



ORIGINAL ARTICLE

Frequency of anemia in individuals with beta-thalassemia trait.

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ABSTRACT... Objective: To determine the frequency of anemia in carriers of Beta thalassemia **Study Design:** Retrospective Observational study. **Setting:** PAEC General Hospital, Islamabad, Pakistan. **Period:** 1st January 2022 to 30th June 2022. **Methods:** In this descriptive study, 131 carriers of Beta-thalassemia trait, diagnosed by hemoglobin electrophoresis on cellulose acetate membrane at alkaline pH, of any age and both genders were included. Complete blood counts were performed by hematology analyzer of Sysmex XN-1000 to determine hemoglobin level and red blood cell indices i.e. mean corpuscular volume. The studied parameters included hemoglobin and mean corpuscular volume as quantitative variables. Severity and type of anemia were the qualitative variables of this study and were expressed in terms of frequency and percentages. SPSS 19 version software was used for data analysis. **Results:** 131 carriers of Beta-thalassemia traits were included in study. 58 (44.27%) were males while 73 (55.73%) were females, male to female ratio being 1: 1.3. Of 131 beta thalassemia traits 67 (51.15%) were found to be anemic while 64 (48.85%) had normal hemoglobin for given age and gender. The mean corpuscular volume of anemic and non-anemics was 59.54 ± 5.82 fl and 63.70 ± 6.95 fl respectively. Mean hemoglobin level of anemic Beta-thalassemia traits was 9.42 ± 1.05 g/dl while non-anemic patients was 12.12 ± 1.39 g/dl. **Conclusion:** Burden of anemia among carriers of Beta-thalassemia traits is high. Understanding the prevalence of anemia in individuals with the trait is crucial for optimizing healthcare interventions and improving the quality of life for affected individuals.

Key words: Anemia, Beta-Thalassemia, Beta-Thalassemia Trait, Hemoglobins.

INTRODUCTION

Thalassemia is defined as a condition in which reduced rate of synthesis of one or more of the globin chains leads to defective haemoglobin production. In Beta-thalassemia, anaemia occurs due to reduced Beta globulin, which in turn reduces Hb-A resulting in reduced MCHC and hypochromicity of the cells.¹ As per the World Health Organization, the most common syndrome associated with a micronutrient deficiency is anemia, which most commonly results from the deficiency of iron. Anemia is defined as a condition where there is less than the normal hemoglobin (Hb) level in the body resulting in decreased oxygen-carrying capacity.² Criteria of hemoglobin levels for anemia were developed in 1968 by World Health Organization (WHO). World Health Organization (WHO) definitions for anemia differ by age, sex, and pregnancy. These

are defined for various categories and ages as follows^{3,4}

1. For children
 - i. Aged 6 months to 6 years, Hb level < 11g/dL
 - ii. Aged 6–14 years, Hb < 12 g/dL
2. Adults males Hb < 13 g/dL
3. Non-pregnant females Hb < 12g/dL
4. Severe anemia is defined as Hb < 7.0 g/dL for all categories and age groups.

Morphologic classification of anemia is based on basic parameters of red cell morphology i.e. mean corpuscular volume (MCV) and allows for a quicker diagnostic approach.⁵ Anemia is highly prevalent in Pakistan. Different studies have been conducted on different cohorts of Pakistani population to estimate burden of anemia.⁶ Although anemia has multi-factorial etiologies

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like deficiencies of micronutrients, infections and chronic diseases, all are generally associated with poor health. Therefore presence of anemia is utilized as adverse health indicator by various health survey programs e.g. Centre for Disease Control (CDC).⁷

This study was conducted to determine burden of anemia among carriers of beta thalassemia populations.

METHODS

This is retrospective, non-interventional, observational study with retrospective collection of demographic, clinical, diagnostic and laboratory data. The study was conducted from 1st January 2022 to 30th June 2022 in the department of Pathology, Pakistan Atomic Energy Commission General Hospital H-11/4 Islamabad, Pakistan after approval from ethical committee (IRB/1047(21.12.21).

