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Maternal Genetics, Health and Hematological Profile of Pregnant Women in Madhya Pradesh, India

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Abstract

A healthy woman is an asset for a happy and healthy family. Public health issues concerning women and their health care are: sanitation, nutrition, pregnancy, childbirth, prenatal and postnatal care. Women face high risk for susceptibility and affliction of diseases, nutrition, fetal growth and development, disabilities and even death at three critical stages of life – infancy, early childhood and reproductive phase. Pregnant women are an important segment of the society. They bear the children and provide nourishment to them during the gestation period of around nine months. The health of a mother reflects the health of a child. A cross-sectional study of pregnant women visiting for antenatal care at NSCB Medical College and Hospital, Jabalpur, in Madhya Pradesh, India was conducted during April 2013 to January 2014. Out of total 231 pregnant women studied, the prevalence of hemoglobinopathies was found to be 14.3%, with alarming 59-80% mild to severe anemia. Major hemoglobinopathies detected were: sickle cell trait (8.7%), sickle cell disease (2.6%), β-thalassemia trait (2.6%), and hemoglobin E trait (0.4%). Reduced values of hematological indices were noted in women afflicted with hemoglobin disorders than the normal controls. Low hematological indices profile does not show significant variations of these pregnant women with and without hemoglobinopathies and indicate very poor health status of pregnant women in general. A more vigorous and realistic campaign of prophylactic regime of supplementations for these pregnant women and child health care is suggested. Mandatory awareness, comprehensive clinical management, and genetic/marriage counseling are highly essential to ameliorate the sufferings of afflicted pregnant women.

Keywords: *Maternal genetic health, Pregnant women, Diet supplementation, Prophylactic regime, Bio-cultural determinants, Comprehensive clinical management, genetic counseling*

Introduction

A healthy woman is an anchor of a happy life and healthy family and is an asset to the nation. Public health issues concerning women and their health care are: sanitation, nutrition, pregnancy, childbirth, prenatal and postnatal care [1]. Women face high risk for nutrition, fetal growth and development, susceptibility and affliction of diseases, disabilities and even death at three critical stages of life – infancy, early childhood and reproductive phase [2]. Pregnant women are an important segment of the society. They bear the children and provide nourishment to them during the period of gestation for about nine months. The health of a mother reflects the health of a child [3].

Anemia in pregnancy is emerging as one of the most important causes of maternal complications, morbidity and offspring mortality in almost all the developing countries of the world [4]. Patients suffering from sickle cell disease are generally anemic and are susceptible to infections [5]. Untreated infections cause aggravation of severity of the sickle cell disease, subsequently, leading to death. Inadequate availability of oxygen to fetus also leads to abortion, miscarriage or stillbirth [4, 6]. Affected infants may present with

dactylitis, fever and overwhelming sepsis, chronic hemolytic anemia, jaundice, episodic vascular occlusive crises, hyposplenism, periodic splenic sequestration (which can be life threatening in a small child) and bone marrow sepsis [4]. The primary purpose of hemoglobinopathy screening in pregnant women is to identify the mothers and fetuses vulnerable to hemolytic anemia due to hemoglobinopathies for which early intervention has been shown to markedly reduce morbidity and mortality [3].

No study pertaining to the prevalence of hemoglobin disorders in pregnant women is available from any part of India. The state of Madhya Pradesh falls under the sickle cell belt for high prevalence of hemoglobinopathies (Average: 7.04%; Range 0-34% in Madhya Pradesh) [7]. Keeping this state of affairs in mind, this study was designed (i). To find the prevalence of sickle cell disorders (genetic burden) in pregnant women, and (ii) to determine the health status and hematological profile of pregnant women in Madhya Pradesh, India.

Materials and Methods

This is a prospective one-time cross-sectional study carried out on pregnant women, attending antenatal care check up at OPD (Out Patients Department) of Department of Gynecology and Obstetrics, NSCB Medical College & Hospital, Jabalpur, Madhya Pradesh, India during April 2013 to January 2014. The study was carried out according to the ethical guidelines for biomedical research on human subjects. Each subject was requested to provide the background information such as name, age, residential address, reproductive history (abortion, miscarriage, stillbirth, etc) if any, month of gestation, history of hospitalization if any, blood transfusion or pregnancy related complications, if any, etc.

