PREVALENCE OF ANEMIA AND ITS RELATIONSHIP WITH ABO BLOOD GROUP SYSTEM AMONG PREGNANT WOMEN VISITING ADISHIHU PRIMARY HOSPITAL, EMBA ALAJE WEREDA, SOUTHERN TIGRAY ZONE, TIGRAY NATIONAL REGIONAL STATE, ETHIOPIA

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Prevalence of Anemia and its Relationship with ABO Blood Group System among Pregnant Women Visiting Adishihu Primary Hospital, Emba Alaje Wereda, Southern Tigray Zone, Tigray National Regional State, Ethiopia

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In Partial Fulfillment of the Requirements for the Degree of Master of Science in Biology

By

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As Thesis Research advisor, We here by certify that We have read and evaluated this Thesis prepared, under my guidance; by Asmare Berhe entitled "prevalence of anemia and its relationship with ABO blood group system among pregnant women Visiting Adishihu Primary Hospital, Emba Alaje *Wereda*, Southern Tigray Zone, Tigray Regional State, Ethiopia." I recommend that it be submitted as fulfilling the thesis requirements.

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As a member of the Board of Examiners of the M.Sc. Thesis Open Defense Examination, We certify that we have read and evaluated the Thesis prepared by Asmare Berhe and examined the candidate. We recommend that the Thesis be accepted as fulfilling the Thesis requirements for the Degree of Master of Science in Biology.

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DEDICATION

I dedicate this thesis to my parents for their love and support during my M.Sc. study.

STATEMENT OF THE AUTHOR

First, I declare that this thesis is my own work and that all sources of materials used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for M.Sc. degree at the Haramaya University. The Thesis is deposited in the Haramaya University Library to be made available to borrowers under the rules of the library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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BIOGRAPHICAL SKETCH

The author, Asmare Berhe, was born on August 24, 1985 in Tselemti *Wereda*, North Zone of Tigray Regional State, from his father Berhe Beyene and his mother Hiwet Haile. He attended his elementary education at Tsehaye Elementary School in 1999 and his secondary and preparatory school education at Shire Secondary School from 2007 to 2010. After successful completion of preparatory education, he joined Mekele University, Department of Biology, in 2011 and graduated with B.Ed. degree in Biology in July 2013.

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LIST OF ACRONYMS AND ABBRIVATIONS

HIV	Human Immunodeficiency Virus
HDN	Hemolytic Disease of the Newborn
IDA	Iron Deficiency Anemia
ISBT	International Society of Blood Transfusion
PCV	packed Cell Volume
RBCs	Red Blood Cells
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

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ABSTRACT

The frequency of ABO blood groups vary geographically, ethnically and from one population to another. Some variations may even occur within one ethnic group. Anemia is a global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development. The general objective of present study was to determine and evaluate the relationships between ABO blood type system and anemia among pregnant women visiting Adishihu Primary Hospital, Emba Alaje Wereda, Southern Tigray Zone, Tigray Regional State, Ethiopia. . A Cross-sectional study design was used to collect data from pregnant women who visited the hospital for antenatal care follow-up from January 2018 to May 2018. ABO blood typing was done using open slide methods, where a drop of blood sample from a pregnant women by sterile finger pricks and placed the blood sample on clean and dry slide and determined the types of blood groups using a drop of anti-A and anti-B. Hemoglobin concentration was tested using a HemoCue HB 201 machine. The result was read immediately after at least five minutes. Logistic regression analysis was performed to identify the predictors of anemia with their corresponding 95% CI were computed to see the strength of relationships. P < 0.05 was considered statistically significant. The majority, 170 (40.28%), of the pregnant women were within the age range of 27–36, 137 of the pregnant women, (32.23%), were within the age range of 15-26 and 115 of the pregnant women, (27.25%), were above 37 years. Pregnant women with blood type O accounts large number, which was 134 (30.7%), followed by blood type A, blood type B and blood type AB in which their percentage distribution was, 128 (30.4%), 100 (23.7%), and 60 (14.2%) respectively in an order of O > A > B > AB. One hundred seventy eight (42.2%) pregnant women were anemic, while the rest two hundred forty four (57.8%) were non-anemic. Out of the 178 anemic pregnant women, blood group A has the highest frequency and blood group O the lowest frequency in an order of A>B>AB>O (43.8,30.4,20.2 and 5.6) respectively. From the 178 anemic women 43.8 %(78) were blood type-A, of which, 10.7 %(19/178), 3.9 %(7/178) and 29.2 %(52/178) were mild, moderate and severe anemic respectively. In case of blood type-B, 15.7% (28/178), 14.1 %(25/178), and 0.6% (1/178) were mild, moderate and severe anemic respectively. For blood type-AB, also shown that, 10.1 %(18/178), 7.3 %(13/178) and 2.8 %(5/178) were mild, moderate and severe anemic respectively. For blood type-O also had 2.2 %(4/178), 2.8 %(5/178) and 0.6 %(1/178) were mild, moderate and severe anemic respectively. Of those anemic pregnant women, A blood type 78 (18.24%) were significantly related with anemia AOR= 28.03 (95% CI 14.202-70.150) at p- value < 0.001. than individuals with type O blood. Pregnant women with blood type A, B and AB are more prone to anemia. It is recommended that health centers must check the blood type of the pregnant women to administer drugs.

Key words: ABO, Anemia, Blood groups, Hospital, Pregnant women,

1. INTRODUCTION

Classification of blood into groups is based on the presence or absence of inherited antigenic substances on the surface of red blood cells (RBCs). Some of these antigens are also present on the surface of other types of cells and body secretions like saliva, sweat, semen, serum, tears, urine etc., which are used in finger print. The ABO blood group system is the most important blood group system in human blood transfusion. AB antigens (as with other serotypes) can cause an adverse immune response to organ transplantation (Muramatsu *et al*., 2014). The associated anti-A and anti-B antibodies are usually IgM antibodies, which are produced in the first years of life by sensitization to environmental substances, such as food, bacteria, and viruses. ABO blood types are also present in some other animals, for example rodents and apes, such as chimpanzees, bonobos, and gorillas (Maton *et al.,* 1993).

Several of these RBC surface antigens that stem from one allele (or very closely linked genes) collectively form a blood group system (Jaf, 2010). Blood groups are genetically determined and exhibit polymorphism in different populations. A total of 30 human blood group systems are now recognized by the International Society of Blood Transfusion (ISBT, 2008). In clinical practice, ABO and Rh blood groups are the most important among the 30 blood groups (Jaf, 2010). The classification of blood groups into type A, B, AB and O in the ABO system is based on the presence or absence of inherited antigenic substances on the surface of the red blood cells. The antigens may be proteins, carbohydrates, glycol-proteins, and glycol-lipids depending on the blood group system which are two known antigen, "A" and "B. RBCs of type ‘A’ have the ‘A’ antigen on their surface, those of type ‘B’ have antigen ‘B’, type AB red cells bear both antigens, while type O cells bear neither antigen. The distribution of these blood types is also different in different races. The frequencies of ABO blood types vary from one population to another and from time to time in the same region.

In addition to the antigens on the surfaces of the RBCs, there are also antibodies in blood plasma of individuals with different blood types: blood type-A has anti-B antibody; blood type-B has anti-A antibodies; blood type-AB has none of the anti-A or anti-B antibodies at all, and blood type-O (which does not have any of the two antigens on the surface of RBCs) has both of the anti-A and anti-B antibodies in blood plasma (Daniels, 2005). Not all blood groups are compatible with each other. Mixing incompatible blood types leads to blood clumping or agglutination, which is dangerous for individuals. For a blood transfusion to be successful, ABO blood types must be compatible between the donor blood and the recipient blood. If they are not, the RBCs from the donated blood will clump or agglutinate.

The agglutinated RBCs can clog blood vessels and stop the circulation of the blood to various parts of the body. The agglutinated RBCs also crack and its contents leak out in the body (Anstee and Tanner, 2009). The RBCs contain hemoglobin which becomes toxic when outside the cell. This can have fatal consequences for the patient. If the donor blood and the recipient blood are not compatible, the RBCs will be linked together, like bunches of grapes, by the antibodies and this clumping could lead to death (Daniels, 2005).

The ABO blood group system is widely credited to have been discovered by the Austrian scientist Karl Landsteiner, who found three different blood types in 1900 (Adhikari *et al*., 2008). He described ABO blood group for which he was awarded the Nobel Prize in 1930. Alfred Von Decastello and Adriano Sturli discovered the fourth type AB, in 1902 (Lourenco *et al*., 2004).The ABO blood group system is arguably the best known, and yet the most functionally mysterious, genetic polymorphism in humans. In clinical practice, ABO is the most important system for blood group compatibility. In the century since their discovery, ABO antigen associations with infections and other diseases have been the subject of hundreds of publications (CsertiandDzik, 2007). Frequency of ABO blood types vary worldwide and are not found in equal numbers even among different ethnic groups. Among African-Americans, ABO blood group, the frequency of type O, is 46%; type A, 27%; type B, 20%; and type AB; 7%. In Caucasians of the United States, the frequency is type O, 47%; type A, 41%; type B, 9%; type AB, 3% (Kassahun, 2014).

