**PREVALENCE OF ANEMIA AND ASSOCIATED FACTORS AMONG PREGNANT WOMEN OF DHARAN SUB-METROPOLITAN CITY, SUNSARI, NEPAL**

by

**Sunita Tamang**

**Department of Nutrition and Dietetics**

**Central Campus of Technology, Dharan**

**Institute of Science and Technology**

**Tribhuvan University, Nepal**

**2017**

**PREVALENCE OF ANEMIA AND ITS ASSOCIATED FACTORS AMONG PREGNANT WOMEN OF DHARAN SUB-METROPOLITAN CITY, SUNSARI, NEPAL**

***A dissertation submitted to the Department of Nutrition and Dietetics, Central Campus of Technology, Tribhuvan University, in partial fulfillment of the requirements for the degree of B. Sc. in Nutrition and Dietetics***

by

**Sunita Tamang**

**Department of Nutrition and Dietetics**

**Central Campus of Technology, Dharan**

**Institute of Science and Technology**

**Tribhuvan University, Nepal**

**2017**

**Tribhuvan University**

**Institute of Science and Technology**

**Department of Nutrition and Dietetics**

**Central Campus of Technology, Dharan**

**Approval Letter**

**This *dissertation* entitled *Prevalence of Anemia and its Associated Factors among Pregnant women of Dharan Sub-metropolitan City, Sunsari, Nepal* submitted by Sunita Tamang has been accepted as the partial fulfillment of the requirement for the B.Sc. degree in Nutrition and Dietetics.**

**Dissertation Committee**

**1. Head of the Department**

**(Mr. Dambar B. Khadka, Teaching Asst.)**

**2. External Examiner**

**(Mr. Birendra Kumar Yadav, Assc. Prof.)**

**3. Supervisor**

**(Mr. Man K. Tamang, Teaching Asst.)**

**4. Internal Examiner**

**(Mr. Dambar B. Khadka, Teaching Asst.)**

**July, 2017**

**Acknowledgements**

I would like to express my deepest sense of gratitude to my respected supervisor Mr. Man Kumar Tamang, Teaching Assistant, Central Campus of Technology, Dharan for his supervision, valuable advice, comments, encouragements, continuous support, constructive guidance, invaluable time and suggestions during my dissertation and I especially appreciate his quick, detailed feedback. His insight and knowledge provided tremendous support throughout my thesis.

I feel deeply honored in expressing my sincere thanks to the Prof. Dr. Dhan Bdr. Karki, Campus Chief, Central Campus of Technology, for enormous support and guidance. I am also grateful to Dambar Bdr. Khadka, Department Head of Nutrition and Dietetics, Central Campus of Technology for providing me with all the necessary facilities for the study and valuable insights leading to the successful completion of my thesis. I would like to express my heartfelt gratitude towards Central Campus of Technology and Department of Bsc Nutrition and Dietetics. I am extremely thankful and indebted to all the teachers and for sharing expertise, and sincere and valuable guidance and encouragement extended to me and also for the thesis study. I would also like to thank for their valuable input in the various phases of the survey. I would also like to express myspecial thanks to the statistician Mr. Dinesh Shrestha and Mr. Homnath Baral for their statistical helps during analysis.

I really would like to express my deep gratitude and appreciation to my parents. Their prayers are always my source of strength. I am deeply indebted to them for their patience, encouragement, concern and love. Also I would like to thank my brothers and sister for their endless love and support.

I greatly acknowledge the support I received from various institutions in implementing the study. My sincere gratitude goes to all the administrative and staff members of BPKIHS, FPAN and Health post of Dharan for their time, support, collaboration and valuable input during the time of my data collection. I would especially like to thank the head of dietetic section of BPKIHS, Ms. Shilpi Kumari for her invaluable guidance and advice.

I wish to express cordial thanks to all my colleagues and friends especially Sarita Rai, Prabesh Pakhrin, Jeevan kr. Limbu and Pradip Khadka for their help and support as well as sharing me their ideas during my study.

I extend my deepest gratitude to all the pregnant women who participated in the study for their patient, time and co-operation in responding to the survey.

Date of submission: July, 2017

Sunita Tamang

**Abstract**

The current study aimed to estimate the prevalence of anemia among pregnant women (15-49 years) who attended antenatal care at different health centers of Dharan sub-metropolitan city and to explore and assess factors associated with anemia. A semi-structured questionnaire was administered to the participants for socio-demographic and food frequency questionnaire for dietary data. The cyanmethemoglobin method was used to determine blood hemoglobin level. Anthropometric measurement was used to determine BMI and MUAC. Chi-square test was used to analyze the association between anemia and various factors.

The mean Hb level of participants was 11.12 gm/dl and the median was 11.10gm/dl with minimum and maximum of 8 gm/dl and 15.5 gm/dl respectively. Out of 213 pregnant women enrolled in the study, 74 (34.74%) were found to be anemic. In terms of severity, 47 (22.06%) were mildly anemic and 27 (12.68%) moderately anemic and there was no severe anemia identified (with Hb <7gm/dl). This study showed that demographic characteristics such as caste, religion and family size had no association with anemia. While the socio-economic factors like annual income of the family was significantly associated with anemia among pregnant women. Among the sample characteristics, age, MUAC and BMI were significantly associated while factors like education, age at marriage, eating habits and frequency of meal consumption had no relation with anemia. Similarly, gestational period, frequency of pregnancy and frequency of ANC visits were also associated with anemia. Nutritional factors like frequency of meat, fruits, milk & milk products and types of tea consumption showed no any association, whereas, frequency of egg, green leafy vegetables and tea consumption were significantly associated with Hb level among participants. Overall, the study indicated that anemia is still a significant problem among pregnant women of Dharan sub-municipality. A well and clear health education sessions strategy regarding anemia and early initiation of antenatal care needs to be more effective to overcome these issues.

Table of Contents

**Approval Letter** iii

**Acknowledgements** iv

**Abstract** v

**Table of contents** vi

**List of Tables**…………………………………………………………………………….viii

**List of figures** ix

**List of Abbreviations** x

[**Introduction**……………………………………………………………………………...1](#_Toc489341812)-4

[**1.1 Background to the study** 1](#_Toc489341813)

[**1.2 Problem Statement and Justification** 3](#_Toc489341814)

[**1.3 Objectives of study** 3](#_Toc489341815)

[**1.3.1 General objectives** 3](#_Toc489341816)

[**1.3.2 Specific Objectives** 3](#_Toc489341818)

[**1.4 Research Question** 4](#_Toc489341823)

[**1.5 Significance of Study** 4](#_Toc489341826)

[**1.6 Limitation of Study** 4](#_Toc489341828)

[**Literature Review**……………………………………………………………………...5](#_Toc489341829)-24

[**2.1 Anemia definition** 5](#_Toc489341830)

[**2.2 Types of Anemia** 6](#_Toc489341831)

[**2.3 Causes of anemia** 8](#_Toc489341832)

[**2.3.1** **Nutritional deficiencies** 8](#_Toc489341833)

[**2.3.2 Loss of blood or destruction of RBCs** 10](#_Toc489341834)

[**2.3.3 Decreased or faulty RBCs production** 11](#_Toc489341835)

[**2.3.4 Other underlying causes** 11](#_Toc489341836)

[**2.4 Symptoms of Anemia** 11](#_Toc489341837)

[**2.5 Consequences of Anemia** 12](#_Toc489341838)

[**2.6 Nutritional Need of Pregnant women** 13](#_Toc489341839)

[**2.7 Assessing anemia** 14](#_Toc489341840)

[**2.8 Assessment of Nutritional status through MUAC and BMI** 15](#_Toc489341841)

[**2.8.1 MUAC** 15](#_Toc489341842)

[**2.8.2 Body Mass Index** 16](#_Toc489341843)

[**2.9 Prevalence of Anemia** 17](#_Toc489341844)

[**2.9.1 International Scenerio**………………………………………………………17](#_Toc489341845)

**2.9.2 National Scenerio**………………………...……………….…………………22

[**Materials and Methods**……………………………………………………………….25](#_Toc489341846)-29

[**3.1 Research Design** 25](#_Toc489341847)

[**3.2 Study site** 25](#_Toc489341848)

[**3.3 Target population** 25](#_Toc489341849)

[**3.4 Sampling Techniques** 25](#_Toc489341850)

[**3.5 Sample size calculation** 25](#_Toc489341851)

[**3.6 Criteria for sample selection** 26](#_Toc489341852)

[**3.7 Research variables** 26](#_Toc489341853)

[**3.8 Pretesting** 27](#_Toc489341854)

[**3.9** **Data collection techniques** 27](#_Toc489341855)

[**3.10 Validity and reliability** 28](#_Toc489341856)

[**3.11** **Logistical and Ethical considerations** 28](#_Toc489341857)

[**3.12 Data analysis** 28](#_Toc489341858)

[**Results and Discussions**………………………………………………………………30](#_Toc489341859)-40

[**4.1** **Prevalence of anemia** 30](#_Toc489341860)

[**4.2 Demographic and socioeconomic characteristics and anemia** 31](#_Toc489341861)

[**4.2.1 Caste and Religion Distribution and Anemia among pregnant women** 31](#_Toc489341862)

[**4.2.2** **Family characteristics and anemia** 32](#_Toc489341863)

[**4.2.3** **Annual family income and anemia** 32](#_Toc489341864)

[**4.2.4 Sample characteristics and anemia** 33](#_Toc489341865)

[**4.2.5** **Knowledge about anemia and balanced diet and anemia** 37](#_Toc489341866)

[**4.2.6 Dietary Practices and anemia** 37](#_Toc489341867)

[**Conclusions and Recommendations**…………………………………………………41](#_Toc489341868)-42

[**5.1 Conclusions** 41](#_Toc489341869)

[**5.2 Recommendation** 42](#_Toc489341870)

[**Summary**………………………………………………………………………………43](#_Toc489341871)-44

**Reference**………………………………………………………………………………45-50

**Appendices**…………………………………………………………………………….51-69

**List of Tables**

|  |  |  |
| --- | --- | --- |
| **Table no.** | **Titles** | **Page no.** |
| Table 2.1 | Global anemia prevalence and number of individuals affected………..............6 | |
| Table 2.2 | Recommended Daily Allowances for Pregnant women…………...................14 | |
| Table 2.3 | Hemoglobin thresholds used to define anemia………………………...……...15 | |
| Table 2.4 | Blood Hemoglobin Values (g/dl) Defining Anemia in Pregnant Women........15 | |
| Table 2.5 | BMI cut offs points for Asian………………………………………………...16 | |
| Table 2.6 | Recommended weight gain for pregnant women based on BMI……………..17 | |
| Table 2.7 | Global and WHO regional mean blood hemoglobin concentration and prevalence of anemia among pregnant women……………………………….18 | |
| Table 2.8  Table 2.9 | Prevalence of anemia among pregnant women in South Asian Countries……………………………………………………………………...21  Prevalence of anemia among Nepalese women (15-49 years) in NDHS, 2011…………………………………………………………………………..22 | |
| Table 4.1 | Caste and Religion distribution and anemia among pregnant women……….31 | |
| Table 4.2 | Family size and anemia among pregnant women…………………………….32 | |
| Table 4.3 | Economic status of family and anemia among pregnant women………........33 | |
| Table 4.4 | Sample characteristics and anemia among pregnant women…………………35 | |
| Table 4.5 | Knowledge about anemia and balanced diet and anemia among pregnant women………………………………………………………………………...37 | |
| Table 4.6 | Dietary practices and anemia among pregnant women………………………………………………………………………..38 | |
| Table 8.1 | Distribution of different forms of anemia based on different study variables……………………………………………………………………...66 | |

**List of figures**

|  |  |  |
| --- | --- | --- |
| **Figure no.** | **Title** | **Page no.** |
| Figure 4.1 | Classification of anemia among study participants (n=213)……………..36 | |