A total of *231* intravenous (2-3 ml) blood samples were collected from a cross-section of pregnant women using disposable syringes and needles under aseptic conditions in disodium salt of Ethylene Diamine Tetra-acetic Acid (EDTA) coated vials after taking informed/written consent from each pregnant woman. Confirmed cases of sickle cell disorders/other hemoglobnopathies formed our study group, whereas, the negatives, without hematological disorders, were taken as control group. Cases suffering from other abnormalities were not referred by the doctor.

Laboratory investigations were carried out following the standardized laboratory procedures and techniques [8, 9]. Hematological parameters were studied using an automated Blood Cell Counter (Model $MS_5$9, Melet Schloesing Laboratories, Cergy-Pontoise Cedex, France). For classification of anemia, WHO Report [10] guide-lines were followed. All the carriers/affected persons were imparted genetic counseling.

Those cases with iron or folic acid deficiency, etc. were treated with supplementations by the referring doctor of NSCB Medical College & Hospital, Jabalpur.

Observations and Results

Out of a total of 231 pregnant women tested for hemoglobinopathies, 11.3% had sickle cell disorders, 2.6% were β–thalassemia trait and hemoglobin E trait each, and the overall prevalence of hemoglobinopathies were recorded to be 14.3% (Table 1).

High prevalence of severe anemia (17%) was noted in normal pregnant women as well as in different hemoglobinopathies (Table 2) cases it was still higher (26.7%) as per WHO classification.[10]

The overall prevalence of anemia was 61.5%, with a range being in between 59-80% in pregnant women of central India (Table 2).

Reduced values of hematological indices were noted in pregnant women afflicted with hemoglobin disorders than the normal controls (Table 3). Low profile of hematological indices do not show significant variations between pregnant women with and without hemoglobinopathies and indicate very poor health status in general (Table 3).

Table 1. *Prevalence of Hemoglobinopathies in Pregnant Women referred from NSCB Medical College and Hospital, Jabalpur during April 2013 to 15 January 2014*

Total Pregnant Women	Normal	Sickle Cell Trait	Sickle Cell Disease	Beta-Thalassemia Trait	Hemoglobin E Trait
231	198	20	6	6	1
Percent	85.7	8.7	2.6	2.6	0.4
Percent Prevalence of Hemoglobinopathies	-	14.3			

Table 2. *Different Grades of Anemia in Pregnant Women with and without Hemoglobinopathies*

Grades of Anemia (WHO 1989)	Normal (Control) N=198		Sickle Cell Trait N=20		Sickle Cell Disease N=6		β-Thalassemia Trait N=6		Hemoglobin E Trait N=1	
	No.	%	No.	%	No.	%	No.	%	No.	%
Severe Anemia (Hb <7.0 g/dl)	33	16.67	6	30.00	5	83.30	1	16.67	0	0.00
Moderate Anemia (Hb 7.1-10.0 g/dl)	61	30.81	7	35.00	1	16.70	1	16.67	1	100.00
Mild Anemia (Hb 10.1-11.0 g/dl)	22	11.11	3	15.00	0	0.00	1	16.66	0	0.00
Normal (Hb >11.1 g/dl)	82	41.41	4	20.00	0	0.00	3	50.00	0	0.00

Table 3. *Comparison of Hematological Indices of Pregnant Women with and without Hemoglobinopathies.*

Hematological Indices	Normal (Control) N=198		Sickle Cell Trait N=20		Sickle Cell Disease N=6		β-Thalassemia Trait N=6		Hemoglobin E Trait N=1
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean
Hb (g/dl)	9.86	2.77	8.67	2.67	4.60	1.90	10.50	3.98	8.40
RBC ($x10^3$/µl)	3.82	0.88	3.69	0.96	1.60	0.70	3.88	0.89	4.00
MCV (fl)	74.00	12.10	70.60	17.70	80.60	7.34	76.30	8.47	59.80
HCT (%)	28.50	7.00	25.50	6.95	13.00	5.40	30.32	8.82	23.90
MCH (pg)	25.80	5.29	24.08	7.21	27.50	4.15	26.10	5.98	21.10
MCHC (g/dl)	34.20	3.00	33.77	2.89	34.00	3.64	33.87	4.76	35.30
RDW (%)	13.20	7.53	13.20	2.13	12.80	1.12	13.60	0.61	16.30
WBC($x10^3$/µl)	9.42	6.89	8.89	3.62	12.00	3.20	10.20	1.40	9.50
Sickling Test	-ve		+ve		+ve		-ve		-ve
Electrophoresis (pH 8.9)	AA		AS		SS		AA_2		AE
Hb A_2/E (%)	2.42	0.36	2.52	0.30	2.40	0.13	6.02	1.31	25.00
Hb Fetal (%)	1.00	0.53	1.23	0.33	18.00	7.40	1.38	0.40	1.20