Also, among Western Europeans, type O, is 46%; type A, 42%; type B, 9%; and type AB, 3%. The need for studying the distribution of blood types in a blood group system is multipurpose, as besides their importance in evolution; their relation to disease and environment is being increasingly sought in modern medicine. Blood group antigens are not only important in relation to blood transfusion and organ transplantation, but also have been utilized in genetic research, anthropology and training ancestral relation of humans (Rikimaru *et al.*, 2003).

In modern medicine besides their importance in evolution, the relation of ABO group system to disease and environment is being increasingly important. For instance Blood groups are known to have some relation with diseases like duodenal ulcer, diabetes mellitus, urinary tract infection, and ABO incompatibility of newborn and recently with anemia (Megbaru *et al.,* 2014). ABO antigen relation with infections and other diseases has been the subject of hundreds of publications (CsertiandDzik, 2007). However, relations with diseases affecting humans after reproduction are not expected to exert any genetic selection. Thus, despite a large body of literature, the evolutionary basis for the origin and diversity of ABO blood group system antigens remains uncertain.

Anemia is a condition in which the number of RBCs (and consequently their oxygen-carrying capacity) is insufficient to meet the body's physiologic needs. Specific physiologic needs vary with a person's age, gender, residential elevation above sea level, smoking behavior, and different stages of pregnancy. Iron deficiency is thought to be the most common cause of anemia globally, but other nutritional deficiencies (including folate, vitamin B12 and vitamin A), acute and chronic inflammation, parasitic infections, and inherited or acquired disorders that affect hemoglobin synthesis, red blood cell production or red blood cell survival, can all cause anemia (Berhane *et al*; 2001).

The other causes of anemia include acute and chronic infections like TB and HIV and also deficiency of other vitamins and genetic defects (Allen, 2000). Anemia harm cognitive development reduces physical work capacity and in severe cases risk of mortality particularly during prenatal period. The most vulnerable to be at risk of anemia is young children and pregnant women. Anemia during pregnancy is defined as a hemoglobin concentration less than 11 g/dl and classified as mild (9.0–10.9g/dl), moderate (7-8.9g/dl) and severe <7g/ dl (WHO 2008).

Anemia can affect all age groups but the risk is higher in pregnant women because of an increased iron requirement, physiological demand, loss of blood and infections, social, cultural and economic factor and Anemia during pregnancy can result premature birth, low birth weight, fetal impairment and infant deaths (Kefiyalew *et al*., 2014; Morales-Borges, 2013). Anemia was a major public health problem, which had an effect on both developing and developed countries with major consequences for human health as well as social and economic development. It affects over 2 billion people globally and one-fifth of maternal death refers to anemia worldwide but the problem is very high and serious in children, non-pregnant women and pregnant women mainly in the developing countries of Asia and Africa (Abriham *et al.,* 2014). Although Ethiopia has different climatic conditions and grows a variety of cereals, root crops and vegetables, the dietary habit of the society is poor and depends on single staple food rather than dietary diversity and this results nutritional deficiency in pregnant women (CSA, 2011).

Anemia in pregnant women has severe consequences on health, social, and economic development which result in at risk of low physical activity, increased maternal morbidity and mortality, especially those with severe anemia. Iron deficiency anemia affects the development of the nation by decreasing the cognitive development of children and productivity of adults. Highest proportions of individuals affected by anemia are in Africa and in Ethiopia, anemia is a severe problem for both pregnant (62.7%) and non-pregnant women of child-bearing age (52.3%). Since there are no studies done on the relationships of ABO with anemia among pregnant women in the study area.

The general objective of the present study is to determine and evaluate the relationships of ABO blood groups with anemia among pregnant women visiting Adishihu Primary Hospital from January 2018-May 2018.

Specific objectives

- To determine the distribution of the ABO blood types among pregnant women visiting Adishihu Primary Hospital
- To determine the prevalence of anemia among pregnant women visiting Adishihu Primary Hospital
- To test the relationships of ABO blood group system with anemia in pregnant women visiting Adishihu Primary Hospital.

2. LITERATURE REVIEW

2.1. ABO Blood Group System

Humans contain a series of glycoproteins and glycolipids on the surface of RBCs which constitute the blood group antigens. According to the presence or absence of antigens human blood can be classified into different blood group systems, example ABO blood group, MN blood group, Rh blood group systems, etc. All blood groups in human are under genetic control, each series of blood groups being under the control of genes at a single locus or of genes that are closely linked and behave in heredity as though they were at a single locus, (Jaff, 2010). The human blood groups have been studied extensively for their involvement in incompatibility reactions. There are many blood group systems on the basis of different blood group antigens. ABO systems are important in clinical practice, (Mandal, 2002).

2.2. Discovery of ABO blood group

At the beginning of the 20th century an Austrian scientist, Karl Landsteiner, noted that the RBCs of some individuals were agglutinated by the serum from other individuals (Henrik, 2012). He made a note of the patterns of agglutination and showed that blood could be divided into groups. This marked the discovery of the first blood group system, ABO, and earned Landsteiner a Nobel Prize. Landsteiner explained that the reactions between the RBCs and serum were related to the presence of markers (antigens) on the RBCs and antibodies in the serum, (Giri, 2011). Agglutination occurred when the RBC antigens were bound by the antibodies in the serum. He called the antigens A and B, and depending upon which antigen the RBC expressed, blood either belonged to blood group A or blood group B. A third blood group contained RBCs that reacted as if they lacked the properties of A and B, and this group was later called "O" after the German word " Ohne", which means "without". The following year the fourth blood group, AB, was added to the ABO blood group system. These RBCs expressed both A and B antigens, (Avent and Reid, 2000).

In 1910, scientists proved that the RBCs antigens were inherited, and that the A and B antigens were inherited co dominantly over O. There was initially some confusion over how a person's blood type was determined, but the puzzle was solved in 1924 by Bernstein's "three allele model". The ABO blood group antigens are encoded by one genetic locus, the ABO locus, which has three alternative (allelic) forms A, B, and O (Avent and Reid, 2000).

2.3. Distribution of ABO Blood Group

As Garratty *et al*. (2000) indicated the knowledge of blood group distribution is important for clinical studies, for reliable geographical information and it will help in reducing the maternal mortality rate, as access to safe and sufficient supply of blood will help significantly in reducing the preventable deaths. The role of ABO grouping is not only in blood transfusion practice, it is also useful in population genetic studies, researching population migration patterns and resolving certain medico legal issues, particularly of disputed paternity cases. In modern medicine besides their importance in evolution, their relation to disease and environment is being increasingly important (Megbaru *et al*., 2014).

Blood group antigens plays a vital role in transfusion safety, understanding genetics, inheritance pattern, researching population migration patterns, as well as resolving certain medico-legal issues. Some blood groups can act as a receptor and ligand for bacteria, parasites and viruses (Gupta *et al*., 2004). In Ogbomosho, Oyo state Nigeria, 50% of the population are blood group O, 22.9% blood group A, 21.3% blood group B and 5.9% blood group AB (Adhikari *et al* 2008).

2.4. Clinical Significance of ABO Blood Group

2.4.1 Blood Transfusion

Blood transfusion is a commonly used form of therapy in hospital practice but it is not without its problems. Adverse reactions to blood transfusion can occur, and the most serious are associated with red cell destruction due to sensitization of red cells by antibody (Joyce Poole, 2001). Transfusion medicine is a specialized branch of hematology that is concerned with the study of blood groups, along with the work of a blood bank to provide a transfusion service for blood and other blood products. Across the world, blood products must be prescribed by a medical doctor in a similar way as medicines (Daniels *et al*., 2005).

Much of the routine work of a blood bank involves testing blood from both donors and recipients to ensure that every individual recipient is given blood that is compatible and is as safe as possible. If a unit of incompatible blood is transfused between a donor and recipient, a severe acute hemolytic reaction with hemolytic (RBC destruction), renal failure and shock is likely to occur, and death is a possibility. Antibodies can be highly active and can attack RBCs and bind components of the complement system to cause massive hemolysis of the transfused blood (Nickel *et al*., 1999). Patients should ideally receive their own blood or type-specific blood products to minimize the chance of a transfusion reaction. Risks can be further reduced by cross-matching blood, but this may be skipped when blood is required for an emergency. Cross-matching involves mixing a sample of the recipient's serum with a sample of the donor's red blood cells and checking if the mixture agglutinates, or forms clumps. If agglutination is not obvious by direct vision, blood bank technicians usually check for agglutination with a microscope. If agglutination occurs, that particular donor's blood cannot be transfused to that particular recipient (Bruce, 2002).

2.4.2. ABO Blood Group Genotyping

In addition to the current practice of serologic testing of blood types, the progress in molecular diagnostics allows the increasing use of ABO blood group genotyping. In contrast to serologic tests reporting a direct blood type phenotype, genotyping allows the prediction of a phenotype based on the knowledge of the molecular basis of the currently known antigens. This allows a more detailed determination of the blood type and therefore a better match for transfusion, which can be crucial in particular for patients with needs for many transfusions to prevent all immunization (Anstee, 2009).

