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ORIGINAL ARTICLE

Incidence of Beta-Thalassemia Minor among Healthy Blood Donors

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ABSTRACT

Background: Disorders with a markedly slowed rate of globin chain synthesis are referred to as thalassemia. Hemoglobinopathy is a word used to describe diseases that cause structurally aberrant hemoglobin. Iron deficiency is seen in beta-thalassemia minor, which may change the typically increased HbA2 levels. According to World Health Organization (WHO) statistics, 7% of the global population carries a hemoglobin problem. Thalassemia is the most prevalent of the hemoglobinopathies, which are significant genetic issues in Pakistan. The prevalence of -thalassemia in Pakistan is around 5%, whereas the prevalence of hemoglobin S or E is between 0.5% and 1%. The purpose of the study was to determine how common beta thalassemia minor was among blood donors.

Methods: A total of 500 individuals were recruited in this cross-sectional study who were referred for hemoglobin electro-phoresis between September 2015 and March 2016 were the subject of this investigation. A thorough clinical history was taken, including information on the patient's age, sex, cast, family history, history of blood transfusions, and physical findings such as splenomegaly. Hb Electrophoresis tests were performed on all blood samples.

Results: Out of total 500 patients, male were 83.1% (n=79) while female were 16.9% (n=16). Among total individuals, 18.3% (n=94) were found positive cases on Hb electrophoresis technique while remaining 406 patients were observed negative. All recruited individuals were categorised in four (04) different groups based on age; highest number of individuals were found in 18-30 years of age group with 69 patients, followed by 31-40 years of age group (n=19), 41-50 years of age group (n=5.3), and 51-60 years of age group (n=01). 94 (18.3%) had abnormal hemoglobin and beta thalassemia minor. Of them, 79 (84.4%) were men and 16 (17.2%) were women.

Conclusion: Many groups in Pakistan continue to struggle with hemoglobin problems. Preventive interventions, such as pre-marriage carrier status identification and screening for beta thalassemia minor, are required to lower the incidence of beta thalassemia major by forcing couples with beta thalassemia minor to abort their pregnancies.

Keywords: Hemoglobin Disorders, Thalassemia, β-Thalassemia, Healthy Blood Donors, Hemoglobinopathy

INTRODUCTION

Hemoglobinopathies are the most common hereditary hemoglobin diseases, characterized by faulty hemoglobin molecule synthesis or structure. These illnesses range in severity from asymptomatic problems to serious ones like thalassemia major, which need frequent blood transfusions and extensive medical attention[1]. More than 200 point mutations or deletions that interfere with the translation or transcription of alpha- or beta-globin mRNA[2]. Thalassemia major, Thalassemia intermediate, and Thalassemia minor are the three primary types of beta thalassemia[3].

The iron deficiency must be present for beta thalassemia minor to be diagnosed since it may change the typically increased HbA2 readings. Depending on the underlying genetic mutation, high amounts of HbF may also be present. The RBC of a carrier have low mean cell volume, are hypochromic (mean corpuscular volume 79fL), and are microcytic[2]. In cases of severe beta thalassemia, IE leads to enlarged marrow cavities that press against healthy bone and deform the skull and face long bone. In addition, severe lymphadenopathy is caused by erythroid activity proliferating in extramedullary hematopoietic locations[2].

According to World Health Organization (WHO) statistics, 7% of the global population carries a hemoglobin problem. With a population of over 1.2 billion and more than 12,000 newborns born each year with clinically severe hemoglobinopathy, India has a cumulative gene frequency of hemoglobinopathies of 4.2%. India has a wide range of carrier states for b-thalassemia, ranging from 1% to 17%, with an average of 3 hepatosplenomegalies and occasionally extramedullary tumours[2].

Some people's erythrocytes can undergo reversible shape changes in response to variations in the partial pressure of oxygen[4]. Thalassemia and sickle cell disease are among the hereditary hemoglobinopathies for which roughly 240 million people are heterozygous[5]. Thalassemia and different types of hemoglobin are examples of hemoglobinopathies. The most prevalent monogenic diseases in India are B-thalassemias. With a population of over 1 billion and more than 12000 newborns born each year with clinically severe hemoglobinopathy, India has a cumulative gene frequency of hemoglobinopathies of 4.2%. In India, the range of the carrier status for -thalassemia is 1–17%, with an average of 3.2%[6].