One hundred and thirty one people comprising of patients who attended outdoor or indoor services, diagnosed as carriers of Beta-thalassemia traits by hemoglobin electrophoresis performed by cellulose acetate membrane at alkaline pH were consecutively selected after detailed informed consent. Potential site of venepuncture was palpated by phlebotomist. Once determined sample collection site was disinfected with 70 percent alcohol wipe. Using disposable syringe of 5 cc blood samples were drawn and transferred to vacutainers. Butterfly needle was used in children. Vacutainers were labeled with name, PCN (patient control number) and lab order number for identification purposes. Specimens were considered potentially hazardous and universal precautions were observed with all specimen collection procedures. Blood samples were transferred to laboratory in sample racks. All subjects had complete hemogram by automated cell counter (Sysmex XN-1000). Hb A₂ level >3.5–8.0% were diagnosed as being carriers of Beta-thalassemia traits. Both males and females of any age were included in study. Hemoglobin level less than 12 g/dl in females and 13 g/dl in males was taken as cut off of anemia in our study. In this study severity of anemia was graded

depending on hemoglobin levels as follows:

- | | |
|----------------|--|
| 1. Mild | Males= <13-10g/dL,
Females = <12-10g/dL |
| 2. Moderate | < 10-07g/dL |
| 3. Severe | < 07-05g/dL |
| 4. Very severe | < 05 g/dL |

Cases with lower HbA₂ levels, patients taking iron supplements, those on parenteral nutrition, children < 1 year of age, patients with acute blood loss or suffering from any other haemoglobinopathies or hematological disorders were excluded from study. The studied parameters included hemoglobin and mean corpuscular volume as quantitative variables. Severity and type of anemia were the qualitative variables of this study and were expressed in terms of frequency and percentages. SPSS 19 version software was used for data analysis

RESULTS

This study was carried out in department of Pathology, P.A.E.C General Hospital H-11/4, Islamabad from 1st January 2022 to 30th June 2022. All patients of any age and both genders, whose Hb-electrophoresis showed increased hemoglobin A₂ indicating that they are Beta-thalassemia traits were included in study. All those in whom any other hemoglobinopathy was detected were excluded from study. A total of 805 hemoglobin electrophoresis were performed during study time. 131 patients (16.27%) were diagnosed to be Beta-thalassemia traits. Of Beta-thalassemia traits 53 (40.46%) were males while 78 (59.54%) were females, male to female ratio being 1: 1.47. Of 131 beta thalassemia traits 67 (51.15%) were found to be anemic while 64 (48.85%) had normal hemoglobin for given age and gender. Mean age of non-anemic patients was 32.25 ± 14.35 years while mean age of anemic patients was 25.11 ± 18.85 years respectively. Demographic details of individuals are shown in Table-I.

All Beta-thalassemia traits had low mean corpuscular volume except one non-anemic 52 years male whose mean corpuscular volume

was 84.5 fl. Mean mean corpuscular volume of anemics and non-anemics was 59.54 ± 5.82 fl and 63.70 ± 6.95 fl respectively.

Mean hemoglobin level of anemic Beta-thalassemia traits was 9.42 ± 1.05 g/dl while non-anemic patients was 12.12 ± 1.39 g/dl as shown in Table-II.

Age Distribution	Anemic		Non-anemic		Total
	Male	Female	Male	Female	
< 1 year	2	0	0	0	2
1 – 10 years	13	6	1	5	25
11 – 20 years	4	2	1	3	10
21 – 30 years	1	12	6	15	34
31-40 years	3	15	8	6	32
41-50 years	2	3	2	8	15
51-60 years	1	1	7	2	11
60 years	2	0	0	0	2
total	28	39	25	39	131

Table-I. Demographic characteristics of beta thalassemia traits with and without anemia (n=131)

Parameters	With Anemia	Without Anemia
Hemoglobin (g/dl) Mean \pm SD (range)	9.42 ± 1.05	12.12 ± 1.39
MCV (fl) Mean \pm SD (range)	59.54 ± 5.82	63.70 ± 6.95

Table-II. Comparison of hemoglobin levels and mean corpuscular volume between beta thalassemia traits with Anemia and without Anemia

Increased hemoglobin F was noted in some subjects taking 1 % to be normal cut off. 18 anemic beta thalassemia traits had raised hemoglobin F while 17 non-anemic beta thalassemia traits had raised hemoglobin F as shown in Table-III.