2.4.3. Blood Product

A blood product is any component of the blood which is collected from a donor for use in a blood transfusion. Whole blood is uncommonly used in transfusion medicine at present; most blood products consist of specific processed components such as red blood cells, blood plasma, or platelets. Blood products may also be called blood-based products to differ from blood substitutes, which generally refer to artificially produced products. Whole blood may be classified as a blood product or as a separate entity. Also, although many blood products have the effect of volume expansion, the group is usually distinguished from volume expanders, which generally refer to artificially produced substances and are thereby within the scope of blood substitutes (Henrik *et al*., 2012).

2.5. ABO Blood Phenotypes Distribution around the World

The ABO blood group phenotypes are not found in equal numbers in different populations. For example, in Caucasians in the United States, the distribution is type O, 47%; type A, 41%; type B, 9%; and type AB, 3%. Among African American, the distribution is type O, 46%; type A, 27%; type B, 20%; and type AB; 7%. Among Western Europeans, 42% have group A, 9% group B, 3% group AB and the remaining 46% group O (Laura, 2005). Among Ethiopians, the distribution is that type O, is 42%; type A, is 30%; type B, is 22%; and type AB, is 6 %. Among Ethiopian blood donors, the frequency of type O is 40%; type A, is 31%; type B, is 23%; and type AB, is 6 % (Mgbaru, 2014).

2.6. Relationships of ABO Blood Groups with Diseases

Knowledge of blood group distribution is important for clinical studies, for reliable geographical information and it will help in reducing the maternal mortality rate, as access to safe and sufficient supply of blood will help significantly in reducing the preventable deaths. It is therefore imperative to have information on the distribution of these blood groups in any population group (Deshpande and Wadde, 2013). Effective management of blood banks and safe blood transfusion services can be augmented by the knowledge of distribution of ABO blood groups at local and regional levels (Kumarand and Kaushik, 2013). As Mohammad Ali and PourfaThollah (2014) indicated, the association of blood groups with infectious and non-infectious diseases. Among infectious disease, Human immunodeficiency virus (HIV), and Hepatitis virus are of great concern. Some blood groups can act as a receptor and ligand for bacteria, parasites and viruses. The possible pathogenesis for this susceptibility is that as many organisms that may bind to polysaccharide on cells and soluble blood group antigens may block this binding(Gupta *et al*., 2004).

2.7. Effect of Anemia on Maternal Mortality and Morbidity

The major concern about the adverse effects of anemia on pregnant women is the belief that this population is at greater risk of prenatal mortality and morbidity. Maternal mortality in selected developing countries ranges from 27 (India) to194 (Pakistan) deaths per 100,000 live births. Some data show a relationship between a higher risk of maternal mortality and severe anemia, although such data were predominantly retrospective observations of an association between maternal hemoglobin concentrations at, or close to, delivery and subsequent mortality. Such data do not prove that maternal anemia causes higher mortality because both the anemia and subsequent mortality could be caused by some other condition (Dreyfuss, 1998).

For example, in a large the maternal mortality rate for women with a hemoglobin concentration <100 g/L was 70.0/10000 deliveries compared with 19.7/10000 deliveries for non-anemic women(Kaur, 2015). The relation of maternal mortality with anemia reflected a greater extent of hemorrhage and late arrival at admission rather than the effect of a prenatal anemic condition. The cutoff for anemia was extremely low (<65 g hemoglobin/L), and the authors stated that although anemia may have contributed to mortality, it was not the sole cause of death in many of the women's (Lindsay Allen, 2000). Currently, no prospective studies have proven that anemia increases the risk of maternal mortality, and there is inadequate information established hemoglobin concentration below which the risk of mortality increases. Such a cutoff value has been suggested to be as high as 89 g/L. The increased risk of mortality would also be more plausible and predictable if the mechanisms involved were understood. It has been suggested that maternal deaths in the puer-perium may be related to a poor ability to withstand the adverse effects of excessive blood loss, an increased risk of infection, and maternal fatigue; however, these potential causes of mortality have not been evaluated systematically (Lindsay Allen, 2000)

2.8. Level of Anemia

Anemia during pregnancy is considered severe when hemoglobin concentration is less than 7.0 g/dl, moderate when hemoglobin fall between7.0–8.9g/dl and mild from 9.0-10.9g/dl Anemia during pregnancy is a major cause of morbidity and mortality of pregnant women in developing countries and has both maternal and fetal consequences. It is estimated that anemia causes more than 115,000 maternal and 591,000 prenatal deaths globally per year (Salhan *et al*., 2012).

2.8.1. Mild Anemia

Women with mild anemia in pregnancy have decreased work capacity. They may be unable to earn their livelihood if the work involves manual labor. Women with chronic mild anemia may go through pregnancy and labor without any adverse consequences, because they are well compensated (Bryant and Larsen, 2001). Mild, anemia may not have any effect on pregnancy and labor except that the mother will have low iron stores and may become moderately to- severely anemic in subsequent pregnancies (Sharma , 2003).

2.8.2. Moderate Anemia

Women with moderate anemia have substantial reduction in work capacity and may find it difficult to cope with household chores and child care. Available data from India and elsewhere indicate that maternal morbidity rates are higher in women with Hb below 8gm/dl (Sharma, 2003). They are more susceptible to infections and recovery from infections may be prolonged. Premature births are more common in women with moderate anemia. They deliver infants with lower birth weight and prenatal mortality is higher in these babies. They may not be able to bear blood loss prior to or during labor and may succumb to infections more readily. Substantial proportion of maternal deaths due to ante partum and post-partum hemorrhage, pregnancy induced hypertension and sepsis occur in women with moderate anemia (Shaikh *et al*., 2015). Moderate anemia may cause increased weakness, lack of energy, fatigue and poor work performance.

2.8.3. Severe Anemia

According to (Shaikh *et al*., (2015), three distinct stages of severe anemia have been recognized - compensated, decompensate, and that associated with circulatory failure. Cardiac de-compensation usually occurs when Hb falls below 5.0 g/dl. The cardiac output is raised even at rest, the stroke volume is larger and the heart rate is increased. Palpitation and breathlessness even at rest are symptoms of these changes. These compensatory mechanisms are inadequate to deal with the decrease in Hb levels. Oxygen lack results in anaerobic metabolism and lactic acid accumulation occurs. Eventually circulatory failure occur restricting work output. Untreated, it leads to pulmonary edema and death. A blood loss of even 200 ml in the third stage produces shock and death in these women. Even today women in the remote rural areas in India reach to the hospital only at this late decompensate stage. Available data from India indicate that maternal morbidity rates are higher in women with Hb below 8.0 g/dl. Maternal mortality rates show a steep increase when maternal Hb levels fall below 5.0 g/dl. Anemia directly causes 20 percent of maternal deaths in India and indirectly accounts for another 20 per cent of maternal deaths (New Delhi, 1989). Severe anemia, however, is associated with poor outcome. The woman may have palpitations, tachycardia, breathlessness, increased cardiac output leading on to cardiac stress which can cause de-compensation and cardiac failure which may be fatal. Increased incidence of pre-term labor (28.2%), pre-eclampsia (31.2%) and sepsis have been associated with anemia (Sharma, 2003).

2.9. Prevalence of Anemia in Ethiopia

Anemia is found to be a health problem in a study conducted in a different area of the country as well as across country. The prevalence of anemia reported in pregnant women showed variability both locally and in other countries. A study conducted in south East Ethiopia Harar showed prevalence of anemia as 27.9%, and in Gondar (23.2%). A study conducted in Mekele governmental institutional revealed lower prevalence of anemia than the previous studies done on pregnant women at ANC clinic in Shalla Worda, and in Urban Pakistan which is 19%, 36.1% and 64.4% respectively. This finding is consistent with study conducted in Gondar town and nine regional states of Ethiopia with the prevalence of 21.6% and 18% respectively. The prevalence of anemia obtained in the study conducted in north western zone of Tigray come up with similar result with other studies conducted among pregnant women attending antenatal clinics in Sidama and West Arsi with the prevalence of 31.6%, 36.1% and 36.6%, respectively. Report obtained by from north western zone of Tigray was much lower than the previous studies conducted among pregnant women attending antenatal clinics in Gode town with the prevalence of 56.8 % but higher than a study conducted in the national prevalence of anemia noted in 2011, Ethiopian Demographic and Health Survey report where the prevalence anemia among the pregnant women was found to be 22%. The literature underlines the urgency of Intervention measures to be planned and improved based on available information regarding the magnitude and severity of anemia, and associated risk factors in the geographic area that seem to fuel each other.

2.10. Factors Causing Anemia

Factors for iron deficiency anemia (IDA) include low intake of iron, poor absorption of iron from diets, high phytate or phenolic compounds or increased requirements during childhood and pregnancy. There is an increased iron requirement during pregnancy due to greater expansion in plasma volume that results in a decrease in hemoglobin level to

11g/dl. Therefore, any hemoglobin level below 11g/dl in pregnancy is considered as anemia. The consequences of anemia in pregnancy include: still-birth, low birth weight and pre-term births, reduced work capacity, decreased mental performance, low tolerance to infections, death from anemic heart failure and maternal deaths due to uncontrolled bleeding.