Major genetic issues in Pakistan are hemoglobinopathies; 5% of Pakistanis have -thalassemia, and 0.5 to 1% have hemoglobin S or hemoglobin E[7]. Thalassemia is a serious medical issue in Pakistan. With a carrier incidence of 5-8%, it is the most common genetically transmitted blood condition, and each year, about 5000 children are given the diagnosis[8]. An estimated 5000 children in Pakistan are diagnosed with beta-thalassemia major each year, a hereditary blood illness with a carrier incidence of 5-8%. The beta thalassemia trait carrier percentage varies from 1.7 to 9% globally. Every year, 60,000 babies are born with beta-thalassemia major. The carrier rate in Pakistan ranges from 1 to 7 percent. Each year, 5000 infants are born with significant beta thalassemia[7].

According to the D.I. Khan research, out of a total of 300 referred patients, 227 (75.6%) had abnormal hemoglobin levels. Beta thalassemia major was the most prevalent hemoglobin condition, accounting for 87 (38%) cases, followed by sickle cell disease (73, 32%) and beta thalassemia trait (42, 19%). A total of 25 (11%) instances had other hemoglobin abnormalities such as intermediate beta thalassemia, sickle cell trait, sickle cell/beta thalassemia, and HbE condition[9, 10].

Thalassemia mild patients often don't need any special care. Inform patients that their illness is inherited and that doctors can confuse it with iron deficiency. Some pregnant women with the beta thalassemia trait may experience concomitant iron deficiency and severe anemia; if they do not respond to iron replacement therapies, they may need transfusional care. Chronic transfusion treatment, iron chelation, splenectomy, allogeneic hematopoietic transplantation, and supportive measures are all used to treat individuals with thalassemia major. Inducing foetal hemoglobin by medication, reversing splenomegaly with Jak2 inhibitors, improving iron metabolism with hepcidin-related drugs, and delivering the

beta-globin gene via a viral vector are a few examples of emerging treatments[11]. Thalassemia cases are frequently found in regions where cousanguineous marriages are high in ratios particularly in Khyber Pakhtunkhwa region of Pakistan. Few studies of Thalassemia minor are reported from Dera Ismail Khan region of Khyber Pakhtunkhwa. The purpose of this study was to identify the frequency and distribution of B-thalassemia minor in Dera Ismail Khan healthy blood donors from various age and gender categories.

MATERIAL AND METHOD

Study Design and duration: This cross-sectional study was conducted in duration of six months from March to August 2018.

Study Setting: A healthy blood donor visited the District Headquarter Hospital (DHQ) Dera Ismail Khan blood bank over the course of this research to donate.

Consent form: After obtaining the patient's or guardian's informed agreement. Each patient who signed up provided their informed consent, and the parents or guardians of blood donors provided their consent. After thorough discussion with the pathologist and concerned lab personnel, the DHQ Ethical Committee accepted this study as ethical.

Inclusion and Exclusion Criteria: Participants in this study were blood donors who visited the DHQ hospital in Dera Ismail Khan for donation and had hemoglobin levels that were below the normal range. Donors with abnormal hemoglobin levels and donors who refused to participate in the trial were both disqualified from the study.

Procedure: About 500 donors with hemoglobin levels below the normal range were tested for beta thalassemia minor using the hemoglobin electrophoresis method. Five (05) mL of the donor's anticoagulated blood samples were taken[12]. Before joining in this trial, donors were initially screened for hemoglobin levels[13]. 5 mL of the donor's anticoagulated blood samples were taken[12].

In an EDTA container, three ml of blood were taken. The Nihon Kohden, Tokyo company's automated haematology analyzer was used to calculate hemoglobin (HB%), mean cell volume (MCV), mean cell hematocrit (MCH), and peripheral cell count (RCCs)[14].

Blood sample was mixed with distilled water and carbon tetrachloride to create hemolysate. Wealtech's USB was used for hemoglobin electrophoresis. Adjusting the current flow in accordance with the handbook. Hemolysate was applied using a cellulose acetate strip, and various bands of Hb were seen. The results that were reported after being compared to the usual control. Review of clinical records and peripheral blood findings were considered in each instance[10].

Fetal hemoglobin, or HbF, makes up the bulk of the hemoglobin in an adult's erythrocytes at birth. A tiny quantity of HbA2 and some of the main adult hemoglobin, HbA, are also present. The main hemoglobin present at the end of the first year of life and throughout adulthood is HbA, with up to 3.5% HbA2 and less than 2% HbF.

Data analysis: All date were entered and analyzed through Statistical Package for Social Sciences version 22. Percentage and proportions were determined and data showed in table and graphs.