**List of Abbreviations**

|  |  |
| --- | --- |
| Abbreviation | Full form |
| WHO | World Health Organization |
| UN | United Nations |
| UNICEF | United Nations Children’s Fund |
| IDA | Iron deficiency anemia |
| NDHS | Nepal Demographic Health Survey |
| ICMR | Indian Council of Medical Research |
| NGOs | Non-governmental organizations |
| INGOs | International Non-governmental organizations |
| NA | Nutritional anemia |
| DNA | Deoxyribonucleic acid |
| SCA | Sickle cell anemia |
| RBCs | Red blood cells |
| USA | United States of America |
| NSAIDs | Non-steroidal anti-inflammatory drugs |
| HIV | Human Immuno deficiency virus |
| AIDS | Acquired Immuno Deficiency Syndrome |
| APGAR | Appearance, Pulse, Grimace, Activity, Respiration |
| Hb | Hemoglobin |
| MUAC | Mid Upper Arm Circumference |
| BMI | Body mass index |
| CMAM | Community-based management of acute malnutrition |
| SAM | Severe acute malnutrition |
| MAM | Moderate acute malnutrition |
| YLDs | Year lived with disabilities |
| LMICs | Low and middle income countries |
| HICs | High income countries |
| ANC | Antenatal care |
| LBW | Low birth weight |
| ID | Iron deficiency |
| IUD | Intra uterine device |
| FPAN | Family planning association of Nepal |
| BPKIHS | B.P. Koirala Institute of Health Sciences |
| SPSS | Statistical package for social sciences |
| SES | Socio-economic status |
| DGLV | Dark green leafy vegetables |
| USAID | U.S. Agency for International Development |

**Part I**

**Introduction**

**1.1 Background to the study**

According to the World Health Organization (WHO), Anemia is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs, which vary by age, sex, altitude, smoking, and pregnancy statuS. Anemia is a term broadly used to describe the condition in which there is inadequate or defective formation of hemoglobin and defective maturation and formation of red blood cells ([Swaminathan, 2008](#_ENREF_94)). 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 (Sinha *et al*., 2012). It affects all ages of the population with its highest prevalence among children under five years of age and pregnant women. Iron deficiency is the most common cause of anemia. Nutritional deficiencies beside iron deficiency include folate, vitamin B12 and vitamin A deficiencies that contribute to anemia. Other causes of anemia include chronic inflammatory states, parasitic infection like worm infestation and malaria, lead poisoning, genetic disorders such as thalassemias, sickle cell trait, hemoglobinopathies ([Benoist *et al.*, 2008](#_ENREF_17)).

Pregnancy is a period of increased metabolic demands, with changes in the woman's physiology and the requirements of a growing fetus ([King, 2000](#_ENREF_55)). Many women begin pregnancy in a slightly anemic state. In pregnancy, mild anemia can rapidly become more severe; therefore, it needs immediate treatment ([Abu-Hasira, 2007](#_ENREF_3)). Adequate nutrition before and during pregnancy has greater potential for a long term impact than it does in any other time. Maternal health is a complex, influenced by various genetic, social and economic factors, infections and environmental conditions, many of which may effects fetal growth ([Srilakshmi, 2014](#_ENREF_92)).

Nepal is one of the least developed nations in South East Asian Region, which was ranked 157 among 187 countries in the Human Development Index and 0.358 on education index in UN (2013). It has a total land area of 147, 181 Sq. Kms. It is surrounded by China on north and by India on east, south and west ([Malik, 2013](#_ENREF_66)). In Nepal, postpartum hemorrhage, unsafe abortion, infection, pre-eclampsia, and long obstructive labor are the major causes of maternal death (Bhandari and Dangal, 2012).

Anemia is of great concern particularly during pregnancy because of its reported association with a number of adverse outcomes on health (Hyder, 2002). Pregnant women are more vulnerable to iron deficiency anemia (IDA) due to accelerated increase in iron requirements, poor dietary intake of iron, high rate of infection and worm infestation as well as other social factor. During pregnancy a women has increasing demands for energy both for her and the growing fetus (Muzaffar, 2015). During pregnancy, the iron requirements of pregnant women are increased threefold to cover needs of expansion of maternal red cell mass and growth of the fetal placenta. Maternal anemia develops unless these needs are met. According to WHO, Anemia during pregnancy is considered severe when hemoglobin concentration is less than 7.0 g/dl, moderate when hemoglobin falls between 7.0–9.9 g/dl and mild from 10.0-11 g/dl (Rathi et al, 2014).

Anemia causes more than 115,000 maternal and 591,000 perinatal deaths globally per year. Anemia is the most common medical disorder in pregnancy. Nearly half of the pregnant women in the world are estimated to be anemic: 52% in non-industrialized –as compared with 23% in industrialized countries ([WHO, 2001b](#_ENREF_108)). In Nepal, Pregnant women are more likely to be anemic (48%) than lactating women (39%) and reproductive age group women (33%) which could be due to high demand of iron and folic acid during pregnancy ([MOHP *et al.*, 2012](#_ENREF_76)). Despite anemia has been identified as global public health problem for several years, no rapid progresses were observed and the prevalence of the disease is still high globally. The WHO and the United Nations Children Fund (UNICEF) have stated that there is an immediate need to reduce the prevalence of anemia, and the importance of identifying its numerous aetiology, in order to ascertain effective control and preventive programmes (WHO and UNICEF, 2004).

Globally, the prevalence of anemia fell by 12% between 1995 and 2011 – from 33% to 29% in non-pregnant women and from 43% to 38% in pregnant women, indicating that progress is possible but presently insufficient to meet these goals. It is therefore urgent that countries review national policies, infrastructure and resources and act to implement strategies for the prevention and control of anemia ([WHO, 2014](#_ENREF_110)). Iron deficiency anemia affects the development of the nation by decreasing the cognitive development of children and productivity of adults (Dohe et al, 2014).

The objective of this study was to assess the prevalence of anemia among pregnant women of Dharan sub-municipality and to find out association of hemoglobin level with other parameters that may give progression to anemia.

**1.2 Problem Statement and Justification**

Anemia is one of the most common diseases complicating antenatal women worldwide, particularly in the developing countries. Anemia is an extremely serious public health problem in Nepal. The Ministry of Health has acknowledged that reducing anemia is a great public health challenge that cannot be ignored and requires coordinated efforts in order to address its multiple causes where reducing the prevalence of anemia during pregnancy is a key priority ([MoH, 2002](#_ENREF_75)). Anemia is more common during pregnancy; hence pregnant women are at higher risk than non-pregnant women. Pregnancy is nutritionally more vulnerable period as there is increased demand for nutrients due to physiological changes in the body. More nutrients are required for proper growth and development of fetus as well as to maintain good health of mother and fetus. The iron requirement during pregnancy is also increased. A young adult woman normally requires 21 mg/day of iron. An Indian Council of Medical Research (ICMR) requirement of iron during pregnancy is 35 mg/day. The total iron requirement for the entire period of pregnancy is 864 mg. In first trimester iron requirement is similar to the normal requirement of 0.70 mg. During second and third trimester, the daily requirement is 3.3 mg and 5 mg respectively ([Srilakshmi, 2014](#_ENREF_92)). Due to high requirements of iron, pregnancy period is at high risk for anemia. Hence, a large number of women become anemic during pregnancy.

The study on the prevalence of anemia plays important role in making policies and conducting programmes to effectively investigate and manage anemia in pregnancy and therefore reduce the burden of disease. Therefore, this study is aimed to provide data on prevalence of anemia in pregnant women and identifying its associated factors in Dharan sub-metropolitan city of Sunsari district.

**1.3 Objectives of study**

**1.3.1 General objectives**

a. To evaluate the prevalence of anemia and associated socio-economic and demographic, dietary practices and other sample characteristics for anemia among pregnant women.

**1.3.2 Specific Objectives**

a. To estimate anemia based on the blood hemoglobin level.

b. To determine prevalence of anemia.

c. To assess the factors associated with anemia.

d. To determine the significant relationship of prevalence of anemia with selected socio-demographic and other sample variables.

**1.4 Research Question**

a. What is the prevalence of anemia among pregnant women in Dharan sub-metropolitan city?

b. What are the factors associated with hemoglobin level of the participants?

**1.5 Significance of Study**

The significance of the study is to find out the distribution of grades of anemia among pregnant women of study site. Increase awareness about anemia and its consequence in particular population. Encourage the women of the community to bring dietary changes as well as focus on medication to improve their current health status. Serve as helpful guide to government and voluntary institution like NGOs and INGOs for the proper health and nutrition planning and implementation of nutrition strategy and program regarding pregnant women.

**1.6 Limitation of Study**

a. The sample taken from the study population and its findings cannot be generalized for the Sunsari district.

b. As this is cross–sectional study, the prevalence of anemia might be affected by seasonal variation which was not taken into consideration.

c. The study did not assess the types of anemia due to economic, equipments and time constraints.

**Part II**

**Literature Review**

**2.1 Anemia definition**

Anemia is a condition in which there is diminished oxygen-carrying capacity of the blood, as a result of reduction in total circulating hemoglobin and/or reduction in red cell mass ([Antia and Abraham, 2002](#_ENREF_11)). WHO describes Anemia as a condition in which the number and size of red blood cells, or the hemoglobin concentration, falls below an established cut-off value, consequently impairing the capacity of the blood to transport oxygen around the body. Anemia is an indicator of both poor nutrition and poor health ([WHO, 2014](#_ENREF_110)). Anemia is a major public health concern all over the world affecting all the ages and both gender ([Mamta and Devi, 2014](#_ENREF_67)).

Anemia is one of the most frequently observed nutritional deficiency diseases in the world today ([WHO, 1992](#_ENREF_105)). Nutritional anemia (NA) is defined as the condition that results from the inability of the erythropoietic tissue to maintain a normal hemoglobin concentration on account of inadequate supply of one or more nutrients leading to the reduction in total circulating hemoglobin ([Srilakshmi, 2014](#_ENREF_92)).

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 survival, can all cause anemia ([WHO, 2011](#_ENREF_109)). Iron deficiency anemia (IDA) is a condition in which the body does not have enough iron to build healthy red blood cells. Prevalence of IDA varies greatly according to host factors: age, gender, physiological, pathological, environmental and socioeconomic condition (WHO, 2001). In addition, reproductive biology, poverty, lack of education, socio-cultural traditions and disparities in household contribute to under nutrition in women further resulting in anemia. Children and women of reproductive age, in part because of their physiological vulnerability, are at high risk, followed by elderly people, and men ([Mclean *et al.*, 2009](#_ENREF_71)). Anemia is both a cause and an indicator of poor health states among women, neonates, and children ([Lover *et al.*, 2014](#_ENREF_62)).

**Table-2.1:** Global anemia prevalence and number of individuals affected

|  |  |  |
| --- | --- | --- |
| Population group | Prevalence of anemia (%) | Population affected number (millions) |
| PSAC | 47.4 | 293 |
| School age children | 25.4 | 305 |
| PW | 41.8 | 56 |
| NPW | 30.2 | 468 |
| Men | 12.7 | 260 |
| Elderly | 23.9 | 164 |
| Total population | 24.8 | 1620 |

Source: ([Benoist *et al.*, 2008](#_ENREF_17))

PSAC- Pre-school age children

PW- Pregnant women

NPW- Non-pregnant women

**2.2 Types of Anemia**

a. Iron deficiency anemia (IDA):

IDA is the most common type anemia which can result from inadequate iron intake, decreased iron absorption, increased iron demand, and increased iron loss ([Benoist *et al.*, 2008](#_ENREF_17)). Iron deﬁciency accounts for about half the world’s anemia burden ([WHO, 2001a](#_ENREF_107)). IDA is a well documented nutritional deficiency during pregnancy in both developed and developing countries. Iron deficiency anemia is one of the most dangerous and devastating causative form of malnutrition in developing countries. Increased demands for iron, such as fetal growth in pregnancy, and children undergoing rapid growth spurts in infancy and adolescence, can also cause iron deficiency anemia. IDA is the most common medical complication of pregnancy, primarily because of expansion of plasma volume without normal expansion of maternal hemoglobin mass. The most common symptoms of chronic IDA include tiredness, weakness, shortness of breath and sometimes, a fast heartbeat. This condition can be treated with iron supplementation as well as the treatment of the underlying cause of the iron deficiency.