SD= *Standard Deviation*

Discussion

During pregnancy, growth of the fetus and of the uterus, and other changes taking place in the expectant mother, lead to an increase in the demand for many nutrients, especially iron and folic acid. Since most women in the under developed world start pregnancy with depleted body stores of these nutrients, their extra requirement is even higher than usual. If, because of dietary deficiencies, these needs are not met, the rate of formation of hemoglobin declines and its concentration in the circulating blood falls.

Anemia is the term used to describe the condition in which there is a reduction of the concentration of hemoglobin in the blood stream to a level (for pregnant women) below 11.0g/dl. Hemoglobin is the red pigment present in solution in the red corpuscles of the blood, and its primary function is to transport oxygen to all parts of the body. Iron, folic acid, vitamins, and trace elements are all required for the formation of hemoglobin, which takes place in the bone marrow. These substances are all ingested from food; green vegetables and such staples as potatoes and yams are important sources of folic acid, and most cereals, meat and vegetables contain iron. Under normal circumstances not all the iron ingested and absorbed daily from the small intestine is needed immediately. The excess is usually stored in the bone marrow, so that during periods of physical stress it can be used to increase the rate of formation of hemoglobin to satisfy increased needs. One such period of physical stress is pregnancy.

Another important point is that anemic women who have a low erythrocyte volume fraction (hematocrit) are much more likely to die than women with normal levels. (This is the ratio of volume of red cells to the volume of whole blood, and it is measured by centrifuging a sample of blood to separate out the components). However, a very high erythrocyte volume fraction in a pregnant woman can be dangerous too in that it may indicate a change in the composition of the blood whereby the fluid is reduced in amount but not the red blood cells. Women with eclampsia, ruptured uterus, and untreated obstructed labor are particularly prone to become short of body fluids to the extent that it affects the composition of their blood. Such women when lose blood during delivery or operation, replacement of the loss by blood transfusion may be dangerous. For such women, replacement of the fluid loss by glucose solution appears to be a safer course of action. This finding has important implications for reducing maternal mortality especially in women with major obstetric complications [11].

The early stages of anemia in pregnancy are often without symptoms. However, as the hemoglobin concentration falls, oxygen supply to vital organs reduced, and the expectant mother begins to complain of general weakness, tiredness, dizziness, and headaches. Pallor of the skin and of the mucous membranes, as well as the nail beds and tongue, becomes noticeable when the hemoglobin drops to 7 g/dl. With a further fall in hemoglobin concentration to 0.04g/dl, the most tissues of the body become starved of oxygen, and the effect is most marked on the heart muscles, which may fail altogether if there is, severe anemia. Death from anemia is the result of heart failure, shock, or infection that has taken advantage of the patient's impaired resistance to disease.

While less severe anemia may not be a direct cause of maternal death, it can contribute towards death from other causes. Anemic mothers do not tolerate blood loss to the same extent as healthy women. During child-birth, blood loss of up to one liter will not kill a healthy woman, but in a grossly anemic woman, a loss of as little as 150 ml can be fatal. Anemic women are poor anesthetic and operative risks. Anemia lowers resistance to infection and for this reason, after surgery, wounds may fail to heal promptly or may break down altogether. The higher rate of death from obstetric hemorrhage has been reported.

Treatment along with these lines takes 4 weeks or longer to restore the hemoglobin concentration to something like the normal level. Thus, the real problem arises when severe anemia is seen for the first time towards the end of the pregnancy, or during abortion or in labor, because on these occasions there is not enough time for treatment with iron, folic acid and anti-malarial drugs to correct the condition before the patient aborts or delivers. Under such circumstances, the bleeding that normally follows abortion or delivery cannot be fatal. The only way in which the low hemoglobin concentration can be raised quickly to a safe level is through blood transfusion.