HbF (%)	No (%) of Subjects	
	Anemic (% of total)	Non anemic (% of total)
<1	28 (41.79%)	30 (46.87 %)
1-2	34 (50.74%)	31 (48.43 %)
2.1-5	3 (4.47%)	2 (3.12 %)
>5	2 (2.98 %)	0 (0 %)

Table-III. HbF (%) in subjects

Highest frequency of anemia was noted in females of ages between 21-40 years accounting for 27 (69.23 %) out of total 39 anemic beta thalassemia carriers. Of total 67 anemic Beta-thalassemia traits 21 (31.34%) had mild anemia while 46 (68.66%)

had moderate anemia. None had severe or very severe anemia.

DISCUSSION

Beta-Thalassaemia, an autosomal recessive hemoglobinopathy, is one of the commonest genetically transmitted disorders throughout the world.⁸ An estimated 5000-9000 children with Beta-thalassemia are born per year, although no documentary registry is available in Pakistan. The estimated carrier rate is 5-7%, with 9.8 million carriers in the total population.⁹

This study of 131 Beta-thalassemia carrier individuals noted higher frequency of anemia in females carriers. Highest frequency of anemia was noted in females of ages between 21-40 years i.e. reproductive age. This may be explained by greater frequency of iron deficiency anemia among females of reproductive age due to increased requirements of iron during pregnancy, delivery and lactation. This result is similar to other studies carried out in general Pakistani population and other parts of the world. 23.3% females were found to be anemic as against 1.4 % males in a study of university students of Peshawar. Similar results were obtained in another study of moderate to severely anemic patients in Peshawar. Greater number of female nursing students in India were anemic as compared to their male counterpart. Anemia was more commonly found in females (15.9%) than in males (6.1%) in Tokat province of Turkey. Similarly, anemia is more prevalent in females than in male population in U.S.A.^{10,11,12}

Mean hemoglobin level of non-anemic beta thalassemia traits was higher than anemic carriers indicating other contributory factors to anemia other than hemoglobinopathy itself. If underlying cause of anemia in carriers of Beta-thalassemia may be identified and treated, their hemoglobin levels and thus disability-adjusted life year may be improved.

Our study utilizing W.H.O cut-off values for mild, moderate and severe anemia found 31.34% to have mild, 68.67% to have moderate anemia. Similarly, mild anemia was also more prevalent in female university students of Sharjah with

prevalence of 88.4%. Moderate anemia was found in 7.2% and severe anemia in 2.3%. Most studies have documented low prevalence of severe and very severe anemia.^{13,14,15}

Elevation of Hb-F in a beta thalassemia trait is usually associated with deletion of the 5' part of the beta globin gene or coinheritance of nondeletional hereditary persistence of fetal haemoglobin. As this study didn't include determination of underlying mutation resulting in beta thalassemia trait: therefore, further studies may be carried out to determine relationship between mutation of beta thalassemia trait, percentage of hemoglobin-F and its clinical significance.

This study considered a limited number of Beta-thalassemia carriers. Results are not readily generalized to whole population.

CONCLUSION

The above findings suggest burden of anemia is high among carriers of Beta-thalassemia.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING






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AUTHORSHIP AND CONTRIBUTION DECLARATION

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2	Sundas Ali	Data analysis, literature search, result interpretation.	
3	Masooma Raza	Data collection, literature search, draft manuscript preparation.	
4	Naheed Khattak	Data analysis, literature search.	
5	Zahra Rashid Khan	Manuscript draft preparation.	
6	Fatima Babar	Literature search.	