For prevention of iron deficiency anemia, globally it is recommended to increase dietary iron intake, iron fortiﬁcation of industrialized foods, and medical iron supplementation ([Dutra-de-Oliveira *et al.*, 2011](#_ENREF_33)).

b. Megaloblastic anemia:

Megaloblastic anemia is characterized by the formation of abnormally large erythrocytes in the bone marrow and by abnormally large (macrocytic) erythrocytes and hyper-segmented neutrophils in the blood. Megaloblastic anemia is caused by a reduction in the rate of DNA biosynthesis, resulting in abnormal nuclear maturation and ineffective erythropoiesis. The most common aetiology for megaloblastic anemia is folate and B12 deﬁciencies. Other less common factors are the use of drugs that interrupt DNA biosynthesis and inherited conditions presenting defective enzymes of DNA biosynthesis.

c. Pernicious anemia:

A severe malabsorption of vitamin B12 leads to pernicious anemia. Vitamin B12 deficiency is rarely a result of an absence of the vitamin in the diet. It is much more common to find deficiencies in patients who fail to absorb the vitamin from the intestine. Apart from the symptoms of anemia (fatigue, dizziness, etc.), the vitamin B12 deficiency may also have some serious symptoms such as nerve damage, Neurological problems such as confusion, dementia, depression, and memory loss, nausea and vomiting, heartburn, abdominal bloating and gas, constipation or diarrhoea, loss of appetite, and weight loss, an enlarged liver. Blood tests may show fewer but larger red blood cells, low numbers of young red blood cells, low levels of vitamin B12, and antibodies to intrinsic factor. Pernicious anemia is treated by replacing the missing vitamin B12 in the body which could be a lifelong treatment.

d. Aplastic anemia:

It is a rare bone marrow failure disorder in which the bone marrow stops making enough blood cells (red blood cells, white blood cells, and platelets). It is a life-threatening disease, predisposing to bleeding tendencies and serious infections. This occurs as a result of destruction or deficiency of blood-forming stem cells in your bone marrow, in particular when the body’s own immune system attacks the stem cells. Aplastic anemia can be inherited, can occur without apparent cause, or can occur when the bone marrow is injured by medications, radiation, chemotherapy, or infection. Treatment for aplastic anaemia includes blood transfusions, blood and marrow stem cell transplants, and medication. These treatments can prevent or limit complications, relieve symptoms, and improve quality of life.

e. Sickle cell anemia (SCA):

SCA is an inherited blood disorder in which the body produces abnormally shaped RBCs. In sickle cell anemia, the hemoglobin in RBCs clumps together which causes RBCs to become stiff and sickle or C-shaped. These sickle cells block blood and oxygen flow in blood vessels as well as in many parts of the body, which can results in pain, serious infections as well as tissues and organ damage. Sickle cells breakdown more rapidly than normal red blood cells, which results in anemia. Sudden pain throughout the body is a common symptom of SCA. This pain is called a "sickle cell crisis", and often affects the bones, lungs, abdomen, and joints. Treatment goals for SCA aim to relieve pain, prevent infections, and manage complications. However, bone marrow transplantation is the only potential cure for SCA ([UMMC, 2015](#_ENREF_100)).

f. Hemolytic anemia:

This type of anemia develops when red blood cells are destroyed faster than bone marrow can replace them. A number of diseases, conditions and factors can cause the body to destroy its red blood cells. Hemolytic anemia can lead to various health problems such as fatigue, pain, arrhythmias, an enlarged heart and heart failure. Certain blood diseases increase red blood cell destruction. Some inherit a hemolytic anemia, or develop it later in life. Treatments for hemolytic anemia include blood transfusions, medicines, plasmapheresis, surgery, blood and marrow stem cell transplants and lifestyle changes.

g. Thalassemia:

It is an inherited condition which occurs when the red cells can't mature and grow properly. In this condition the body makes fewer healthy RBCs and less hemoglobin. This condition can range in severity from mild to life-threatening. The two major types of thalassemia are alpha- and beta thalassemia. The most severe form of alpha thalassemia is known as alpha thalassemia major or hydrops fetalis, while the severe form of beta thalassemia is known as thalassemia major or Cooley's anemia. Three standard treatments are used to treat moderate and severe forms of thalassemia; these include blood transfusions, iron chelation therapy, and folic acid supplements.

**2.3 Causes of anemia**

Anemia occurs when there are not enough RBCs in the blood. Anemia is the result of a wide variety of causes that can be isolated, but more often coexist ([Benoist *et al.*, 2008](#_ENREF_17)). There are several causes of anemia, which can be broadly classified under following groups.

**2.3.1** **Nutritional deficiencies**

Nutritional anemia (NA) refers to the low concentration of hemoglobin due to poor diet. According to WHO Nutritional anemia is a condition in which the hemoglobin concentration of the blood is lower than normal as a result of deficiency of one or more essential nutrients, regardless of the cause of such deficiency ([WHO, 1992](#_ENREF_105)). Nutritional deficiency anemia is caused by a lack of iron, protein, vitamin-B12, and other vitamins and minerals that needed for the formation of hemoglobin. Some common types of nutritional deficiencies anemia include:

Iron deficiency:

Iron deficiency is the most common and widespread nutritional disorder in the world ([WHO, 2001a](#_ENREF_107)). It is the only nutritional deficiency that is prevalent in both developing and industrialized countries. Hemoglobin is the iron-containing oxygen-carrying pigment of the RBCs. Iron is necessary for the formation of hemoglobin. An adequate supply of iron is required for the hemoglobin concentration of RBCs to be maintained at normal levels ([Willows, 2000](#_ENREF_113)). Iron-deficiency anemia affects so many people that it’s now widely recognized as a public health epidemic ([Butler, 2017](#_ENREF_23)). Iron deficiency in the body might be caused due to various reasons like low nutrient intake, poor absorption or utilization, increased nutrient losses and/or demands due to worm infestation, pregnancy or delivery, malarial infection, etc. The form of iron present in the diet (heme and non-heme), factors inhibiting (for example, phytate, calcium) or enhancing (for example, ascorbic acid) its absorption are also important factors affecting iron deficiency in the body ([MacPhail and bothwell, 1992](#_ENREF_63)). Iron deficiency with or without anemia is reported to affect about 25 % of the poorer pregnant women even in developed countries like the USA (Beard, 1994).

Folic acid deficiency:

Folic acid is one of the B vitamins, and it helps our body make new cells, including new RBCs. Hence, deficiency of Folic acid leads to decrease in RBCs count causing anemia. Folic acid deﬁciency contributes to megaloblastic anemia, a condition characterized by cells with large and malformed nuclei resulting from impaired DNA synthesis. Folic acid deficiency is caused by insufficient intake of nutrient in diet, increased demand due to pregnancy or some medical problems like SCA, lower absorption due to excess alcoholism or severe kidney problems, intake of medicine for cancer, rheumatoid arthritis and seizures. Folic acid deficiency, although not quite as common as iron deficiency, yet nearly 40-50 % of pregnant women may suffer from some degree of deficiency ([Seshadri, 2001](#_ENREF_89)).

Vitamin B12 deﬁciency:

Vitamin B12 is synthesized only by microorganisms, and its primary source is from ingestion of animal products. Absorption of vitamin B12 involves a complex process by which gastric enzymes and acid facilitate its release from food sources, before being bound by an intrinsic factor secreted by gastric parietal cells, followed by uptake in the distal ileum. Vitamin B12 deﬁciency can result in a megaloblastic macrocytic anemia, which is more common in severe vitamin B12 deﬁciency. The global prevalence of vitamin B12 deﬁciency is unknown, but evidence from several developing countries suggests that deﬁciency is widespread and is present throughout life ([Balarajan *et al.*, 2011](#_ENREF_15)). Many developing countries have relatively poor intake of foods containing Vitamin B12 because of lack of accessibility and high cost. The main causes of vitamin B12 deﬁciency are inadequate dietary intake, especially from vegetarian diets, pernicious anemia, an autoimmune disorder resulting from autoantibody against intrinsic factor, tropical sprue ([Misra *et al.*, 2002](#_ENREF_74)).

Vitamin A deﬁciency:

Vitamin A deﬁciency results from low dietary intake of preformed vitamin A from animal products and carotenoids from fruits and vegetables. Vitamin A plays an important part in erythropoiesis and has been shown to improve hemoglobin concentration and increase the eﬃcacy of iron supplementation ([Fishman *et al.*, 2000](#_ENREF_35)). The pregnant women are particularly vulnerable to Vitamin A deficiency, particularly during the last trimester of pregnancy when demand by both the fetus and the mother is highest. The mechanisms are not fully understood, but are suggested to operate through eﬀects on transferrin receptors aﬀecting the mobilization of iron stores, increasing iron absorption, stimulating erythroid precursors in the bone marrow, and reducing susceptibility to infections ([Balarajan *et al.*, 2011](#_ENREF_15)). Hence, Vitamin A deficiency plays role in the prevalence of anemia. Women with a low serum retinol concentration were more than twice as likely to be anemic compared with those with a higher serum retinol concentration, suggesting that vitamin A deﬁciency decreases hemoglobin synthesis ([Dreyfuss *et al.*, 2000](#_ENREF_31)).

Protein deficiency:

Decreased dietary intake of protein may lead to mild to moderate anemia. This protein deficiency anemia is seen in vegans, vegetarians, elderly, endurance athletes, anorexia nervosa and people of diminished intake of protein for any cause. Anemia caused due to protein is also called as hypo proliferative anemia and may even develop in people with chronic liver disease, chronic kidney disease and low function thyroid. Inadequate intake of protein slows down the body metabolism. Decreased metabolic activity resulted from protein deficiency impairs the release of erythropoietin (EPO) hormone, which causes decreased production of RBC leading to anemia.

Nutritional deficiency anemia can be prevented through a diet that meets the dietary guidelines ordinarily having enough iron, folate, and vitamin B 12. Women of child bearing age are well advised to take supplemental iron and folic acid, and preterm infants are often prescribed iron supplements.

**2.3.2 Loss of blood or destruction of RBCs**

RBCs can be lost through bleeding, which often can occur slowly over a long period of time, and can go undetected. This kind of chronic bleeding commonly results from the following:

* Gastrointestinal conditions such as ulcers, hemorrhoids, gastritis (inflammation of the stomach), and cancer.
* Use of non-steroidal anti-inflammatory drugs (NSAIDs) such as aspirin or ibuprofen, which can cause ulcers and gastritis.
* Menstruation and childbirth in women, especially if menstrual bleeding is excessive and if there are multiple pregnancies
* Accidental hemorrhage
* Parasitic infestation and malarial infection
* Inherited conditions, such as sickle cell anemia and thalassemia
* Chronic diseases like cancer, HIV/AIDS, rheumatoid arthritis, kidney disease, Crohn's disease, celiac disease, tuberculosis

**2.3.3 Decreased or faulty RBCs production**

In some cases of anemia, the body may produce too few blood cells or the blood cells may not function correctly. RBCs may be faulty or decreased due to abnormal red blood cells or a lack of minerals and vitamins needed for red blood cells to work properly. Some of the stem cells found in bone marrow develop into red blood cells. If stem cells are too few, defective, or replaced by other cells such as metastatic cancer cells, anemia may result. Other conditions like advanced kidney disease, hypothyroidism, other chronic diseases, such as cancer, infection, lupus, diabetes, and rheumatoid arthritis as well as old age leads to the formation of too few hormones necessary for RBC production which causes anemia.

**2.3.4 Other underlying causes**

Globally, many studies had reported different socioeconomic, demographic and clinical characteristics of pregnant woman may affect the magnitude of anemia ([Elashiry *et al.*, 2014](#_ENREF_34)). The predisposing factors include grand multiparity, low socio-economic status, maternal infection, late prenatal care and inadequate spacing of children (Broek *et al*., 2000). Regarding other socio-demographic factors, being from lower economic and education category, and living in rural areas were identified as predisposing factors to anemia ([Gebremedhin and Enquselassie, 2011](#_ENREF_37)). Similarly, the high prevalence of anemia was attributed to limited access to nutrition and health education information which lead to low uptake and utilization of the public-health intervention package to combat anemia in pregnancy ([Mbule *et al.*, 2012](#_ENREF_70)). Maternal height, age of marriage, parity and foetal loss also contributed to hemoglobin level (Agarwal *et al*., 2006). Consumption of tea also inhibits the absorption of non-heme iron to a significant extent ([Disler *et al.*, 1975](#_ENREF_30)), which, on the contrary, does not exert any appreciable effect on heme iron assimilation ([Gabrielli and Sandre, 1995](#_ENREF_36)).