2.11. Socio economic Factors

Factors that put women at risk of acquiring anemia in pregnancy include family income and family size, this lead to nutrient deficiency, which is also significantly prevalent in industrialized countries. Socio economic condition of the mother and the sanitary conditions of the household among other things also significantly increased prevalence of anemia, as income decreases and family size increased the households will often purchase the lowest quality, less nutritious foods and huge suffering in health expenses because this leads to increase the risk of anemia.

2.12. Relationship of ABO Blood Group with Anemia

The hemoglobin contained in a quantity of blood accurately reflects the functional competence of the blood to supply oxygen to the tissue (Weatherall, 2000). The structural abnormality may cause premature red blood cell destruction, easily denatured hemoglobin, hemoglobin with abnormal oxygen affinity, altered solubility and in some instances reduced globin synthesis Sickle hemoglobin (HbS) differ from normal hemoglobin (HbA). When the availability of oxygen is reduced, the erythrocytes containing sickle hemoglobin change from round to sickle shaped red cells. The sickle cell homozygote (HbSS) almost always suffers anemia. The sickle cell trait (HbAS) is immune to malaria (Egesie *et al.*, 2008). As Basak and Maji (2013), reported, anemia is a global problem and at its worst in developing countries. Though oral supplementation of iron and vitamin B12 and folic acid are most commonly used as a therapeutic measure to correct anemia; it is suggested that the oral supplementation of iron is not the best way to correct anemia (especially which are not due to iron deficiency) especially due to its adverse effect on some other body functions for which the patients sufferings becomes worst. Under this situation, it is far better to take the preventive measure to combat anemia by taking iron or vitamin rich diet On the other hand, blood group is one of the important and comparatively known parameter to the large number of present population which exhibits a strong correlation with some common diseases like cardiovascular diseases, gastric cancer and even HIV infection (Abdulazeez *et a*l., 2008).

3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was conducted in Adishihu Primary Hospital, which is located in Adishihu town of Emba Alaje *Wereda*, Southern Zone, Tigray Regional State, Ethiopia; Adishihu is located at 12^{0}56' 00" N latitude and 39^{0} 30'59 " E longitudes. The *Wereda* is bordered by HintaloWejerat from the South, by Endamehoni from the North, Raya Azebo from the West, by SahartiSamre from the East. The administrative center of the *wereda*, Adishihu town, is found approximately at 697 km North of Addis Ababa, 85 km South of Mekelle, the capital of the regional state, 39km North of Maychew town (Emba Alaje Planning and Development Bureau report, 2016, unpublished). The district has altitudinal variation ranging from 1850 to 3250 meters above sea level (Fig.1)

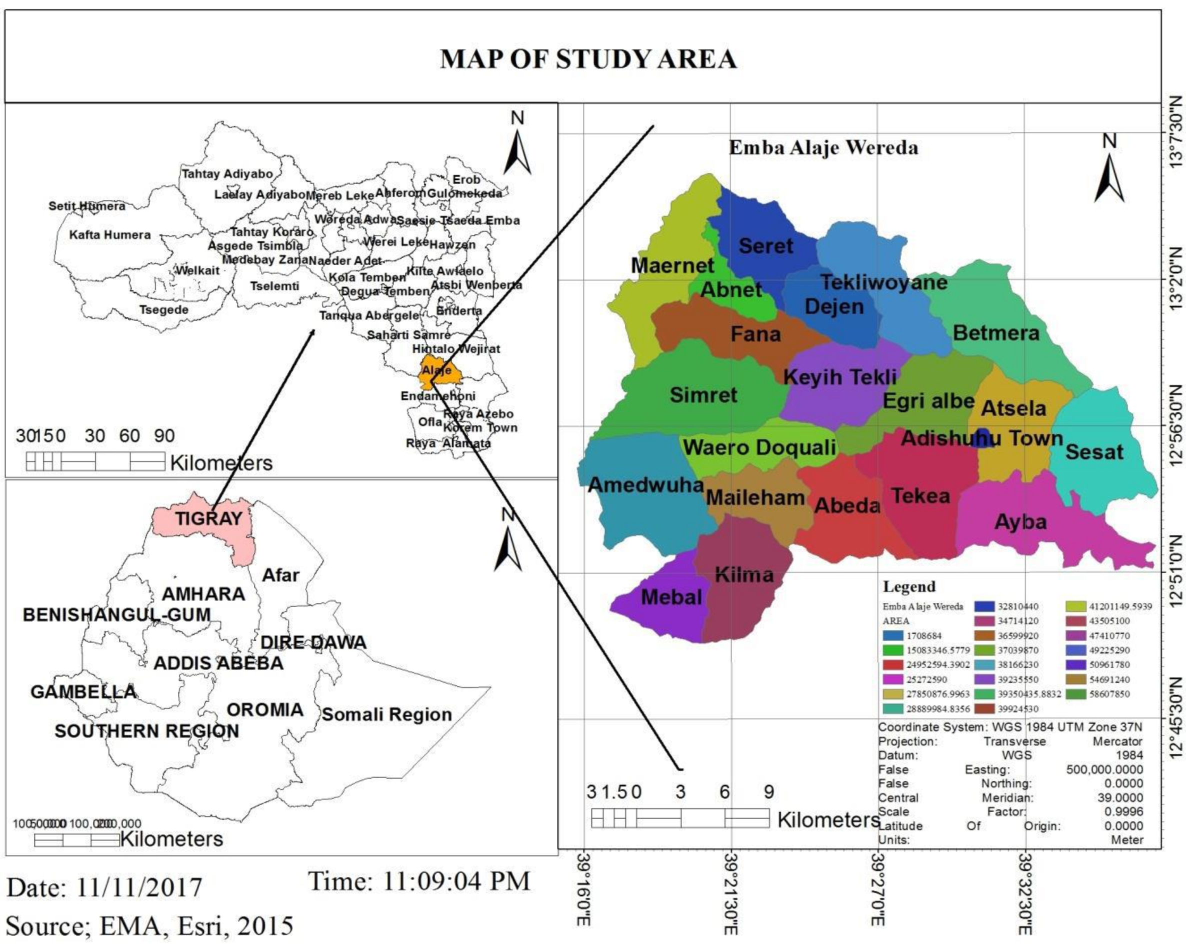

Figure 1: Map of Emba Alaje Wereda

Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA, 2007), the *wereda* has a total population of 107.972 of which 52,844 are men and 55,128 women and 7.01% are urban inhabitants.

The majority of the inhabitants said they practiced Ethiopia Orthodox Christanity, with 99.68% reporting that as their religion. The two largest ethnic groups reported in Alaje were the Tigryan (98.18%) and the AgawKamyr (1.4%), all other ethnic groups made up to 0.42% of the population. Tigrigna was spoken as a first language by 98.78% and 0.96% spoke Kamyr, the remaining 0.26% spoke all other primary languages reported. The *Wereda* has 21 health posts, four health centers (Bora, Della, Betmera and Tekea Health Centers) and one primary hospital, Adishihu Primary Hospital. According to statistical information obtained from the primary hospital data a number of pregnant women visiting daily from within the town as well as from the nearby *Wereda*. For instance, in 2016 and 2017 about 1214 and 1246 pregnant women visited the hospital per year respectively (Adishihu Primary Hospital unpublished, 2017).

3.2. Study Design

In this study, a health center based-cross-sectional study was used to assess the prevalence of anemia and ABO blood types and to evaluate the relationship between the two traits in pregnant women who visited Adishihu Primary Hospital for antenatal care follow-up during the months of January 2018-May 2018.

3.3. Study Population

The study population was the number of pregnant women who visited the hospital for antenatal care during the study period.

3.4. Sample Size and Sampling Technique

The required sample size (n) was determined using one population proportion formula at a confidence level of 95%, value of a standard normal distribution score using 0.05 level of significance d = 0.05, degree of accuracy desired according to the following formula (Naing *et al*., 2004).

$$n = \frac{z^2 p(1-p)}{d^2}$$

Where, n= sample size; d=marginal error between sample and the population; here a value of 0.05 is taken; z= 95% confidence interval which is ±1.96 (i.e. at 0.05 significance level); and p=prevalence rate (50%) Since the overall prevalence rate (P) anemia is not known for the study area, the prevalence rate was taken to be 50%.The formula gives a sample size (n) of 384 individuals. However, assuming that there were attritions, a 10% contingency was considered making the total sample size to be about 422.Volunteer pregnant women visiting the hospital were the study participants, i.e. purposive sampling was used until the required sample size is filled. Study participants were selected based on the inclusion and exclusion criteria.

3.5 Data Collection Methods

In the study the following data were collected from each study participant and analyzed: ABO blood type was determined and hemoglobin level was measured to determine their anemia status.