Apart from nutritional deficiency of iron and folic acid, there are other causes of anemia [2]. Malaria, hemoglobinopathies, bacterial infections, and blood loss from abortion, ectopic pregnancy or intestinal parasites such as hookworms [1] are all important causes. In malaria and hemoglobinopathies, red blood corpuscles are destroyed faster than the body can replace them. In the case of bacterial infections, normal bone marrow function is suppressed so that even if the relevant nutrients are, all present in the body, their conversion to hemoglobin cannot take place until the infection is brought under control. In the course of blood loss from the causes mentioned above, red corpuscles, and hence hemoglobin, are lost. If the hemorrhage is very heavy, the hemoglobin concentration is very heavy, the hemoglobin concentration will fall and will remain low until the lost red cells are replaced.

Treatment of anemia in pregnancy often involves supplementary iron and folic acid coupled with malaria chemoprophylaxis in places where the malaria is endemic. The latter is important because the immunity to malaria built up during repeated attacks in childhood begins to break down in pregnant women at about the 14th week, for reasons that are not yet known. The process is most marked in first pregnancies. A well balanced diet also helps to correct anemia.

Iron and folic acid supplements, together with malarial chemoprophylaxis taken throughout pregnancy, have long been known to prevent severe anemia in most areas in the under developed world including in India. In addition, screening for anemia three times during pregnancy - at the first visit for prenatal care, at the 30th

week, and at the 36th week - is always worthwhile. In this way, it should be possible to identify those who fail to comply with treatment, and others who are anemic for other reasons, such as hemoglobinopathies.

Behind the medical causes of anemia, socio-economic factors play an important role [3]. The extent of poverty in developing countries largely explains why severe anemia is so common and why its effects are so serious throughout most of the underdeveloped world [5, 12-20]. About two-third of pregnant women in developing countries are estimated to be anemic, compared with 14% in developed world [15, 16]. Hardships imposed by poor nutrition, water shortage, food taboos, inadequacies in food production and storage, and absence of effective systems of social security all combine to undermine women's health and cause anemia as well as a host of other debilitating diseases. All these constitute the bio-cultural determinants and have significant contributions (bearing) in maternal health and anthropological genetics pertaining to the health and disease.

Each one of us is distinctive and unique by virtue of genome. There are 50,000 to 100,000 genes packed in 46 chromosomes. Practically, all diseases have a genetic origin. All individuals are destined to develop a disorder or disease on the basis of imprints in our genome. Surrounding environment and ecological influences determine the timing or the onset of a disease process in an individual. Advances in molecular genetics and in the latest technologies have revolutionized diagnostic and therapeutic concepts and their applications [21]. The health education strategies should focus attention on issues such as care and nutrition of a girl child, health and nutritional education, environmental sanitation, vaccination, female literacy and above all, the status of women in the society. It must be realized that mother is the best primary health worker and we must improve her knowledge, skills and attitudes in the art of mother craft. The women must be accorded special status in society, keeping in mind that they are the creators of progeny and health of mothers and children is closely interlinked. It is impossible to improve the health status of children and health of our nation, unless due attention is paid to the welfare of female children without any discrimination by the society [21-23]. The basic goal of medicine is to assist every child to achieve the optimal growth and developmental potential [22, 23].

Mandatory awareness for consumption of balanced diet, comprehensive clinical management, and genetic/marriage counseling after prenatal diagnosis are highly essential to ameliorate the sufferings of afflicted (especially pregnant) women in India.

A more vigorous and realistic campaign of prophylactic regime of supplementations for these pregnant women and child health care is suggested to ameliorate the human sufferings.

Concluding Comments

A cross-section of 231 pregnant women visiting NSCB Medical College & Hospital, Jabalpur for antenatal care check up were investigated for the incidence of hemoglobinopathies during April 2013 to 15 January 2014.

Out of total 231 pregnant women studied, the incidence of hemoglobinopathies was found high: 14.3%, and contribution of sickle cell disorders being 11.3%. Major hemoglobinopathies detected were: sickle cell trait (8.7%), sickle cell disease (2.6%), β-thalassemia trait (2.6%), and hemoglobin E trait (0.4%).

Overall anemia incidence was 61.5%, range between 59-80% in pregnant women

Reduced values of hematological indices were noted in pregnant women afflicted with hemoglobin disorders than the normal controls.

Low profile of hematological indices do not show significant variations between pregnant women with and without hemoglobinopathies and indicate very poor health status in general.

Mandatory awareness for consumption of balanced diet, comprehensive clinical management, and genetic/marriage counseling after prenatal diagnosis are highly essential to ameliorate the sufferings of afflicted (especially pregnant) women.

A more vigorous and realistic campaign of prophylactic regime of supplementations for these pregnant women and child health care is suggested.

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