The risk factors that are involved are young age, educational status, poor birth spacing, repeated cycles of reproduction and lack of compliance to iron and folic acid supplementation ([Noronha *et al.*, 2012](#_ENREF_79)). A study by ([Miah *et al.*, 2014](#_ENREF_72)) pertained that girls with menstrual blood flow of 2-3 days were less anemic (7.4%) as compared with those with menstrual bleeding of more than 5 days (35.48%). Cultural beliefs, taboos and inappropriate food practices in our society are also the causes of anemia.

**2.4 Symptoms of Anemia**

At first anemia can be so mild that it goes unnoticed. But symptoms worsen as anemia worsens. Anemia signs and symptoms vary depending on the cause of anemia. Some of the common symptoms may include: Fatigue, weakness, Headache**,** pale or yellowish skin, Irregular heartbeats, Shortness of breath, Pounding or "whooshing" in your ears, dizziness or lightheadedness, Chest pain, Cold hands and feet, Leg cramps, Difficulty concentrating, Insomnia. Symptoms of anemia in children may include impaired mental or motor development. Other symptoms associated with specific forms of anemia are:

* Hunger or craving for strange substances such as paper, ice, or dirt (a condition called pica), upward curvature of the nails, soreness of mouth and tongue are common during IDA.
* A tingling sensation in the hands or feet, Loss of sense of touch, an unsteady, wobbly gait and difficulty walking, Clumsiness and stiffness of the arms and legs and Dementia are observed in anemia caused vitaminB12 deficiency.
* Jaundice (yellow skin and eyes), Brown or red urine, Leg ulcers, Failure to thrive in infancy, Symptoms of gallstones are common signs of chronic RBC destruction while Abdominal pain, Brown or red urine, Jaundice (yellow skin and eyes), Small bruises under the skin, Seizures, Symptoms of kidney failure are usually observed during sudden RBC destruction.
* Fatigue, Susceptibility to infection, Delayed growth and development in children, Episodes of severe pain, especially in the joints, abdomen and limbs are common symptoms of SCA.
* Blue-black line on the gums referred to as a lead line, Abdominal pain, Constipation, Vomiting, Seizures in severe cases, especially in children are the common symptoms of anemia caused by chronic lead poisoning.

**2.5 Consequences of Anemia**

Anemia can affect psychological and physical behavior. Even very mild forms influence the sense of wellbeing, lessen resistance to fatigue, aggravate other disorders and affect work capacity ([WHO, 1992](#_ENREF_105)). Anemia or low concentrations of hemoglobin, adversely affect cognitive and motor development and cause fatigue and low productivity ([Stevens *et al.*, 2013 59](#_ENREF_93)). The negative effects of anemia can be premature birth, low birth weight, infant mortality and maternal morbidity and mortality ([Allen, 2000](#_ENREF_8)). Anemia in pregnancy is considered one of the major risk factors contributing to maternal deaths in developing countries ([Abouzahr and Royston, 1991](#_ENREF_1)). It is estimated that anemia causes more than 115,000 maternal and 591,000 perinatal deaths globally per year ([Salhan *et al.*, 2012](#_ENREF_85)). Severe anemia is associated with small for gestational age infants, as well as low Apgar score and high perinatal mortality. The risk of preterm delivery and low birth weight among the anemic women was 4 and 1.9 times more respectively than the non-anemic women. The neonates of anemic women also had 1.8 times increased risk having low Apgar scores at 1 minute and there was a 3.7 greater risk of intrauterine fetal death among the anemic women than the non-anemic women ([Lone *et al.*, 2004](#_ENREF_61)).

The Severe maternal anemia carries significant risk of hemorrhage and infection in the mother as well as maternal death due to decompensated cardiac failure ([Jaleel and Khan, 2008](#_ENREF_46)), delayed physical recovery following pregnancy (Hyder *et al*., 1998). The study done in North East India showed that complications like night blindness, swelling of legs, face and body, excessive fatigue are more common among severely anemic women ([Gogoi and Prusty, 2013](#_ENREF_39)). There was increased risk of pregnancy induced hypertension, postpartum hemorrhage, incidence of wound infection among severely anemic pregnant women (Ghimire and Ghimire, 2013). IDA in infants and children can cause impaired motor development and co-ordination, impaired language development and scholastic performance, psychological and behavioural effects (inattention, fatigue, insecurity etc.), decreased physical activity, decreased resistance to infection ([Awasthi *et al.*, 2005](#_ENREF_12)) and impaired immune functions (Kaur, 2014). Folic acid deficiency anemia has been associated with pregnancy complications and congenital malformation as well as neural tube defects in newborns ([Scholl and Johnson, 2000](#_ENREF_86)). Anemia if left untreated for long periods of time, it can damage the heart, brain, and other vital organs ([Wikipedia, 2017](#_ENREF_112)).

**2.6 Nutritional Need of Pregnant women**

Nutritional status is an indication of the overall well being of a population. Adequate nutritional status of women is important for good health and increased work capacity of women themselves as well as for the health of their offspring (Black *et al*., 2008). Pregnancy is a demanding physiological state. As a result of the normal physiological changes in pregnancy, plasma volume expands by 46–55%, whereas red-cell volume expands by 18–25% (Broek, 2003). The additional energy and nutrient should be contained in the daily diet of a woman. Vitamins and minerals, referred to collectively as micronutrients, have important influences on the health of pregnant women and the growing fetus (Black, 2001). Some micronutrients are specially required in extra amounts during these physiological periods. The daily requirements for iron as well as folate are six times greater for a woman in the last trimester of pregnancy than for a non pregnant woman ([Singh *et al.*, 2013](#_ENREF_91)).

According to WHO, women of childbearing age need to absorb 2-3 times the amount of iron required by men or older women ([WHO, 2000](#_ENREF_106)). The expansion of plasma volume, increase in erythropoiesis and increased demand of the fetoplacental unit for iron occur throughout gestation. Vitamin A is believed to be essential for normal embryogenesis, hematopoiesis, growth and epithelial differentiation. In pregnancy, extra vitamin A is required for growth and tissue maintenance in the fetus, for providing it with reserves and for maternal metabolism.

In many developing countries, it is difficult to meet daily nutrient requirements with diet alone especially for pregnant women. Animal products and fats are often relatively expensive and in addition, there may be food taboos which influence dietary intake in pregnancy. The benefit of multiple micronutrient supplements is therefore being considered ([Huffman *et al.*, 1998](#_ENREF_45)). Poor nutrition is indicative of greater health risk to both mother and children born to them ([Branca *et al.*, 2015](#_ENREF_22)). Improper dietary intake pattern in women of reproductive age in Nepal has resulted in the deficiency of essential nutrients. Adequate nutritional status and proper dietary intake pattern of women improves maternal and child health (Bhandari *et al*., 2016). The nutritional status of a woman before and during pregnancy is important for a healthy pregnancy outcome ([Semba and Victora, 2008](#_ENREF_88)). Adequate nutrition, a fundamental cornerstone of any individual's health, is especially critical for women because inadequate nutrition wreaks havoc not only on women's own health but also on the health of their children. Children of malnourished women are more likely to face cognitive impairments, short stature, lower resistance to infections, and a higher risk of disease and death throughout their lives ([Ransom and Elder, 2003](#_ENREF_83)).

**Table-2.2:** Recommended Daily Allowances for Pregnant women

|  |  |  |  |
| --- | --- | --- | --- |
| Nutrients | Sedentary worker | Moderate worker | Heavy worker |
| Energy kcal/day | 2250 | 2580 | 3200 |
| Protein g/day | 78 | 78 | 78 |
| Fat g/day | 30 | 30 | 30 |
| Calcium mg/day | 1200 | 1200 | 1200 |
| Iron mg/day | 35 | 35 | 35 |
| Vitamin A µg/day  Retinol  β –carotene | 800  6400 | 800  6400 | 800  6400 |
| Thiamin mg/day | 1.2 | 1.3 | 1.6 |
| Riboflavin mg/day | 1.4 | 1.6 | 1.9 |
| Nicotinic- acid | 14 | 16 | 18 |
| Pyridoxin mg/day | 2.5 | 2.5 | 2.5 |
| Ascorbic acid mg/day | 60 | 60 | 60 |
| Folic acid µg/day | 500 | 500 | 500 |
| Vitamin B12 µg/day | 1.2 | 1.2 | 1.2 |

Source: (ICMR, 2010)

**2.7 Assessing anemia**

Hemoglobin (Hb) assessments are the most reliable indicator widely used to screen individuals for anemia. Measuring Hb concentration is relatively easy and inexpensive, and this measurement is frequently used as a proxy indicator of iron deficiency. However, anemia can be caused by factors other than iron deficiency ([Benoist *et al.*, 2008](#_ENREF_17)). The cyanmethemoglobin and the HemoCue system are the methods generally recommended for use in surveys to determine the population prevalence of anemia. The HemoCue system is a reliable quantitative method widely used for determining hemoglobin concentrations in field surveys, based on the cyanmethemoglobin method which has been shown to be stable and durable in field settings. It is portable, requires only a small sample of capillary/venous blood, is relatively inexpensive and simple to use, does not require access to refrigeration or even electricity, and gives immediate, digitally displayed results ([Jahr *et al.*, 2002](#_ENREF_6)).

In this study, the cyanmethemoglobin method was used for determining hemoglobin concentration in the blood sample of study participants. The cyanmethemoglobin method is the best laboratory method for the quantitative determination of hemoglobin. It serves as a reference for comparison and standardization of other methods. A fixed quantity of blood was diluted with a reagent (Drabkins solution) and hemoglobin concentration was determined after a fixed time interval in an accurate, well-calibrated photometer ([WHO, 2001b](#_ENREF_108)).

**Table-2.3:** Hemoglobin thresholds used to define anemia

|  |  |
| --- | --- |
| Age or gender group | Hb threshold (g/l) |
| Children (0.50–4.99 yrs) | 110 |
| Children (5.00–11.99 yrs) | 115 |
| Children (12.00–14.99 yrs) | 120 |
| non-pregnant women(≥15.00 yrs) | 120 |
| pregnant women | 110 |
| men(≥15.00 yrs) | 130 |

Source: (WHO, 2001)

**Table-2.4:** Blood Hemoglobin Values (g/dl) Defining Anemia in Pregnant Women

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Types of Anemia | | | |
| Normal | Mild anemia | Moderate anemia | Severe anemia |
| Pregnant women | ≥11 | 10.0-10.9 | 7.0-9.9 | <7.0 |

Source: (WHO, 2011)

**2.8 Assessment of Nutritional status through MUAC and BMI**

Nutritional status of pregnant women was measured by MUAC and BMI.

**2.8.1 MUAC**

Measurement of the circumference of the mid upper arm is proved to be useful and practical means of assessing protein- calorie deficiency of individual. The use of mid-upper-arm circumference (MUAC) as a screening measure for assessing under-nutrition has the following advantages are it makes use of simple equipment, it is easy to carry to field sites, and requires minimal training ([Jeyakumar *et al.*, 2013](#_ENREF_47)). The MUAC measurement is usually used to screen and assess for acute malnutrition among children by increasing the reach and enhancing the quality of Community-Based Management of Acute Malnutrition (CMAM) services ([Collins *et al.*, 2006](#_ENREF_27)). Increasingly, MUAC is also being used to assess nutritional status and determine eligibility for nutrition support among adolescents and adults in low-resource settings, especially among pregnant women ([Bahwere *et al.*, 2011](#_ENREF_13)). Various studies have found increased risk among mothers with low MUAC during pregnancy reporting the association between low MUAC and poor birth outcomes as well as poor maternal health outcomes, including anemia among pregnant women ([Tang *et al.*, 2013](#_ENREF_96)).

The adult MUAC tape was used for the measurement of mid upper arm circumference of adults. It is now a standard stock item. The tape is not color coded, as there is no agreement as yet on a universal colour code. Graduation was in millimeters and can be used for taking measurements of MUAC up to 50 cm ([UNICEF, 2016](#_ENREF_102)).

Classification of MUAC for adults

SAM- <21 cm

MAM- <23 cm

**2.8.2 Body Mass Index**

The most useful measure of malnutrition in adults is the body mass index ([WFP, 2004](#_ENREF_104)). Height and weight are the most commonly used measures, not only because they are rapid and inexpensive to obtain, but also because they are easy to use. BMI is accepted as a better estimate of fatness and health risk than body weight. This index does not require any standard tables. BMI is calculated by dividing the weight (in kilograms) by the height (in meters square).