3.5.1. Collection of Blood Sample

With all aseptic precautions, 2ml of blood was collected from finger pricks by qualified medical laboratory technicians, using the standard clinical procedure with syringes, 1 ml portion of the blood were used for determination of hemoglobin concentration, and the remaining 1ml portion of the blood was used for the determination of ABO blood type (Ghai, 2007).

3.5.2. Determination of Hemoglobin Concentration

The blood sample collected from the participants by laboratory technician using disposable syringes and the blood sample was added into a cuvet and placed in a HemoCue HB 201 machine. The result was read immediately after at least 5 minutes and finally the result was displayed after 15-30 seconds. Hemoglobin concentration was read in g/dl. According to World Health Organization guidelines anemia was then defined as Hgb<11 g/dl in pregnant women and <12 g/dl for non-pregnant women (WHO, 2002).

3.5.3. ABO Blood Type Determination

The ABO blood type of each participant was determined using the slide testing Method. A drop of blood was placed on each of two spots on a clean, dry microscopic glass slide. A drop of anti-A, anti-B was added to the first and the second blood spots respectively and mixed with a clean glass rod.

3.6. Data Analysis Method

The data was entered into Microsoft Excel and then imported into a Statistical Package known as SPSS version 20.0 for analyses. Frequencies of ABO blood types and of anemia were expressed both as fraction and percentages. Chi-square ($\chi 2$) test was used test relationships between anemia status and ABO blood group system and a p value < 0.05 was regarded as statistically significant (Prakash Sah *et al.*, 2013).

3.7. Ethical Consideration

Ethical approval was obtained from Adishihu Primary Hospital after getting a letter of support from School of Biological Sciences and Biotechnology, Haramaya University. Before data collection the solicitation to participate letter was submitted to the administration of the hospital. The aim of the study was explained to each study participant and participation was on voluntary basis after signing a consent form (attach as appendix). The information obtained from the study participants were kept strictly confidential and they were assured that only aggregate data was to be report.

4. RESULTS AND DISCUSSION

4.1. Age of Pregnant Women

A total of 422 pregnant women participated in the study, yielding the response rate of 100%. The majority, 170 (40.28%), of the participants were within the age range of 27–36, 137 of the participants (32.47%), were within the age range of 15-26 and 115 (27.25%) were, within the age range of above 37 years as shown in Table 1.

Table 1: The age distribution of the study participants in the present study at Adishihu Primary Hospital (n=422)

Age	Number	%
15-26	137	**32.47%**
27-36	170	**40.28%**
≥ 37	115	**27.25%**
Total	**422**	**100.00**

Table1 indicates that the participants age from 27-36 were accounts the highest percentage (40.28%) and followed by pregnant women's aged 15-26 in which their percentage was 32.47% and lastly women's aged above 36 were 27.25%.

Women's aged 25-39 years had that the age category is fertility intensive in women's life. According EDHS, 2005, approximately 60% of all births occurred in this age category (ORC Macro and CSA, 2006). Studies conducted so far reported various patterns of association between age and of anemia. Studies in Ethiopia (Umeta *et al*., 2008) and Tanzania (Hinderaker*et al*., 2001), reported higher prevalence in older age groups. A study in Mexico documented higher prevalence in the 20-29(57.32%) of age than the younger or older age categories (Monárrez-Espino and Martínez, 2001).

4.2. Distribution of ABO Blood Types

The ABO blood type distribution of the study participants (n=422) is presented in Table 2.

Table 2: Distribution of ABO blood types among the study participants (n= 422).

Blood group	**No of pregnant women**	**(%)**
A	128	**30.4%**
B	100	**23.7%**
AB	60	**14.2%**
O	134	**31.7%**
Total	**422**	**100%**

From the total number of 422 pregnant women that took part in this study in Adishihu Primary Hospital blood type-O accounts large number, which was 134(31.7%), followed by blood type-A, blood type-B and blood type-AB in which their percentage distribution was, 128 (20.4%), 100(23.7%), and 60(14.22%) respectively in an order of O > A> B > AB. The result of the present finding agreed with similar study on pregnant women was reported from Mekelle University with a result of blood types-O > A > B >AB which was 41.5% > 28% > 25% > 5.5%, (Megbaru *et al*., 2014), respectively in their order. Among the African Americans the distribution is group O 46%, group A 27%, group B 20% and group AB 7% by Scholl and Hedinger, (1994) which was agreed with this present study. In the Caucasians living in the United States, the distribution of ABO blood group is O (47%), blood group A (41%), and blood group B (9%) and blood group AB (3%). On the other hand the finding of the present findings seem to be deviated from the results obtained by Khan and his colleagues on the phenotype frequency occurred from Bannu region in Pakistan where the ABO blood group frequency the order of B > A > O > AB, where their percentage frequency were 37.8% > 34.8% > 29.10% > 10.58 (Khan et al, 2009) respectively.

4.3. Distribution of ABO Blood Types and Anemia

Table 3 presents the distribution of ABO blood types for anemic and non-anemic pregnant women in the present study was in a pattern of 42.2 %(178/422) and 57.8 % (244/422). From the finding blood group type-A has the highest frequency whereas blood type-O has lower frequency among the anemic pregnant women in an order of A, B, AB, and O (43.8%, 30.4%, 20.2%and 5.6%) respectively. So that blood type-O is the most prevalent while blood type-A is more acceptable to anemia. From none anemic woman blood type-O the most dominant blood type whereas blood type-AB the least frequent blood type from the participants in the study, 50.8%, 20.3%. 18.5%, 9.8%, O, A, B & AB, respectively.

A total of 422 study participants that visited the hospital during the study period and from those 42.2% (178/422) were anemic pregnant women, whereas the remaining 57.8 % (244/422) were non-anemic pregnant as indicated in Table3. This indicates that the number of anemic pregnant women was lower than the non-anemic pregnant women but it is high prevalence of anemia in the study area. With reference to the WHO (2008), the magnitude indicates moderate public health significance of anemia is in Ethiopia. A recent study by Umeta *et al*., (2008), also documented a comparable prevalence of anemia.

Table 3: Distribution of ABO Blood types and Anemia among in this study (n=422).

		Blood group				**Total**
		A	**B**	**AB**	**O**	
Anemic	Count	78	54	36	10	178
	%within anemia	43.8%	30.4%	20.2%	5.6%	100.0%
	% with Total Blood group	18.5%	12.8%	8.5%	2.4%	42.2%
Non-anemic	Count	50	46	24	124	244
	%within Non-anemia	20.3%	18.5%	9.8%	50.8%	100.0%
	%within total Blood group	11.8%	10.9%	5.6%	29.4%	57.8%
Total		128	100	60	134	422
	% of Total	**30.4%**	**27.7%**	**14.2%**	**31.7%**	**100.0%**

Anemia during adolescence severely impairs the physical and mental development; weakens behavioral and cognitive development; reduces physical fitness; decreases the work performance and even contributes to the adverse pregnancy outcomes (Megbaru *et al*., 2014).The overall distribution of anemia in pregnant women visiting the study area was found to be one hundred seventy eight (42.2%) pregnant women's were anemic, while the rest two hundred forty four (57.8%) was non-anemic. It has also been reported that, the prevalence of Anemia in pregnant women in several studies which was consistent with the present study conducted in Arba Minch town, GamoGofa Zone (32%), (Dim *et al*., 2007:Siteti *et al*.,2014) and (Alemayehu *et al*., 2015) respectively as well as in Nigeria (40.4%) in Kakamega (Kenya) 40%. The present study was slightly higher than the studies reported in North Western Zone of Tigray, by Abel and Afework, (2015), which was found that 36.1% of the pregnant women and the study results reported from Arsi zone Oromia Regional state reported from Jimma University Specialized Hospital which was 36.6% and 38.2%, (Niguse Obse *et al*., 2013) and (Belachew Tesfaye *et al.*, 2006) respectively.

The result of the present finding was much higher than the findings reported from Hawassa Health Center (15.1%) by Sulban et al., (2003) as well as those reported from rural Southern Ethiopia (29%) by Hamze and Rebecca, (2009). Reports about the prevalence of anemia in pregnant women from Trinidad and Tobago (20.9%) by Nwachi et al.,(2010), in Iran 4.7% by Mirzaie et al., (2009) and in addition findings from Gondar (21.6%), by Alem et al., (2013), and from Nigeria (23.2%), by Buseri et al., (2008), respectively. The higher prevalence of anemia in the present study than previous reports in different area of the world may be due to the differences in dietary habits of study participants as well as may be due to a difference in socio-economic and educational difference of the study populations.

The result of the present study is much lower than the similar studies reported from Jima where the prevalence of anemia in pregnant women was (57%), reported by Desalegn (1993). The prevalence of anemia in pregnant women from Peru was (50%) as indicated by Zavaleta et al., (1993). According to Xing et al., (2009) in highlands of Tibet (China), the prevalence of anemia in pregnant women was (70%). According to WHO (1993-2005), most of the pregnant women of developing countries 35-75 % were anemic.