RESULTS

The current study was carried out between September 2015 and March 2016 at the District Head Quarter (DHQ) hospital D.I. Khan KPK blood bank. Hb electrophoresis was used to investigate 500 smears in total. 94 (18.3%) samples from these 500 patients tested positive for beta thalassemia minor, while 406 (81.2%) cases tested negative. HbA2 was elevated by more than 3.5%, RBC count by more than 5x109/L, and MCV by less than 70 fL in individuals identified as having the beta thalassemia trait. In these cases, peripheral blood films showed a microcytic hypochromic blood image with red blood cells that were shaped like targets. It's critical to distinguish between iron deficiency and beta-thalassemia minor during the regular workup of these instances. Early detection of carriers may now be achievable because of improvements in carrier diagnostics utilizing hematological indices as a beneficial tool. Red blood cell morphology is microcytic hypochromic and varies according to the degree of anemia. Anisopoikilocytosis, which is characterized by the presence of pencil-shaped red cells in peripheral blood, is also present (Table 1 & Figure 1).

Table 1: Frequency of beta thalassemia minor cases in District D.I.Khan

Parameters	Total cases	Positive cases	Negative cases	Percentage
Hb electrophoresis	500	94	406	18.3

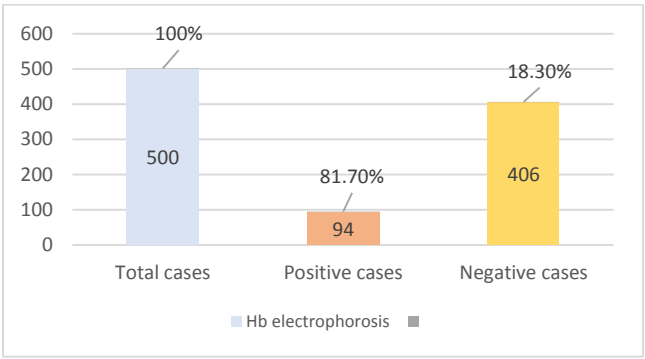

Figure 1: Frequency of beta thalassemia minor cases in District D.I.Khan

As per gender categories, a total of 79 male healthy donors were included in the current study which contributed majorly with 84.4% while 16 female healthy donors were recruited in the present study which contributed 16.9% (Table 2 and Figure 2).

Table 2: Gender-wise distribution of beta thalassemia minor in the population of district D.I.Khan

Gender	No. of Cases	Percentage
Male	79	83.1
Female	16	16.9

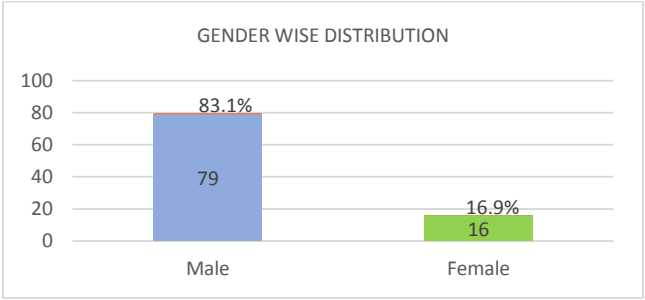

Figure 2: Gender-wise distribution of beta thalassemia minor in the population of district D.I.Khan

Table 3: Age-wise distribution of positive cases of beta thalassemia minor patients in district D.I.Khan

Age Group	No. of Patient	Percentage
18-30	69	73.4
31-40	19	20.2
41-50	5	5.3
51-60	1	1.06

Of the 94 (18.3%) positive cases, 79 (84.4%) of the subjects were men and 16 (17.2%) were females. The probable beta thalassemia minor patients were divided into four groups according to their ages. The age-wise distribution of beta thalassemia minor positive individuals showed 69 (73.4%) cases in the age range of 18 to 30 years, 19 (20.2%) in the age range of 31 to 40 years, 5 (5.3%) in the age range of 41 to 50 years, and 1 (0.06%) in the age range of 50 to 60 years (Table 3 & Figure 3).