BMI= weight (kg)/ height (m2)

**Table-2.5:** BMI cut offs points for Asian

|  |  |
| --- | --- |
| Classification | BMI(kg/m2) cut-off points |
| Under weight | <18.5 |
| Normal | 18.5-24.99 |
| Over weight | 25-29.99 |
| Obese | ≥30 |

Source: (WHO, 2004)

Regardless of BMI, those women who gained the recommended amount of weight in pregnancy had fewer adverse outcomes ([Crane *et al.*, 2009](#_ENREF_28)).

**Table-2.6:** Recommended weight gain for pregnant women based on BMI

|  |  |
| --- | --- |
| Weight category based on BMI | Total weight gain (kg) |
| Under weight | 12.5-18 |
| Normal | 11.5-16 |
| Over weight | 7- 11.5 |
| Obese | 6 |

Source: (Srilakshmi, B., 2014)

**2.9 Prevalence of Anemia**

**2.9.1 International Scenerio**

Anemia is a major public health problem aﬀecting 1.62 billion people globally, among which 56 million are pregnant women ([Mclean *et al.*, 2009](#_ENREF_71)). The WHO estimated that worldwide, 24.8% of the world’s population, 43% of children, 38% of pregnant women, and 29% of non pregnant women and 29% of all women of reproductive age have anemia globally ([WHO, 2015](#_ENREF_111)). In the report ʻBloodʼ it was found that while the global prevalence of anemia decreased between 1990 and 2010 (from 40.2% to 32.9%), the disease remains responsible for a significant burden on society, with an increase in global years lived with disability (YLDs) from 65.5 million to 68.4 million over the 20-year period. By comparison, this global disease burden is greater than burden associated with major depression (63.2 million YLDs), chronic respiratory diseases (49.3 million YLDs), and general injuries (47.2 million YLDs) ([Sciences, 2013](#_ENREF_87)). In 2011, 29% (496 million) of non-pregnant women and 38% (32.4 million) of pregnant women aged 15–49 years were anemic ([Stevens *et al.*, 2013](#_ENREF_93)).

**Table-2.7:** Global and WHO regional mean blood hemoglobin concentration and prevalence of anemia among pregnant women

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| WHO region | Mean blood hb concentration (g/L) | % of PW with anemia | No. of PW with anemia (millions) | % of PW with severe anemia | No of PW with severe anemia (millions) |
| African Region | 111 | 46.3 | 9.2 | 1.5 | 0.3 |
| Region of the Americas | 119 | 24.9 | 2.4 | 0.3 | 0.0 |
| South-East Asia Region | 110 | 48.7 | 11.5 | 1.1 | 0.3 |
| European Region | 118 | 25.8 | 1.8 | 0.3 | 0.0 |
| Eastern Mediterranean Region | 113 | 38.9 | 3.9 | 1.1 | 0.1 |
| Western Pacific Region | 119 | 24.3 | 3.6 | 0.4 | 0.1 |
| Global | 114 | 38.2 | 32.4 | 0.9 | 0.8 |

Source: (WHO, 2015)

Anemia has major consequences on human health as well as social and economic development. Anemia continues to be an endemic problem of large magnitude, and the increasing trends in several developing countries point to the failures of existing approaches to alleviate this burden. Anemia is the world’s second leading cause of disability and is responsible for about 1 million deaths a year, of which three-quarters occur in Africa and South-east Asia. Africa and Asia are the most heavily aﬀected regions, with Africa having the highest prevalence of anemia, and Asia bearing the greater absolute burden ([Benoist *et al.*, 2008](#_ENREF_17)).

Anemia in pregnancy is a common and worldwide problem that deserves more attention. The WHO estimates that about 56% of pregnant women in low- and middle income countries (LMICs) and 23% in high-income countries (HICs) are anemic. The highest prevalence of anemia exists in the developing world where its causes are multi-factorial ([Tolentino and Friedman, 2007](#_ENREF_97)).

Worldwide, anemia contributes to 20% of all maternal deaths ([Driskell, 2008](#_ENREF_32)). Anemia in pregnancy in the highlands of Tanzania was found to be 22.7%, where the higher risk of anemia was seen at higher maternal age, increased gestation period, rainy season and malarial infection ([Hinderaker *et al.*, 2001](#_ENREF_43)). The prevalence of anemia was high among pregnant women of Ethiopia 52% with diarrhea and previous history of malaria ([Mihiretie *et al.*, 2015](#_ENREF_73)). Another study conducted in Ethiopia to estimate the prevalence of anemia among pregnant women found anemia prevalence of 19.7% where meal frequency less than 2 per day, low dietary diversity score, parity and meat consumption less than once per week were the factors affecting anemia in pregnant women ([Abriha *et al.*, 2014](#_ENREF_2)). Similar other studies done in different parts of Ethiopia reported anemia prevalence during pregnancy as 29.4% ([Haidar and Pobocik, 2009](#_ENREF_41)). Intake of less dark green leafy vegetables, chicken, being in 1st trimester, HIV infection and medication were positively associated with anemia (Tadesse *et al*., 2017).The study done in pregnant women attending ANC in Southern Ethiopia found 39.94% of anemic patients, of which the majority had moderate anemia. Age 15-24 years, family size >5, having low income, multigravida, intestinal parasitic infection, current clinical illness, being in third trimesters, history of excess menstrual bleeding and low body mass index were identified as independent predictors of anemia among pregnant women ([lealem *et al.*, 2015](#_ENREF_58)).

High prevalence of 61.6% anemia in pregnancy was seen in Southern Ethiopia with higher prevalence of mild anemia which was more common during third trimester and primigravida ([Lelissa *et al.*, 2015](#_ENREF_59)). In an Urban area of Eastern Ethiopia, more than half (56.8%) of the pregnant women studied were anemic, Gravidity and trimester were important variables which had shown a significant association with anemia in the study ([Alene and Dohe, 2014](#_ENREF_7)). The study done in Northwest Ethiopia reported anemia prevalence of 21.6% where over half of pregnant women attended ANC in second trimester. The study also showed that pregnant women with age>34, rural residence, history of malaria attack, hookworm infection and absence of iron supplements were at increased risk of anemia ([Alem *et al.*, 2013](#_ENREF_6)). A study on prevalence of anemia in Nigeria found that 43.5% of pregnant women were anemic where increased maternal age and reduced number of ANC visits were statistically significant factors to be associated with anemia in pregnancy ([Bassi *et al.*, 2016](#_ENREF_16)). A study in South Africa showed that 42.7% of women were anemic during pregnancy and majority were mildly anemic where the higher prevalence was seen in HIV-positive pregnant women ([Tunkyi and Moodley, 2016](#_ENREF_98)).

The study done by ([Mbule *et al.*, 2012](#_ENREF_70)) reported 63.1% of anemia among pregnant women in rural Uganda. A study in Kenya by ([Nduhiu-Githinji, 2010](#_ENREF_78)) revealed anemia prevalence during pregnancy was 36.2%. Similar studies done to find anemia prevalence among pregnant women in Ghana and Palestine represented 57.1% ([Amengor *et al.*, 2005](#_ENREF_10)) and 38.6% ([Khader *et al.*, 2009](#_ENREF_53)) of anemia respectively. Low parity and young age, malarial parasites, hookworm infestation were the associated factors of low hb level during pregnancy. The prevalence of anemia in pregnant women in Northern Nigeria was 30% where the most common cause of anemia was iron deficiency ([VanderJagt *et al.*, 2007](#_ENREF_103)). Anemia in pregnant women in eastern Sudan was found to be 62.6% ([Adam *et al.*, 2005](#_ENREF_4)) where malaria and pica were the major risk factors. A cross-sectional survey done on Risk factors for iron-deﬁciency anemia among pregnant women living in rural Vietnam found 43.2% of anemia prevalence during pregnancy with risk factors including lack of iron intake, hookworm infestation and preference for traditional medicine ([Aikawa *et al.*, 2006](#_ENREF_5)). A study among pregnant women in Malaysia showed 35% of anemia prevalence. The prevalence was higher in the teenage group, grandmultiparas and the third trimester and from urban residence ([Haniff *et al.*, 2007](#_ENREF_42)).

The study on Etiology of anemia in pregnancy in south Malawi showed the anemia prevalence of 57% with 23% iron deficient only, 33% deficient in iron and one or more of the micronutrients studied, and 26% were not iron deficient but had evidence of another micronutrient deficiency, most often vitamin A (Broek *et al*., 2000). In an East Anatolian province, Turkey, anemia prevalence of 27.1% was seen among pregnant women where the risk factors included low family income, pica and being at third trimester. Of the anemic women, 50% had iron deficiency, 34.5% were deficient in vitamin-B12 and 71.7% were deficient in folate ([Karaoglu *et al.*, 2010](#_ENREF_51)).

South Asian countries represents Quarter of the World’s population with 1.5 billion people facing formidable health challenge of which anemia is still a persistent one. Anemia prevalence is estimated to be even higher among pregnant women in South Asia, being highest in India ([Kalaivani, 2009](#_ENREF_49)). In Asia 65% of the pregnant women are anemic compared to 14% in Europe ([Srilakshmi, 2014](#_ENREF_92)). Prevalence of anemia in India is among the highest in the world. Prevalence of anemia is higher among pregnant women and preschool children. In the study done in Mangalore, among 636 pregnant women, 36.7% were primigravidas, 63.2% were multigravidas, patients 94.18% were in age group 20-34, 2.83% were teenage pregnancies and 45.28% were found to be anemic, in which majority were mild anemic (38.20%), followed by moderate (6.28%), and 0.79% were severe anemic. The study concluded that in developing countries like India prevalence of anemia is very high which adversely affect both maternal and fetal outcome which is directly linked to low birth weight, prematurity, poor APGAR score and neonatal death and maternal morbidity and mortality ([Prakash *et al.*, 2016](#_ENREF_82)).

A hospital based study in North India found the anemia prevalence 60% during pregnancy which showed that anemia is strongly associated with LBW, preterm delivery and early neonatal death ([Chauhan and Tomar, 2013](#_ENREF_26)). Anemia was found to be more prevalent in pregnant women aged more than 30 years, illiterate, working and those belonging to Muslim community. Similarly, Multiparous women, women with poor personal hygiene and non-vegetarian diet were slightly more anemic as compare to their contrary one, with the prevalence of 43.38% (Agarwal *et al*., 2011).

According to a study done in rural India, anemia was present in the majority of children <10 years, women after puberty, and older adults. Children <5 years had the highest prevalence of anemia; especially children aged 1-2 years ([Alvarez-Uria *et al.*, 2014](#_ENREF_9)). The study done to identify prevalence of anemia in specified population in south India and to know various adverse consequences of anemia in mother and child found maternal anemia as 60% and there was 2.5 to 3.5 times increase in LBW, preterm delivery and early neonatal death in anemic group ([Dayal and Dayal, 2014](#_ENREF_29)). Similar, other studies done in different parts of India reported the anemia prevalence of 40% ([Kumari and Priya, 2016](#_ENREF_56)), 87.21% ([Lokare *et al.*, 2012](#_ENREF_60)), 43.4% ([Bivalkar *et al.*, 2014](#_ENREF_20)), 73.1% ([Gupta *et al.*, 2016](#_ENREF_40)), 69.9% ([Jaleel and Khan, 2008](#_ENREF_46)). From these studies it was seen that factors such as religion, level of education of women and their husbands and socioeconomic status were found to be significantly associated with the prevalence of anemia in pregnancy. In the study among pregnant & lactating women in India the anemia prevalence of 68.1% and 65.8% were found in pregnancy and lactation respectively (Agarwal *et al*., 2006).