4.4 Age Distribution among Anemic Pregnant women

A total of 178 anemic pregnant women were detected from the 422 study participants that visited Adishihu Primary Hospital during the study period. The age and blood group distribution of anemic pregnant women are presented in Table 4 below blood type A pregnant women, 52.6% (41/78) were aged ≥37 year old which is the highest followed by women 29.5% (23/78) aged from 27-36, and women aged 15-26, 17.9 % (14/78).

From the 54 blood type B pregnant women, 46.3% (25/54) were aged ≥ 37 years old which is higher, followed by women aged 15-26, 29.6% (16/54) and women aged from 27-36, 24.1% (13/54). For AB blood type, from the 36 pregnant women, women 55.6% (20/36) aged ≥ 37 which is the highest followed by women aged from 27-36, 33.3% (12/36) and women aged 15- 26, 11.1% (4/36) and for O blood type, from the 10 pregnant women, women aged ≥ 37 60% (6/10) followed by women aged 27-36 20% (2/10) and the aged 15-26 20% (2/10). Out of the 178 anemic pregnant women in Table

4, pregnant women with blood group A had the highest frequency whereas blood group O which is much lower frequency distribution in an order of percentage frequency is A > B > AB > O (43.8, 30.3, 20.2 and5.7) respectively. Of the 178 anemic pregnant, women aged ≥ 37 years old had the highest frequency and women aged from 15-26 were lower frequency in percentage order of 51.7, 28.1 and 20.2 (≥ 37, 27-36 and 15-26) respectively.

Table 4: Age and ABO blood group distribution among anemic pregnant women (n=178)

Blood group	**15-26**	**27-36**	**>37**	**Total %**
A	14	23	41	78 (43.8)
B	16	13	25	54 (30.3)
AB	4	12	20	36 (20.2)
O	2	2	6	10 (5.7)
Total	36(20.2%)	50(28.1%)	92(51.7%)	178 (100%)

From the result blood group A has the highest frequency whereas blood group O has lower frequency among the anemic pregnant women in an order of A, B , AB , and O (43.8, 30.4, 20.2 and 5.6) respectively. So that blood group O is the most prevalent while blood group A is more acceptable to anemia than none-A blood group.

According EDHS, (2005), women aged 25-39 years had the highest risk of anemia. This might be due to the fact that the age category is fertility intensive in women life. Approximately 60% of all births occurred in this age category (Macro and CSA, 2006). Studies conducted so far reported various patterns of relationship between age and of anemia. Studies in Ethiopia (Umeta et al., 2008) and in Tanzania (Hinderaker *et al*., 2001), reported higher prevalence in older age groups. A study in Mexico documented higher prevalence in the 20-29(57.32%) of age than the younger or older age categories (Monárrez and Martínez, 2001) which is in contrast to the present studies.

4.5. Level of Anemia among Anemic Pregnant Women

Table 5 below shows that, of the total 178 anemic pregnant women that their hemoglobin value <11g/dl, based on that for blood group A, 29.2% (52/178), 10.7% (19/178) and 3.9 % (7/178) were severe, mild and moderate anemic respectively. In case of blood group B, 15.7% (28/178), 14.1 % (25/178), and 0.6% (1/178) were mild, moderate and severe anemic respectively. For blood group AB also shown that, 10.1% (18/178), 7.3% (13/178) and 2.8% (5/178) were mild, moderate and severe anemic respectively. For blood group O also shown that 2.8% (5/178), 2.2% (4/178) and 0.6% (1/178) were moderate, mild and severe anemic respectively were observed. In the result of the present study, blood group B was the higher frequency in mild and in moderate were as blood group A was higher in severe.

The result shows blow from the blood group B 15.7% (28/178) has slightly more mild anemic pregnant women followed by blood groups A 10.7% (19/178), AB 10.1% (18/178) and O 2.2% (4/178) in an order of B > A > AB > O. Regarding the moderate anemia, blood group B 14.1%(25/178) show more moderate anemic pregnant women followed by blood groups AB 7.3% (13/178), A 3.9% (7/178) and O 2.8% (5/178) in an order of B>A>AB>O. Regarding the severity of anemia blood group A 29.2% (52/178)) had more severe anemia followed by blood groups AB 2.8% (5/178), B 0.6% (1/178), and blood group O has the same value with blood group B, 0.6% (1/178) in an order of A > AB > B and O respectively.

Table 5: level of anemia among ABO blood group of anemic pregnant women (n=178)

Blood group	**Level of anemic**			**Total**
	Mild% 9-10g/dl	**Moderate %7-8.9g/dl**	**Severe% <7g/dl**	
A	19(10.7)	7**(**3.9**)**	52(29.2)	78(43.8%)
B	28(15.7)	25(14.1)	1(0.6)	54(30.4%)
AB	18(10.1)	13(7.3)	5(2.8)	36(20.2%)
O	4(2.2)	5(2.8)	1(0.6)	10(5.6%)
Total	69(38.%	50(28.1%)	59(33.2%	178(100%

The result of the present finding indicates mild anemia was higher for blood group B and A with percentage of (15.7%) and (10.7%), respectively, followed by severe anemia blood group A and AB with percentage (29.2%) and (2.8%), and moderate anemia blood group B and AB with percentage 14.1%) and 7.3% respectively. Whereas moderate anemia was lower than severe and mild anemia with the percentage of 69 (38.7%), 59 (33.2%) and 50 (28.1%), respectively.

Generally, from the 178 anemic pregnant women 69 (38.7%), were mild anemia (Hb=9-10.9 g/dl), 59 (33.2%) were severe (Hb= < 7g/dl) anemia and 50 (28.1%) were moderate (Hb=7-8.9g/dl anemia. This shows that from the total of anemic pregnant women there were slightly more mild anemic pregnant women and very low moderate anemic pregnant women in the study area.

4.6. Relationships of ABO Blood Group System with Anemia

In this study the relationship of ABO blood group system and anemia status was analyzed among the participant pregnant women. It was found out that blood type A individuals are more susceptible to anemia than the other blood types: the frequency of anemia in the four blood types are, type A (43.8%), B (30.4%), AB (20.2%) and O (5.6%).

In this study, significant relationship was observed among blood type A with anemia. Of those anemic pregnant women, A blood type 78 (18.24%) were significantly related with anemia Ajusted odd ratio (AOR) = 28.03 (95% CI 14.202-70.150) at p- value < 0.001 than individuals with type O blood as shown in Table 6. This finding was agreed with a previous study conducted by Megbaru *et al*. (2014) at Mekelle were the relation of ABO blood group and Hemoglobin level among pregnant women.

Similar findings were seen in the study conducted by Kaur (2015) in which individuals according to blood groups and their relationship to anemiat was found more frequent in blood type B (41.2%) followed by blood type-AB (40.0%), A (33.3%) and least in the blood type-O (25.8%) which was not statistically significant. So, the regular intake of iron and vitamin rich diet in individuals having blood groups A, B, and AB can prevent the occurrence of anemia (Harvey, 2004).

Table 6: Relationships of ABO and anemia among anemic pregnant women

Blood system	Anemia condition		AOR	(95 %CI)	p- value
	Anemic	Non anemic			
A	78(43.8)	50(20.3)	28.03	(14.202-70.150)	0.000
B	54(30.4)	46(18.5)	16.33	(9.765-58.901)	0.844
AB	36(20.2)	24(9.8)	16.39	(6.701-64.303)	0.575
O	10(5.6)	124(50.8)	1.000	(0.0547-1.637)	0.906
Total	**178(42.2)**	**244(57.8)**			

5. SUMMARY, CONCLUSION AND RECOMMENDATION

5.1. Summary

The research was conducted in Adishihu Primary Hospital, Adishihu town of Emba Alaje *Wereda*, Tigray Regional State Ethiopia. The researcher had aimed at providing information on the relationship of ABO, group and anemia among individuals of pregnant women visited the Adishihu Primary Hospital, with a view of contributing to existing knowledge on the subject matter.

A 422 of pregnant women that visited the Primary Hospital were selected and cross sectional study design was used. Blood samples were collected from each pregnant woman from finger pricks by qualified medical laboratory technicians, using the standard clinical procedure, with disposable syringes from January to May 2018. ABO blood types was carried out using ant-sera (anti-A and ante-B) blood grouping reagents and hemoglobin concentration was determined (using blood sample was added to the in a cuvet and placed in a HemoCue HB 201 machine. The result was read immediately after at least 5 minutes and finally the result was displayed after 15-30 seconds.

The frequencies of ABO blood system among pregnant women were blood type O was the most predominant, AB blood group is the least frequency in the general sample of pregnant women in the study area with the percentage distribution was in order of O, A, B and AB (31.7, 30.4, 23.7 and 14.2%) respectively in Table2. Among the pregnant women is the lowest frequency in the Table3, 57.8% were non-anemic, whereas 42.2% were anemic from the total participants Table 4. From the anemic pregnant women blood group B 40.6% has slightly more mild anemic pregnant women followed by blood groups A 10.7%,AB 10.1% and O 2.2% in an order of B, A, AB, O. Regarding the moderate anemia, blood group B 14.1% show more moderate anemic pregnant women followed by blood groups AB 7.3%,A 3.9% and O 2.8% in an order of B, AB,A, O. Regarding the severity of anemia blood group A 29.2% had more severe anemia followed by blood groups AB 2.8%, B 0.6% and blood group O has the same value with blood group B 0.6% in an order of A, AB, B&O, respectively in Table 5.

result of the present finding indicates mild anemia was higher for blood group B and A with percentage of 15.7% and 10.7% respectively, followed by severe anemia blood group A and AB with percentage 29.2% and 2.8%, and moderate anemia blood group B and AB with percentage 14.1% and 7.3%, respectively, whereas mild anemia was higher than severe and moderate anemia with the percentage of 38.7%, 33.2% and 28.1%, respectively Table 5.

