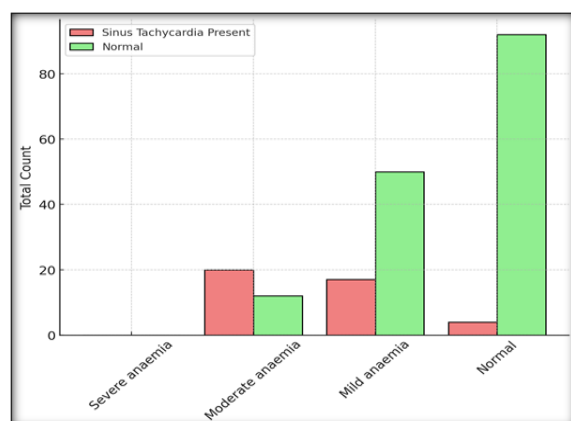
Figure 2: Prevalence of sinus tachycardia among different grades of anaemia

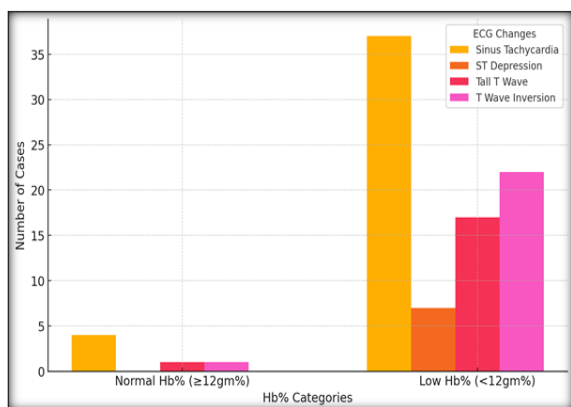**Figure 5: Prevalence of ST depression among different grades of anaemia**

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International Journal of Academic Medicine and Pharmacy (www.academicmed.org)
ISSN (O): 2687-5365; ISSN (P): 2753-6556

Figure 6: Prevalence of ECG changes in participants with normal Hb and in anaemic participants

DISCUSSION

In our study, correlation of hemoglobin with ECG changes was carried out to observe different ECG changes with severity of anaemia among 195 female hostel boarders of Jorhat Medical College within the age group 18 – 30 years.

The main objectives of the study were to study the pattern of ECG changes in apparently healthy female hostel boarders with different levels of hemoglobin. Then to compare the ECG changes with normal hemoglobin percentage and low hemoglobin percentage and demonstrate the association of ECG changes with severity of anaemia.

In the current study, participants with moderate anaemia, 65.6% (21 out of 32) displayed ECG abnormalities, while 32.8% (22 out of 67) of individuals with mild anaemia exhibited similar changes. Conversely, ECG abnormalities were significantly less frequent among participants with normal hemoglobin levels, affecting only 6.25% (6 out of 96). The data demonstrates a strong association (p< 0.001) between anaemia severity and ECG changes, indicating presence of cardiovascular effects of low hemoglobin levels. A similar study was conducted by Mohit Khatri et al,[14] where they also investigated the association between the severity of anaemia and ECG changes, finding that the association was highly significant. In the current study, the data showed a significant relationship (p < 0.0001) between severity of anaemia and the presence of sinus tachycardia. Similar findings were observed in the studies done by Dhamangaonkar et al,[15] Yogesh Parmar et al,[16] S. M. Biradar et al,[17] Appu Patil et al,[18] Renuka BG et al,[19] where they observed presence of sinus tachycardia in different grades of anaemia. The study demonstrates a significant association (p < 0.0001) between anaemia severity and T wave inversion. The study also showed a statistically significant relationship (p < 0.0001) between severity of anaemia and tall T wave. Similar kind of observations were made in the study done by Mohit Khatri et al,[14] In the current study, ST-segment depression was present in 15.6% of individuals with moderate anaemia (5 out of 32) and

3% of those with mild anaemia (2 out of 67). No cases of ST-segment depression were observed in participants with normal Hb levels (0%). The p-value (0.0002) indicates a significant association, suggesting that lower Hb levels increase the likelihood of ST-segment depression. Similar findings were observed in previous studies done by Mohit Khatri et al,[14] However, some studies, such as studies conducted by Neha H. Pandya et al,[20] Sirdesai N,[21] have reported no significant correlation between anaemia and ECG changes.

Overall, the findings in the current study reinforce the importance of monitoring ECG changes in anaemic patients, as ECG abnormalities may serve as an indicator of underlying cardiac stress. Early detection of such changes could facilitate timely intervention and prevent potential cardiac complications. However, further studies with larger sample sizes are required to validate these findings and elucidate the precise mechanisms underlying the observed ECG alterations in different types of anaemia and assess their clinical significance, particularly in evaluating cardiovascular risk in anaemic individuals.

CONCLUSION

The present study was an institution based cross-sectional study conducted to determine the correlation of hemoglobin with ECG changes in female hostel boarders of JMCH of the age group 18-30 years. The study demonstrated a strong correlation between the severity of anaemia and the presence of sinus tachycardia, T wave changes, and ST depression. The increased likelihood of ECG changes with severity of anaemia suggests that as anaemia worsens, the likelihood of ECG abnormalities increases, likely due to myocardial hypoxia, increased cardiac workload and compensatory mechanisms such as tachycardia and left ventricular hypertrophy.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556

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ISSN (O): 2687-5365; ISSN (P): 2753-6556