**Table-2.8:** Prevalence of anemia among pregnant women in South Asian countries

|  |  |
| --- | --- |
| South Asian countries | Total % of Pregnant Women with anemia |
| Afghanistan | 44 |
| Bangladesh | 48 |
| Bhutan | 46 |
| Maldives | 39 |
| Nepal | 44 |
| India | 54 |
| Pakistan | 51 |
| Sri Lanka | 26 |
| South Asia | 52 |

Source: (The World Bank, 2013)

The prevalence of anemia was seen high among pregnant women in Pakistan according to the findings of the studies done by ([Shahani *et al.*, 2012](#_ENREF_90)) 71% and ([Ullah *et al.*, 2013](#_ENREF_99)) 67.6%. Even higher prevalence of 90.5% was found in the study done by ([Baig-Ansari *et al.*, 2008](#_ENREF_14)) which indicated that pica, tea consumption, and low intake of eggs and red meat were associated with anemia. The study on Maternal anemia and its impact on perinatal outcome in a tertiary care hospital in Pakistan reported the prevalence of 49.8% maternal anemia with the perinatal outcomes like preterm delivery, low birth weight, intrauterine growth retardation, perinatal death, low Apgar scores and intrauterine fetal death ([Lone *et al.*, 2004](#_ENREF_61)). A study done in the rural Bangladesh among pregnant women also reported high prevalence of anemia, 50% where two out of three anemic women and four out of ten non-anemic women had an indication of ID (Hyder *et al*., 2004). On the surface, anemia seems to be simply a physical ailment, the result of low iron and protein intake, perhaps aggravated by hookworm, malaria, or hemorrhage. But anemia is much more complex. It is a symptom of serious socio-economic and political illness ([Kaur, 2014](#_ENREF_52)).

Nutritional anemia is the most common anemia in South Asia ([UNICEF, 2002](#_ENREF_101)). Nutritional anemia in South Asia accounts for nearly half of global cases of anemia. Iron deficiency is the major underlying factor in anemia in this region ([Seshadri, 2001](#_ENREF_89)). There had also been done several studies to find out the IDA prevalence among pregnant women. Previous study on IDA among pregnant women had revealed the prevalence of 21.7% in Palestine done by ([Abu-Hasira, 2007](#_ENREF_3)). The data of the study done in South China showed that more than 70% of pregnant women had iron-deficiency anemia during pregnancy ([Huang *et al.*, 2015](#_ENREF_44)). Another study done in Nepal had reported the IDA prevalence of 24.52% during pregnancy ([Raut *et al.*, 2014](#_ENREF_84)). The study done in eastern Nepal reveals that IDA was most frequent in the female age group of 21-40, that the rate of incidence was very much associated with pregnancy who needed iron supplementation and caring for the decrease of the incidence and complications. The study also reported the prevalence of 25.57% IDA among people of Morang district (Sinha *et al*., 2011).

**2.9.2 National Scenerio**

In national context, there had been many studies on anemia in pregnancy in Nepal. Though Nepal has decreasing trend of prevalence of anemia, it is still high (48% in 2011). According to the National Demographic and Health Survey 2011, 35% of women age 15-49 are anemic, pregnant women were more likely to be anemic (48%) than women who were breastfeeding (39%) and women who were neither pregnant nor breastfeeding (33%). Anemia was more prevalent among women in rural areas and terai region ([MOHP *et al.*, 12012](#_ENREF_76)). Anemia has been recognized as a serious public health problem in Nepal for many years ([Pokharel *et al.*, 2011](#_ENREF_80)). A Study conducted in Kathmandu showed the prevalence of anemia during pregnancy was 42.6% and it was also reported that the birth weight, Apgar score at the time of birth, prevalence of preterm delivery and IUFD were more common in anemic group than in non-anemic group ([Marahatta, 2008](#_ENREF_68)).

**Table-2.9:** Prevalence of anemia among Nepalese women (15-49 years) in NDHS, 2011

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | | Anemia status (in %) by hemoglobin level | | |
|  |  | Any anemia | Mild | Moderate | Severe |
| Back ground | Non Pregnant | <120g/l | 100-119 g/l | 70-99 g/l | <70 g/l |
| Characteristic | Pregnant | <11 g/l | 100-119 g/l | 70-99 g/l | <70 g/l |
| **Age**(years) |  |  |  |  |  |
| 15-19 |  | 38.6 | 32.5 | 5.7 | 0.4 |
| 20-24 |  | 36.8 | 30.6 | 6 | 0.2 |
| 25-29 |  | 35.1 | 28.8 | 5.9 | 0.3 |
| 30-39 |  | 32.4 | 26.1 | 6 | 0.3 |
| 40-49 |  | 31.1 | 26.2 | 4.7 | 0.2 |
| **Residence** |  |  |  |  |  |
| Urban |  | 27.8 | 22.7 | 4.9 | 0.2 |
| Rural |  | 35.8 | 29.7 | 5.8 | 0.3 |
| **Ecological Zone** |  |  |  |  |  |
| Mountain |  | 26.7 | 21.1 | 5.2 | 0.3 |
| Hill |  | 26.5 | 22.3 | 3.8 | 0.4 |
| Terai |  | 41.9 | 34.6 | 7.1 | 0.2 |
| Total |  | 34.8 | 28.8 | 5.7 | 0.3 |

Source: ([Khadka, 2012](#_ENREF_54))

The study on the prevalence of anemia in pregnant Nepali women done in Kathmandu, observed prevalences of anemia and severe anemia were 62.2% and 3.6%, respectively. In the study, high prevalence of anemia was observed among teenagers, farmers, women of short height, the ethnic groups Lama/Sherpa/Tamang, and women married to industrial workers or illiterate men. Also, the risk of anemia increased with gestation ([Bondevik *et al.*, 2000](#_ENREF_21)). In the hospital based study done in Kathmandu, among 53 participants overall prevalence of anemia was 37.74%. The study also found that the prevalence of IDA among pregnant women was 24.52% and the prevalence of IDA among anemic pregnant women was 65%. The study suggested that there is high chance of being iron deficient in case of the anemic pregnant women who have not taken iron supplements ([Raut *et al.*, 2014](#_ENREF_84)). The high prevalence of anemia 72.6% and 80.6% of IDA were seen among pregnant women in plains of Nepal ([Dreyfuss *et al.*, 2000](#_ENREF_31)).

In the study done by ([Jiang *et al.*, 2005](#_ENREF_48)) multiple micronutrient deﬁciencies were common among pregnant women and the prevalence of anemia was 33% in rural Nepali pregnant women. In the study done in Western Nepal, out of 512 pregnant women 41.02% were anemic where the majority of them were mildly anemic, from the age group of (20-35) years and at second trimester ([Singh *et al.*, 2013](#_ENREF_91)). The findings of the study done on Dietary intake patterns and nutritional status of women of reproductive age in Nepal showed that pregnant women were five times more likely to be anemic than non-pregnant women and the women of age 15 to 24 years were 2.7 times more likely to be malnourished than women of 35 to 49 years age (Bhandari *et al*., 2016). The prevalence of anemia and IDA in rural Nepali pregnant women were 51% and 69.4% respectively, the risk factors of anemia included hookworm infestation, impaired dark adaptation, lack of iron supplement intake, a diet low in heme iron and malnutrition manifested by thinness and short stature ([Makhoul, 2007](#_ENREF_65)).

The burden of anemia in pregnant population is still high in eastern region of Nepal (Ghimire and Ghimire, 2013). A hospital based study done in Eastern Nepal by (Shah and Baig, 2005) revealed that 58.9% of pregnant women had anemia which was significantly associated with hookworm infestation and education. In the hospital based study done among pregnant women who were attended the Birat Hospital and Research Centre, Biratnagar, Nepal, out of 364 subjects, 172 (47.25%) were diagnosed as anemic where the majority of these anemic pregnant women were found to be mildly anemic (68.60%). The study showed that the prevalence of anemia was higher among pregnant women at second trimester and also at the 20-35 years age group (Sinha *et al*., 2012). Another study by ([Maskey *et al.*, 2014](#_ENREF_69)) found the anemia prevalence of 46.6% among pregnant women of Eastern Nepal. The study showed the cases of mild anemia and moderate anemia were 51.0% and 49.0% respectively and the risk factors of anemia included: history of complications during previous pregnancy, education, age at marriage, low socioeconomic status, gravidity and parity, poor knowledge about anemia, abnormal body mass index and smoking.

In the study of General health status of women of reproductive age in Nepal the prevalence of anemia in women of Terai was 24.7% while in Hill it was 26.0% where more than half of pregnant women were anemic (Bhandari *et al*., 2014). In a cross sectional study conducted in a Government School of Dharan by ([Kanodia *et al.*, 2016](#_ENREF_50)), among total 433 participants, whose clinical and demographic profile were recorded and analyzed, the prevalence of anemia was found to be 51.3% among adolescent girls, which was more prevalent in pre-menarche age and undernourished girls. According to a study on the prevalence of anemia among non-pregnant and pregnant women of reproductive age in Nepal, the 35.8% of non-pregnant and 42.7% of pregnant women were found to b e anemic ([Bhandary and Shrestha, 2011](#_ENREF_19)).With the onset of menstruation and associated blood loss, there is a further rise in prevalence and severity of anemia in adolescent girls (Beard, 2000). Some studies done in anemia prevalence among adolescent girls reported high prevalence of 68.7% ([Murteli and Patil, 2015](#_ENREF_77)). Early detection and effective management of anemia in pregnancy can lead to substantial reduction in under nutrition in childhood, adolescence and improvement in adult height and reduction in maternal mortality ([Mahmood *et al.*, 2014](#_ENREF_64)).

**Part III**

**Materials and Methods**

**3.1 Research Design**

A cross-sectional hospital based study was conducted among pregnant women age 15-49 years attending antenatal care at primary health care centre, Family Planning Association of Nepal (FPAN), B.P. Koirala Institute of Health Sciences (BPKIHS) of Dharan sub-metropolitan city to assess prevalence of anemia and its associated factors with the help of semi-structured questionnaire and measurements of blood hemoglobin levels, weight, height and MUAC.

**3.2 Study site**

The present study was conducted in Dharan sub-metropolitan city sunsari, Nepal. The city covers the area of 192.61 sq km, and is divided into 20 wards. According to National Population and Housing Census 2011, Dharan sub-metropolitan city constituted 32,693 households with 1, 37, 705 total populations comprising 64,671 males and 73.034 females.

**3.3 Target population**

Pregnant women of age group 15-49 years from Dharan sub-metropolitan city attending ANC at selected health institutes were the target population.

**3.4 Sampling Techniques**

Convenient sampling technique was used to select the study participants

**3.5 Sample size calculation**

The sample size of the study was calculated by using standard statistical Fisher’s formula, n = (z2pq)/d2

Where, n = sample size

z = 95% confidence interval

p = expected prevalence (48%)

q = 1- p (expected non-prevalence)

d = relative desired precision (7%)

Now, Using formula, n = (1.96)2x 0.48x0.52

(0.07)2

= 195.6864 = 196

There might be some non-response condition, so that non- response rate is assumed to be 10% and the final sample size is calculated as:

N=196+10%of 196

=215.6 =216

Therefore, final sample size required for our study is 216 pregnant women. However, a sample of 213 antenatal women was achieved. Three questionnaires were spoilt.

**3.6 Criteria for sample selection**

a. Inclusion criteria

i. Pregnant women of the age between 15-49 years.

ii. Pregnant women who resident in study area.

b. Exclusion criteria

i. Pregnant women with other co-morbidities which directly affects hemoglobin level.

ii. Pregnant women who don’t give consent to participate in the study.

iii. Those who recently report of taking iron supplements or therapy for iron deficiency anemia.

**3.7 Research variables**

Different variables were used in the study which is described below:

a. Dependent variable:

i. hemoglobin level.

b. Independent variable:

i. Demographic and socio-economic variables: Caste, Religion, Family size and Family income

ii. Anthropometric measurements: MUAC, BMI

iii. Sample characteristics: Age, Education level, Age at marriage, Gestational period, Frequency of ANC, Frequency of pregnancy, Intake of deworming tablets, Types of consumers

iv. Dietary practices: Frequency of meal, Frequency of meat consumption, Frequency of fruits consumption, Frequency of egg consumption, Frequency of milk and milk products consumption, Frequency of green leafy vegetables consumptions, Frequency of tea consumption and types of tea consumption.

**3.8 Pretesting**

Pre-testing of questionnaire was performed in 10 pregnant women of the study site to check the clarity and consistency of the tools. Appropriate adjustments were then made and the questionnaire was redesigned according to need.