According to the result of this study, pregnant women having A blood group were more likely relationship with anemia than others whose blood group were B, AB, O Participants having A blood group were significantly related with anemia AOR= 28.03(95% CI (14.202-70.150) at p- value < 0.001 in Table 6. The study reveals that there is a relationship between ABO blood group and anemia. But statistical analysis showed that there is significant difference between the frequency distribution of anemic pregnant women and frequency distribution of non-anemic pregnant women or no significance association of blood group and anemia. The reason for the non-significance was due to small sample size of anemic pregnant women and pregnant women in general.

5.2. Conclusions

It can be concluded that Blood type O found with the highest distribution than blood type A, blood type B, whereas blood type AB was the least frequency among the pregnant women. The prevalence of anemia among the pregnant women was 42.2% from the participants. There is a relationship between blood group with anemia, among pregnant women blood type A, B and AB are comparatively more prone to be anemic, whereas the individuals has blood type O are resistant to anemia. So that regular intake of iron and vitamin rich diet in individuals having blood groups A, B, and AB can prevent the occurrence of anemia.

5.3. Recommendations

From the research findings the following recommendations were drawn.

- The data generated in this study would be helpful as a base for researchers who are interested to conduct further study about the relationships between ABO blood types and other diseases
- The *Wereda* administration health office and health facilities including health extension workers need to emphasize on continuing to strengthen intervention strategies to decrease the risk of anemia among pregnant women.
- Pregnant women with blood group A, B and AB are more prone to anemia it is recommended that health centers must check the blood type of the pregnant women to administer drugs.
- Regular intake of vitamin rich diet in individuals having blood type A, B, and AB can prevent the occurrence of anemia by knowing their blood and use correct nutritional system.

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7. APPENDICES

Appendix: Raw data of ABO blood group and Hemoglobin level of pregnant women

Sample code	Age Level	ABO blood type	Hemoglobin level g/dl	Anemic Group
1	30	O	13.3	Non anemic
2	28	A	12	Non anemic
3	25	O	8.6	Moderate
4	40	AB	8.6	Moderate
5	38	AB	7.9	Moderate
6	20	A	6.1	Severe
7	37	A	6.6	Severe
8	28	AB	8.4	Moderate
9	40	B	8.4	Moderate
10	27	A	6.9	Severe
11	35	A	6.4	Severe
12	28	O	12	Non anemic
13	24	B	8.4	Moderate
14	32	AB	6.9	Severe
15	36	A	6.2	Severe
16	25	O	12	Non anemic
17	27	A	6.6	Severe
18	27	AB	12.4	Non anemic
19	33	O	8.7	Moderate
20	37	A	6.9	Severe
21	39	A	6.3	Severe
22	26	O	8.6	Moderate
23	28	B	8.7	Moderate
24	19	B	11.4	Non anemic
25	29	A	10.5	Mild
26	24	O	11	Non anemic
27	30	B	12	Non anemic
28	29	O	13	Non anemic
29	25	AB	8.8	Moderate
30	18	O	11	Non anemic
31	41	A	6.7	Severe
32	30	O	11.4	non anemic
33	22	B	7.5	Moderate
34	34	AB	6.4	Severe
35	27	O	11.9	Non anemic

36	20	A	6.9	Severe
37	19	B	12	Non anemic
38	27	O	12.4	Non anemic
39	23	A	8.7	Moderate
40	28	A	10	Mild
41	31	O	13	Non anemic
42	41	A	6	Severe
43	29	AB	12.6	Non anemic
44	37	O	8.8	Moderate
45	18	B	11.3	Non anemic
46	41	AB	8	Moderate
47	25	O	13	Non anemic
48	34	A	10	Mild
49	39	B	8.5	Moderate
50	27	AB	12	Non anemic
51	28	A	10.9	Mild
52	22	A	6	Severe
53	28	B	8.8	Moderate
54	39	B	8.9	Moderate
55	31	A	6.8	Severe
56	29	B	12	Non anemic
57	37	AB	6.4	Severe
58	30	O	12.3	Non anemic
59	25	B	12	Non anemic
60	29	AB	8.6	Moderate
61	27	A	10.5	Mild
62	23	O	12	Non anemic
63	27	AB	11.9	Non anemic
64	33	O	12.2	Non anemic
65	37	A	9	Mild
66	35	A	12	Non anemic
67	30	A	10.9	Mild
68	38	B	12.2	Non anemic
69	19	O	11.6	Non anemic
70	44	B	6.9	Severe
71	27	AB	13	Non anemic
72	25	A	6.9	Severe
73	38	B	7.9	Moderate
74	18	A	12	Non anemic

75	31	AB	6.9	Severe
76	37	O	12.2	Non anemic
77	26	B	11.4	Non anemic
78	42	A	6.5	Severe
79	36	O	11.6	Non anemic
80	29	AB	9.7	Mild
81	30	O	12	Non anemic
82	31	A	6.8	Severe
83	37	A	6.9	Severe
84	37	A	6.6	Severe
85	20	O	12	Non anemic
86	34	AB	13	Non anemic
87	28	O	12.4	Non anemic
88	18	A	7	Moderate
89	27	B	8.7	Moderate
90	15	O	7.9	Moderate
91	40	A	6.6	Severe
92	29	O	12	Non anemic
93	26	B	11.6	Non anemic
94	19	O	13	Non anemic
95	28	B	13	Non anemic
96	34	A	6.2	Severe
97	37	O	11.9	Non anemic
98	38	A	9.2	Mild
99	27	B	10	Mild
100	24	A	13	Non anemic
101	38	A	9.5	Mild
102	27	O	13	Non anemic
103	18	A	7	Moderate
104	30	O	12.3	Non anemic
105	37	A	10.9	Mild
106	28	AB	8.5	Moderate
107	41	B	8.9	Moderate
108	27	A	6.7	Severe
109	25	O	13	Non anemic
110	37	AB	12.2	Non anemic
111	19	A	11.9	Non anemic
112	39	O	10	Mild
113	17	AB	8.6	Moderate

114	29	B	10	Mild
115	32	A	11.9	Non anemic
116	37	B	10.6	Mild
117	17	B	7.8	Moderate
118	27	AB	12	Non anemic
119	22	B	11.3	Non anemic
120	28	B	12	Non anemic
121	25	A	6.9	Severe
122	30	B	12.6	Non anemic
123	27	A	10	Mild
124	38	O	11.4	Non anemic
125	37	AB	12.3	Non anemic
126	28	O	12.4	Non anemic
127	34	A	9	Mild
128	20	A	13.5	Non anemic
129	40	O	9.9	Mild
130	27	AB	12	Non anemic
131	22	B	12.2	Non anemic
132	39	A	8.9	Moderate
133	29	O	12	Non anemic
134	39	O	11.7	Non anemic
135	25	A	11.5	Non anemic
136	27	AB	12	Non anemic
137	40	B	9.9	Mild
138	19	O	13	Non anemic
139	29	A	12.4	Non anemic
140	30	AB	13	Non anemic
141	32	B	11.4	Non anemic
142	26	A	12	Non anemic
143	29	B	8.6	Moderate
144	24	B	10	Mild
145	28	O	12	Non anemic
146	39	O	12.1	Non anemic
147	19	A	12.5	Non anemic
148	27	A	11.4	Non anemic
149	21	O	13	Non anemic
150	25	B	12	Non anemic
151	15	O	11.9	Non anemic
152	28	AB	8.7	Moderate

153	39	A	6.9	Severe
154	27	O	13	Non anemic
155	20	B	9	Mild
156	37	AB	11.5	Non anemic
157	38	AB	10.3	Mild
158	22	A	13	Non anemic
159	29	B	12.6	Non anemic
160	20	O	12	Non anemic
161	27	A	10.9	Severe
162	39	B	7.9	Moderate
163	28	AB	11.9	Non anemic
164	33	AB	12	Non anemic
165	19	O	12	Non anemic
166	17	A	10.1	Mild
167	21	O	13	Non anemic
168	37	B	10.2	Mild
169	25	A	12	Non anemic
170	29	B	10	Mild
171	23	O	11.6	Non anemic
172	34	A	9	Mild
173	38	O	10	Mild
174	30	B	9.9	Mild
175	21	A	12.1	Non anemic
176	28	O	13	Non anemic
177	37	B	8.8	Moderate
178	22	O	12	Non anemic
179	28	A	6	Severe
180	20	O	13.9	Non anemic
181	31	O	12.6	Non anemic
182	19	O	13	Non anemic
183	37	AB	10.6	Mild
184	26	B	13	Non anemic
185	29	B	12	Non anemic
186	25	A	6	Severe
187	17	O	12.3	Non anemic
188	37	B	11.9	Non anemic
189	23	B	10	Mild
190	28	A	8.3	Moderate
191	27	A	13	Non anemic