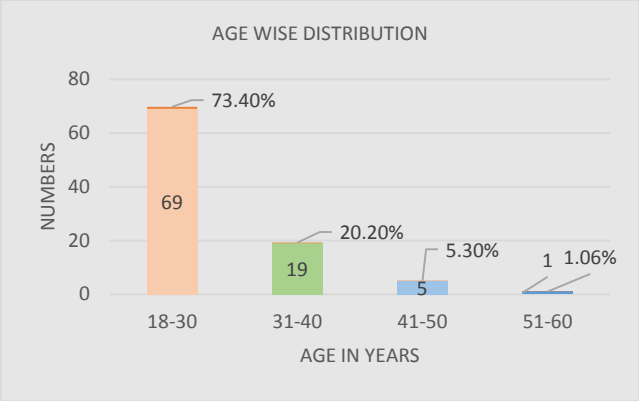

Figure 3: In district D.I. Khan MCV, the age-based distribution of beta thalassemia minor often promotes the identification of iron deficiency anemia. While the existence of target-shaped red blood cells, a red blood cell count of more than 5 million/cm3, a uniformly microcytic hypochromic blood image, limited or absent anisocytosis, and a lowered MCV suggest the diagnosis of beta thalassemia trait.

DISCUSSION

There is a great propensity in Pakistan to marry within one's tribe or family. When first cousins, especially, marry when there is a history of hemoglobinopathy in the family, homozygosity occurs. thalassemia is. It is prevalent throughout Pakistan, and 5000 or more homozygotes are born each year. Varied groups and regions of the nation have different carrier frequencies, ranging from 4.0% to 5.0%. A substantial case of beta thalassemia is present in more than 30 (%.10–14) of the family members. It is crucial to distinguish between iron deficiency and beta-thalassemia minor during regular workups of these individuals[15, 16].

Early detection of carriers may now be achievable because of improvements in carrier diagnostics utilizing hematological indices as a beneficial tool. Red blood cell count typically less than 5.0 million/cm3, aniso-poikilocytosis with the presence of pencil-shaped red cells on peripheral blood, and decreased MCV typically favor the diagnosis of iron deficiency anemia, whereas uniformly microcytic hypochromic blood picture more pronounced in comparison to hemoglobin level, minimal or no anisocytosis, and the presence of target shape red cells do not[16]. Even though hemoglobinopathies are autosomal recessive illnesses, more male patients than female patients were referred. In our study, impacted men made up 84.4% of the cases, while affected women made up 17.2%. In the 2013 D.I.Khan research, afflicted men made up 66% of the participants, while female sufferers made up 34%[10]. The cause of the majority of males over females is the same as that mentioned in our study: more health care is provided for men than for women, and in our setting, men donate the majority of the blood.

In our system, hemoglobinopathy is the most prevalent factor. The current study involved 500 willing blood donors who visited the DHQ hospital D.I. Khan Blood Bank. The majority of patients (84.4%) were men; the low number of female donors may be due to local social circumstances and medical conditions like anemia that prevent them from giving blood. The study's blood donors were women between the ages of 18 and 60 who were fertile. However, since only blood donors were included in this study (whom the law requires to be adults), the age distribution may not be a genuine reflection of the frequency of thalassemia in the general population. However, this study suggests that hemoglobinopathy is important among purportedly healthy blood donors. The most prevalent age group was 21-30 years (73.4%), followed by 31-40 years (20.2%), 41-50 years (5.3%), and 51-60 years (1.06%), which was the typical population concentration of the beta thalassemia trait in the various age groups of D.I. Khan.

500 blood donors were screened, and 94 (18%) of them tested positive for beta thalassemia minor, whereas 406 (82%) of them tested negative. This study is comparable to the Beta Thalassemia Trait Screening at People's University of Medical & Health Science (PUMHS), where a total of 521 participants were examined, with 65.4% of them being female and a male-to-female ratio of 1.8:1. These individuals were 17.5 years old on average. 26 out of a total of 521 patients tested positive for BTT, making the prevalence of BTT in this group 4.9%[17]. According to a very recent study from the department of pathology at Gomal Medical College in D.I. Khan, Pakistan, the distribution of different hemoglobinopathies was as follows: Sickle cell disease 6 (9.7%), Sickle cell trait 2 (3.2%), Sickle cell/Beta thalassemia (double heterozygosity) 2 (3.2%), and HbE/Beta Thalassemia (Double heterozygous) 1 (16.%). Beta thalassemia 28 (45.2%) received normal results from the Hb Electrophoresis test[18].

CONCLUSION

In our system, thalassemia is the most prevalent genetic condition. National screening programs are necessary to lessen the incidence of beta thalassemia major births in our neighborhood. By terminating the pregnancy in couples with beta thalassemia minor, screening for beta thalassemia minor is important to lower the incidence of beta thalassemia major. Carrier screening and public awareness are two ways to avoid beta-thalassemia. To effectively control the illness, preventive measures including pre-marriage carrier status diagnosis must be taken.

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