**3.9** **Data collection techniques**

1. Hemoglobin estimation

The cyanmethemoglobin method was used to determine hemoglobin concentration. It is the best laboratory method for the quantitative determination of hemoglobin.

i. Blood samples were collected from each study participants.

ii. The blood samples were collected in tubes containing solid anticoagulants, such as EDTA.

iii. The spectrophotometer wavelength was set to 540 nm and the absorbance to zero using water as the reference.

iv. A series of labeled test tubes were set for Blank and Tests.

v. 5 ml of the Drabkin’s Solution was added to all the tubes.

vi. 20 µl of the whole blood sample was added to each tube labeled Test, rinsing the pipette 3-4 times with reagent, mixed well and allowed to stand for at least 15 minutes at room temperature (18-26 °C).

vii. Absorbance (A) of each Test versus the Blank as the reference at 540 nm in the same instrument used to prepare the calibration curve was read and recorded.

viii. The total hemoglobin concentration (g/dl) of each Test was determined directly from the calibration curve. Color is stable for several hours.

2. Anthropometric measurements

i. BMI

First, height and weight of participants were determined using Stadiometer and Weighing Balance and those records were used to calculate their respective BMI.

ii. MUAC

Mid upper arm circumference was measured using adult MUAC tape.

a. At First, the tip of the participant's shoulder was located with our fingertips.

b. The participant's left arm was bent at the elbow to make a right angle.

c. The mid-point between the elbow and the shoulder was measured using the tape applied on the arm.

d. The tape was wrapped around the arm at the midpoint mark and the mark was covered with the tape. The end of the tape was put through the slot.

e. The tension of the tape around the arm was checked. The tape was always kept flat on the skin; neither too tight nor too loose.

f. The measurement in the window was noted when the tape is in the correct position.

3. Other variables

Data collection regarding other independent variables such as age, caste, religion, family income, family size, family income, education, age at marriage, gestational period, frequency of pregnancy, frequency of ANC, intake of deworming tablets, eating habits, etc. were done using the questionnaire.

**3.10 Validity and reliability**

Validity and reliability of the study was ensured by pre-testing of the tools, using standardized instruments. Stadiometer and digital weighing balance were calibrated by comparing with the known standards. The pretesting of Questionnaire was done prior to data collection to ascertain clarity, consistency and validity.

**3.11** **Logistical and Ethical considerations**

Prior to the study approval and ethical clearance was obtained from Nepal Health Research Council and permission to conduct survey at Primary health care centre, Family Planning Association of Nepal (FPAN), B.P. Koirala Institute of Health Sciences (BPKIHS) of Dharan sub-metropolitan city was obtained from office of each respective institutes. Verbal as well as written consent from each participant was obtained and the motives and benefits of the study were explained to them. Privacy and confidentiality of the collected information was ensured at all level.

**3.12 Data analysis**

The data was checked for completeness and consistency. The collected data was first edited, organized, coded and entered into statistical package for social science (SPSS) version 20.0. The collected data was analyzed by using both descriptive and inferential statistics.

Descriptive analysis was used to describe the percentages and number distributions of the respondents by socio-demographic characteristics and other relevant variables in the study. Hemoglobin concentration obtained was compared to the WHO hemoglobin level to diagnose anemia at sea level. Anthropometric indices were calculated using reference medians recommended by the World Health Organization (WHO) and classified according to standard deviation units (z-scores), based on the WHO criteria. Cross tabulation and Pearson chi-square tests were used to test the statistical significance and observe any association in the study with significant level p-value was less than 0.05 (95% confidence level).

**Part IV**

**Results and Discussions**

The study involved a total sample size of 213 pregnant women who attended antenatal care (ANC) at different health centers of Dharan sub-metropolitan city.

**4.1** **Prevalence of anemia**

A total number of 213 antenatal mothers of reproductive age 15-49 years were enrolled in the study. The mean Hb level of pregnant women was 11.12 gm/dl and the median was 11.10gm/dl. Similarly, the maximum and minimum values were 15.5 gm/dl and 8.00 gm/dl respectively. Out of 213 women enrolled in the study, 74 (34.74%) were found to be anemic. In terms of severity, 47 (22.06%) were mildly anemic and 27 (12.68%) moderately anemic and there was no severe anemia identified (with Hb<7gm/dl).

**Figure 4.1:** Classification of anemia among study participants (n=213)

According to NDHS (2011), the anemia prevalence among pregnant women of Nepal and Eastern Terai were 48% and 45% respectively. A study done by ([Maskey *et al.*, 2014](#_ENREF_69)) in Eastern Nepal found the prevalence of anemia 46.6% in pregnancy. Similar study by (Sinha *et al*., 2012) showed 47.25% of anemia prevalence among pregnant women of eastern region. Another study on association of anemia with parasitic infestation in pregnant Nepalese women by (Shah and Baig, 2005) mentioned the anemia prevalence of 58.9%. Likewise the various studies done in Kathmandu valley by ([Marahatta, 2008](#_ENREF_68)) and ([Raut *et al.*, 2014](#_ENREF_84)) among pregnant women reported the anemia prevalence of 42.6% and 37.74% respectively. However, ([Bondevik *et al.*, 2000](#_ENREF_21)) found the high prevalence of 62.2%. Another study done by (Shah and Gupta, 2002) among adolescent girls in Dharan found high prevalence of anemia i.e. 68.8%. (Sinha *et al*., 2013) also reported high prevalence of anemia 67.3% among reproductive age women. Similar study done by ([Pomeroy and Jolene, 2014](#_ENREF_81)) in Eastern Terai among women of reproductive age found anemia prevalence of 44.9%. In contrast, the present study has the lower prevalence of anemia as compared to national figure and other studies; this may be due to difference in study area and other associated factors or different methods of the estimation of hemoglobin.

**4.2 Demographic and socioeconomic characteristics and anemia**

**4.2.1 Caste and Religion Distribution and Anemia among pregnant women**

As shown in the Table-4.1 about half of the participants belonged to Janjati community (52.11%) followed by Brahmin/Chhetri (33.80%), Dalit (9.39%) and Madhesi (4.70%). The table also represents that the majority of the participants were Hindus (79.34%) followed by Buddhists (10.80%), others (5.16%) and Christians (4.70%). Religion described as ʻothersʼ here includes kirants, Muslims and Lovism. This study shows that there was no association between hemoglobin levels and demographic factors like caste and religion. Therefore, there was no association of anemia status with caste and religion of the participants. Similar results were observed in the study done in Ethiopia where ethnicity and religion of the respondents did not have association with risk of anemia ([Gebremedhin and Enquselassie, 2011](#_ENREF_37)).

**Table-4.1:** Caste and Religion distribution and anemia among pregnant women

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Caste** | **Percent (%)** | **Anemic (%)** | **Non-anemic (%)** | **P-value** |
| Brahmin/chhetri | 33.80 | 23(31.94) | 49(68.08) | 0.675 |
| Janjati | 52.11 | 38(34.23) | 73(34.27) |
| Madhesi | 4.70 | 5(50) | 5(50) |
| Dalit | 9.39 | 8(40) | 12(60) |
| **Religion** | **Percent (%)** | **Anemic (%)** | **Non-anemic (%)** | **P-value** |
| Hindu | 79.34 | 59(34.91) | 110(65.09) | 0.955 |
| Buddhist | 10.80 | 7(30.43) | 16(69.57) |
| Christian | 4.70 | 4(40) | 6(60) |
| Others | 5.16 | 4(36.36) | 7(63.64) |

**4.2.2** **Family characteristics and anemia**

Table 4.2 shows that about half of the participants (55.40%) were from the family with members less than 5 and 44.60% of participants belonged to families with 5 or more members. Comparatively anemia was mostly prevalent in women with family size 5 and more but it was not statistically significant. Our result is similar to the study done by ([Lone *et al.*, 2004](#_ENREF_61)), (Shah and Baig, 2005), ([Abu-Hasira, 2007](#_ENREF_3)) and ([Gedefaw *et al.*, 2015](#_ENREF_38)).

**Table-4.2:** Family size and anemia among pregnant women

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Family size** | **Percent (%)** | **Anemic (%)** | **Non-anemic (%)** | **P-value** |
| <5 | 55.40 | 35(29.66) | 83(70.34) | 0.083 |
| ≥5 | 44.60 | 39(41.05) | 56(58.95) |

**4.2.3** **Annual family income and anemia**

The annual income of the family was categorized into three groups: income less than 2 lakhs per year, between 2-5 lakhs per year and 5 lakhs or more than 5 lakhs per year. According to Nepal Living Standard survey 2010/11 the nominal average household income per year of the Nepalese family is NRS. 2,02,374 ([CBS, 2011](#_ENREF_24)). In the present study, 48.36% of the women were from the family with annual income between 2-5 lakhs, 47.42% of the women had annual income of the family below 2 lakhs and only 4.22% of the women belong to the family having annual income 5 lakhs or more. The study shows that 44.55% of women with annual family income below 2 lakhs were anemic while the prevalence of anemia was comparatively low among women from family with annual income 5 lakhs or more (22.22%) there was significant association between anemia and economic status of participants (p-value= 0.016). This result is in accordance with the several studies by {([Ullah *et al.*, 2013](#_ENREF_99)); ([Lokare *et al.*, 2012](#_ENREF_60)); ([Mahmood *et al.*, 2014](#_ENREF_64)); ([Mbule *et al.*, 2012](#_ENREF_70))} that incidence of anemia was high among pregnant women with lower socio-economic status. This could be due to the fact that those from lower socioeconomic status (SES) lack the ability to purchase the quality or quantity of foods compared with those from higher SES. In contrast to these results, the study done in Bangladesh did not find any association between economic status and anemia among pregnant women, (Hyder, 2002).

**Table-4.3:** Economic status of family and anemia among pregnant women

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Annual income** | **Percent (%)** | **Anemic (%)** | **Non-anemic (%)** | **P-value** |
| <2 lakhs | 47.42 | 45(44.55) | 56(55.45) | 0.016\* |
| 2-5 lakhs | 48.36 | 27(26.21) | 76(73.79) |
| >5 lakhs | 4.22 | 2(22.22) | 7(77.78) |

**4.2.4 Sample characteristics and anemia**

The mean and median ages of the participants were 24.49 and 24 years with the minimum age of 17 years and maximum age of 40 years. Age wise distribution of participants include 52.11% of participants from age group 15-24 years, 45.07% from 25-34 years and 2.82% were from 35 years and above. Our result shows significant association between age and anemia prevalence. Similar results were found in the studies by ([Bondevik *et al.*, 2000](#_ENREF_21)), ([lealem *et al.*, 2015](#_ENREF_58)), ([Abu-Hasira, 2007](#_ENREF_3)) where the prevalence of anemia were higher among younger pregnant mothers of age group below 24 years. This ﬁnding is in contrast with results from a study by (Shah and Baig, 2005) where no association between maternal age and hemoglobin concentration was found. Studies in Ethiopia ([Gebremedhin and Enquselassie, 2011](#_ENREF_37)) and Tanzania reported higher prevalence in older age groups. A study in Mexico documented higher prevalence of anemia in the 20-29 years of age than the younger or older age categories.

Nutritional status was evaluated by MUAC and BMI of the participants. Majority of the participants (84.04%) had MUAC of 23 or more than 23 cm and the remaining (15.96%) had MUAC less than 23 cm. The mean and median value of MUAC was 24.8465 cm and 24 cm. The minimum value was 21 cm and maximum value was 34 cm. The analysis of survey revealed the significant relation between anemia and MUAC of the pregnant women, where half of the pregnant women with MUAC less than 23 cm were found to be anemic compared with the women who had MUAC of 23 or more than 23 cm, 31.84% anemic. A similar finding was observed in the study done by ([Alene and Dohe, 2014](#_ENREF_7)).This can be explained by the fact that undernourished pregnant women have a higher probability of being micronutrient deficient and therefore iron deficient and anemic.