192	37	A	6.7	Severe
193	20	B	7	Moderate
194	23	O	11.6	Non anemic
195	28	AB	12	Non anemic
196	39	B	8.9	Moderate
197	21	A	12	Non anemic
198	25	A	12.3	Non anemic
199	28	O	12.6	Non anemic
200	38	AB	10	Mild
201	21	A	12.2	Non anemic
202	27	O	11.7	Non anemic
203	17	B	8	Moderate
204	30	O	12	Non anemic
205	29	A	6.7	Severe
206	20	O	13	Non anemic
207	37	B	12	Non anemic
208	28	O	12	Non anemic
209	40	A	6.7	Severe
210	31	O	11.4	Non anemic
211	26	O	12.6	Non anemic
212	37	AB	9.8	Mild
213	32	A	11	Non anemic
214	38	A	6.4	Severe
215	34	B	11.6	Non anemic
216	25	A	9	Mild
217	28	O	12	Non anemic
218	30	A	6.1	Severe
219	37	A	7.7	Moderate
220	27	O	12	Non anemic
221	25	O	13	Non anemic
222	27	AB	9.9	Mild
223	29	O	13	Non anemic
224	37	O	12	Non anemic
225	27	B	10.3	Mild
226	23	O	13	Non anemic
227	31	O	12.5	Non anemic
228	37	A	6	Severe
229	28	AB	12.3	Non anemic
230	37	A	6.6	Severe

231	29	A	6.9	Severe
232	39	O	12.5	Non anemic
233	24	B	11	Non anemic
234	27	B	11.8	Non anemic
235	41	A	6.8	Severe
236	28	O	12	Non anemic
237	38	O	12.2	Non anemic
238	22	A	11.8	Non anemic
239	40	A	8	Moderate
240	27	O	11.5	Non anemic
241	37	B	12	Non anemic
242	18	O	12.4	Non anemic
243	43	B	7.9	Moderate
244	29	O	12	Non anemic
245	23	A	6.8	Severe
246	29	AB	8.8	Moderate
247	25	B	13	Non anemic
248	28	O	12.9	Non anemic
249	30	A	11	Non anemic
250	27	O	12	Non anemic
251	25	B	7	Moderate
252	40	AB	8.9	Moderate
253	37	O	12	Non anemic
254	25	A	11.9	Non anemic
255	28	B	10	Mild
256	24	O	13	Non anemic
257	27	AB	12.3	Non anemic
258	37	A	10.5	Mild
259	24	O	12	Non anemic
260	28	O	12.3	Non anemic
261	38	A	6.9	Severe
262	41	B	10	Mild
263	26	O	12.4	Non anemic
264	29	O	13	Non anemic
265	20	AB	10	Mild
266	37	A	6.8	Severe
267	22	B	11.3	Non anemic
268	27	O	11.9	Non anemic
269	29	O	12.3	Non anemic

270	23	A	13	Non anemic
271	26	B	8	Moderate
272	38	A	6.9	Severe
273	37	A	6.3	Severe
274	40	AB	9.6	Mild
275	22	B	12.6	Non anemic
276	27	A	11.4	Non anemic
277	24	O	12	Non anemic
278	37	B	11.6	Non anemic
279	20	A	11.1	Non anemic
280	39	O	9.9	Mild
281	28	AB	6.9	Severe
282	25	O	11.2	Non anemic
283	40	B	8.7	Moderate
284	24	A	11.8	Non anemic
285	37	A	6	Severe
286	41	B	9.6	Mild
287	20	O	13	Non anemic
288	27	A	12.3	Non anemic
289	25	B	10	Mild
290	28	O	12.6	Non anemic
291	21	A	11.9	Non anemic
292	30	AB	12	Non anemic
293	38	A	6.9	Severe
294	20	B	12	Non anemic
295	37	AB	10.2	Mild
296	17	B	9	Mild
297	27	O	12	Non anemic
298	20	O	12.7	Non anemic
299	38	B	10	Mild
300	37	A	11	Non anemic
301	25	O	12	Non anemic
302	27	A	11.9	Non anemic
303	37	O	12	Non anemic
304	19	B	13	Non anemic
305	27	AB	10	Mild
306	24	A	12.2	Non anemic
307	28	O	13	Non anemic
308	39	B	11	Non anemic

309	39	A	6.5	Severe
310	18	B	12.3	Non anemic
311	32	A	11.5	Non anemic
312	38	O	12	Non anemic
313	22	B	10.6	Mild
314	29	AB	10.4	Mild
315	37	A	6.7	Severe
316	21	O	11.7	Non anemic
317	26	A	12	Non anemic
318	41	AB	9.9	Mild
319	23	B	11.6	Non anemic
320	28	O	12.2	Non anemic
321	39	B	11.8	Non anemic
322	30	O	12.1	Non anemic
323	24	O	13.3	Non anemic
324	37	B	12	Non anemic
325	22	A	10	Mild
326	27	A	11	Non anemic
327	38	A	10	Mild
328	25	B	12	Non anemic
329	28	AB	11.9	Non anemic
330	37	O	12.4	Non anemic
331	26	A	11.7	Non anemic
332	38	B	10	Mild
333	38	A	6.9	Severe
334	29	AB	10.8	Mild
335	23	B	13	Non anemic
336	27	O	12.3	Non anemic
337	30	O	11.8	Non anemic
338	17	A	12	Non anemic
339	29	O	11.5	Non anemic
340	40	B	8	Moderate
341	31	AB	10	Mild
342	27	O	12	Non anemic
343	24	A	12.3	Non anemic
344	38	A	6.8	Severe
345	20	B	10	Mild
346	37	AB	10.7	Mild
347	25	O	12.1	Non anemic

348	31	A	11.6	Non anemic
349	37	B	13.4	Non anemic
350	23	O	12	Non anemic
351	43	AB	9.9	Mild
352	24	O	13	Non anemic
353	28	B	10	Mild
354	37	A	6.9	Severe
355	27	A	13.3	Non anemic
356	26	A	6.5	Severe
357	37	A	11.4	Non anemic
358	28	O	12	Non anemic
359	38	B	10.2	Mild
360	21	AB	8.4	Moderate
361	30	A	11.9	Non anemic
362	29	B	12	Non anemic
363	39	B	10	Mild
364	43	O	6.7	Severe
365	31	A	11.3	Non anemic
366	22	O	12.5	Non anemic
367	27	O	13	Non anemic
368	24	B	12	Non anemic
369	37	AB	10.3	Mild
370	31	A	13	Non anemic
371	29	O	11.9	Non anemic
372	25	A	11.7	Non anemic
373	40	A	6.6	Severe
374	31	B	10.6	Mild
375	27	A	12.4	Non anemic
376	19	O	12	Non anemic
377	37	B	11.1	Non anemic
378	24	A	12.2	Non anemic
379	27	O	11.7	Non anemic
380	28	O	12.4	Non anemic
381	25	B	9	Mild
382	27	AB	12.4	Non anemic
383	29	O	13	Non anemic
384	38	A	6.8	Severe
385	19	O	12.3	Non anemic
386	27	A	11.5	Non anemic

387	38	B	9	Mild
388	37	A	10.8	Mild
389	30	AB	9.6	Mild
390	25	A	13	Non anemic
391	28	O	12	Non anemic
392	32	B	11.5	Non anemic
393	30	O	13.2	Non anemic
394	26	O	11.9	Non anemic
395	27	A	12.4	Non anemic
396	29	O	12	Non anemic
397	39	A	6.9	Severe
398	27	O	12.6	Non anemic
399	31	AB	12	Non anemic
400	27	B	10.2	Mild
401	24	O	13	Non anemic
402	21	B	7	Moderate
403	28	O	11.2	Non anemic
404	37	B	10	Mild
405	23	O	12	Non anemic
406	40	AB	8.8	Moderate
407	29	O	11.9	Non anemic
408	19	B	11.6	Non anemic
409	29	O	12	Non anemic
410	22	A	6.7	Severe
411	26	B	12	Non anemic
412	28	O	12.7	Non anemic
413	37	A	8.8	Moderate
414	30	O	12.3	Non anemic
415	29	O	12.6	Non anemic
416	27	AB	13	Non anemic
417	23	O	13	Non anemic
418	30	O	12.9	Non anemic
419	24	B	13	Non anemic
420	22	O	13	Non anemic
421	38	B	8.7	Moderate
422	27	AB	11.6	Non anemic

Figure 1. Laboratory technician during blood sample taking for ABO blood grouping and Anemia

Figure 2. The antiserums (anti-A, anti-B) and during dropping of antiserum to blood samples

Figure 3. Identification of Hemoglobin level using Hematocrit