The mean and median value of BMI was 21.81 kg/m2 and 21.48 kg/m2 respectively with minimum value of 16.45 kg/m2 and maximum value of 31.11 kg/m2. BMI was categorized as underweight, normal and overweight or obese. Majority of the participants (81.69%) had normal BMI for age followed by overweight or obese (11.27%) and underweight (7.04%). Overall anemia was prevalent among underweight with 80% anemic which was high as compared to normal 33.33% and overweight or obese 16.67%. The finding of the study was similar to the studies conducted by ([Maskey *et al.*, 2014](#_ENREF_69)), ([Gedefaw *et al.*, 2015 120](#_ENREF_38)), ([Bondevik *et al.*, 2000](#_ENREF_21)), ([Bentley and Grifﬁths, 2003](#_ENREF_18)), ([Baig-Ansari *et al.*, 2008](#_ENREF_14)), ([Gebremedhin and Enquselassie, 2011](#_ENREF_37)), (Bhandari *et al*., 2014). All of these studies reported that participants with lower BMI were more prevalent to anemia than those with normal and higher BMI. The reason behind this could be that lower BMI indicates poor nutritional status which means lack of adequate nutrition which contributes to anemia.

The education level was categorized as Primary, Secondary, Higher secondary & above and illiterate. Highest percentage of participants (53.99%) studied up to secondary level, 34.74% had done higher secondary or above study, 8.92% studied primary levels and 2.35% of the women were illiterate. This study failed to observe any relationship between prevalence of anemia and education level of the pregnant women. Similar results were reported in the studies done in Pakistan by ([Lone *et al.*, 2004](#_ENREF_61)), Turkey by ([Karaoglu *et al.*, 2010](#_ENREF_51)), Malaysia by ([Haniff *et al.*, 2007](#_ENREF_42)), India by (Agarwal et al., 2011) and Ethopia by ([Mihiretie *et al.*, 2015](#_ENREF_73)). In contrast, the studies conducted by ([Maskey *et al.*, 2014](#_ENREF_69)) and ([Dreyfuss *et al.*, 2000](#_ENREF_31)) observed the significant association between level of education and anemia among pregnant women.

The present study shows that nearly half 43.66% of the participants were 21 or more than 21 years at marriage, whereas, 40.85% of participants were between 18-20 year and 15.49% were less than 18 years. 39.39% of participants below 18 years at marriage were found to be anemic. This study could not demonstrate any significant association between age at marriage and hemoglobin level of the pregnant women. This finding correlates with the results reported by ([Alene and Dohe, 2014](#_ENREF_7)). According to the gestational period of the pregnant women, 54.93% of the participants were in first trimester and 45.07% were in second trimester. None of the participants from third trimester were included as they were found to be taking oral iron supplements. The study shows that statistically anemia and gestational period of pregnant women were highly associated, (p- value =0.00). Among the participants from first trimester 47.01% were anemic whereas only 19.79% of participants from second trimester were found to be anemic. The risk of developing anemia was more likely higher in the 1st first trimester which could be due to loss of appetite, morning sickness and the start of hemodilution at 8 weeks of gestation. This result is consistent with the studies done by ([Maskey *et al.*, 2014](#_ENREF_69)), ([Makhoul, 2007](#_ENREF_65)) and (Tadesse *et al*., 2017) in which found that the prevalence of anemia is higher in the first trimester in comparison with second trimester. In contrast, findings of some studies conducted by ([Bivalkar *et al.*, 2014](#_ENREF_20)), ([Kumari and Priya, 2016](#_ENREF_56)), (Sinha *et al*, 2012), ([Hinderaker *et al.*, 2001](#_ENREF_43)), ([Bassi *et al.*, 2016](#_ENREF_16)) and ([Singh *et al.*, 2013](#_ENREF_91)) reported that pregnant women from second trimester were more likely to be anemic than those from first trimester.

While looking through the frequency of pregnancy and ANC, most of the participants 54.93% reported their first pregnancy and 45.07% of women mentioned their second or third pregnancy. The prevalence of anemia was seen more in the women with first pregnancy (42.74%) than in women with second or third pregnancy (25%). This result has been supported by ([Lelissa *et al.*, 2015](#_ENREF_59)). Perhaps, following the experience gained from the first pregnancy and the consequent increased awareness and good diet, as well as increased interaction with other pregnant women at the antenatal clinics, might neutralize its effect. However, other studies conducted in did not find association between gravidity and anemia. This could be due to the difference in socio-cultural characteristics of the study populations.

Similarly, more than half of the respondents 60.56% had their 2 or 3 ANC check-up and 39.44% of the participants just had their first ANC check-up. Anemia was more prevalent among women who had only 1 ANC check-up than those who had more ANC check-up. This result of our study was supported by ([Tunkyi and Moodley, 2016](#_ENREF_98)) study where they reported that anemia was more common among pregnant women during their first ANC visit. A study done by (Ghimire and Pandey, 2013) revealed that the level of knowledge as well as level of practice of mothers about prevention of anemia in pregnancy increases with the increase in frequency of ANC visits. A study done in Lucknow found that the prevalence of anemia was significantly lower in those who had received ANC services than who did not ([Gupta *et al.*, 2016](#_ENREF_40)).

In this study more than half of the pregnant women 68.54% had not taken deworming tablets and were found to be more anemic (42.47%) as compared to women who had taken deworming tablets. From this, a view can be drawn that there might be intestinal helminthes among the pregnant women which may be one of the causes of anemia. There are many studies conducted which showed the association between anemia and worm infestation. Some of them were conducted by ([Dreyfuss *et al.*, 2000](#_ENREF_31)), (Shah and Baig, 2005), ([Alem *et al.*, 2013](#_ENREF_6)) and ([Larocque *et al.*, 2005](#_ENREF_57)).

The study samples were categorized according to their eating habits as Vegetarians and Non-vegetarians. Majority 94.84% of the participants were non-vegetarians whereas 5.16% were vegetarians. 54.55% of vegetarians were anemic. The prevalence observed is similar to that reported for adolescent girls of eastern Nepal by ([Kanodia *et al.*, 2016](#_ENREF_50)).

**Table-4.4:** Sample characteristics and anemia among pregnant women

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Percent (%)** | **Anemic (%)** | **Non-anemic (%)** | **P-value** |
| **Age** |  | | | |
| 15-24 | 52.11 | 49(44.14) | 62(55.86) | 0.004\* |
| 25-34 | 45.07 | 22(22.92) | 74(77.08) |
| 35 and above | 2.82 | 3(50) | 3(50) |
| **MUAC** |  | | | |
| <23 | 15.96 | 17(50) | 17(50) | 0.042\* |
| ≥23 | 84.04 | 57(31.84) | 122(68.16) |
| **BMI** |  | | | |
| Underweight | 7.04 | 12(80) | 3(20) | 0.000\* |
| Normal | 81.69 | 58(33.33) | 116(66.67) |
| Overweight and Obese | 11.27 | 4(16.67) | 20(83.33) |
| **Education level** |  | | | |
| Primary | 8.92 | 3(15.79) | 16(84.21) | 0.205 |
| Secondary | 53.99 | 40(34.78) | 75(65.22) |
| Higher secondary and above | 34.74 | 30(40.54) | 44(59.46) |
| Illiterate | 2.35 | 1(20) | 4(80) |
| **Age at marriage (years)** |  | | | |
| <18 | 15.49 | 13(39.39) | 20(60.61) | 0.745 |
| 18-20 | 40.85 | 28(32.18) | 59(67.82) |
| ≥21 | 43.66 | 33(33.48) | 60(64.52) |
| **Gestational period** |  | | | |
| 1st trimester | 54.93 | 55(47.01) | 62(52.99) | 0.000\* |
| 2nd trimester | 45.07 | 19(19.79) | 77(80.21) |
| **Frequency of pregnancy** |  | | | |
| 1 | 54.93 | 50(42.74) | 67(57.26) | 0.007\* |
| 2-3 | 45.07 | 24(25) | 72(75) |
| **Frequency of ANC visit** |  | | | |
| 1 | 39.44 | 43(51.19) | 41(48.81) | 0.000\* |
| 2-3 | 60.56 | 31(24.03) | 98(75.97) |
| **Deworming tablet** |  | | | |
| No | 68.54 | 62(42.47) | 84(57.53) | 0.000\* |
| Yes | 31.46 | 12(17.91) | 55(82.09) |
| **Types of consumer** |  | | | |
| Vegetarian | 5.16 | 6(54.55) | 5(45.45) | 0.157 |
| Non-vegetarian | 94.84 | 68(33.66) | 134(66.34) |

**4.2.5** **Knowledge about anemia and balanced diet and anemia**

The evaluation of the respondent’s knowledge about anemia and balanced diet was done using a self developed multiple choices questionnaire. The questionnaire regarding anemia comprised of four questions based on symptom of anemia, cause of anemia, casualty of anemia and foods to be taken during such condition with a score of 1 for the correct response and a zero score for a incorrect or nil response. Out of 100 percent knowledge score, participants with less than 50% knowledge score were considered to have poor knowledge about anemia. Those with 50% and more knowledge score were considered to have good knowledge about anemia. Table- 4.5 shows that most of the participants (83.57%) were aware about balanced diet but only (16.43%) had good knowledge about anemia. There was no significant relation between knowledge about anemia and Hb level of the pregnant women, whereas the knowledge about balanced diet and anemia was found to have statistically associated with P-value = 0.001.

**Table-4.5:** Knowledge about anemia and balanced diet and anemia among pregnant women

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Percent (%)** | **Anemic (%)** | **Non-anemic (%)** | **P-value** |
| **Knowledge about anemia** |  | | | |
| <50% | 83.57 | 60(33.71) | 118(66.29) | 0.475 |
| ≥50% | 16.43 | 14(40) | 21(60) |
| **Knowledge about balanced diet** |  | | | |
| No | 19.25 | 23(56.10) | 18(43.90) | 0.001\* |
| Yes | 80.75 | 51(29.65) | 121(70.35) |

**4.2.6 Dietary Practices and anemia**

Table-4.6 represents the food habits and the pattern or the frequency of consumption of foods from different food groups by the study participants. Majority of the participants used to have meals 1-2 times/day and were found to be more anemia prevalent as compared to those participants who had meal 3 or more times/day. This finding was in line with the results of the study done by ([Abriha *et al.*, 2014](#_ENREF_2)). However, the present study could not demonstrate any significant association between frequency of meal and anemia (p>0.05). Looking through the food frequency tables, higher prevalence of anemia was observed among the participants, who used to have no meat and egg, 1-3 times of fruits/week, once or less than once of milk/milk products per week and once per day or less of green leafy vegetables. Frequency of taking meat, fruits and milk & milk products consumption had no relation with the anemia or hemoglobin level of the participants (p-value > 0.05). While the study reported that frequency of egg and green leafy vegetables consumption were significantly associated with anemia among participants (p-value <0.05). The findings of the study depicts that there was greater risks of anemia among women who never consume eggs or consume eggs less than thrice a week, which was closer to the results recorded among the pregnant women of Pakistan, ([Baig-Ansari *et al.*, 2008](#_ENREF_14)). In the study done by (Tadesse *et al*., 2017), inadequate intake of dark green leafy vegetables (DGLV) was appeared to be positively related to anemia development among pregnant mothers which was similar to the results of present study. Similarly, other literatures showed that lower consumption of DGLV was significantly associated with increased risk of developing anemia, ([Haidar and Pobocik, 2009](#_ENREF_41)). This might be because low consumption of DGLV results in reduced intake of non-heme iron, vitamin A and vitamin C.

Similarly, the frequency of tea and types of tea consumption was also studied among the participants. The distribution of anemia was found high among those participants who drank 2 or more times of tea and milk tea. A study done in Anemia prevalence and risk factors in pregnant women in an urban area of Pakistan by ([Baig-Ansari *et al.*, 2008](#_ENREF_14)) observed that greater the quantity of tea consumed during pregnancy, the lower the mean hemoglobin concentration. Although the study showed significant association between frequency of tea consumption and anemia, there was no statistical relation between anemia and types of tea consumed by the participants.

**Table-4.6:** Dietary practices and anemia among pregnant women

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency** | **Percent (%)** | **Anemic (%)** | **Non-anemic (%)** | **P-value** |
| **Meal** |  | | | |
| 1-2 | 79.34 | 61(36.09) | 108(63.91) | 0.416 |
| ≥3 | 20.66 | 13(29.55) | 31(70.45) |
| **Meat** |  |  |  |  |
| 0 | 6.10 | 8(61.54) | 5(38.46) | 0.076 |
| Daily | 8.45 | 3(16.67) | 15(83.33) |
| 1-3/wk | 65.26 | 47(33.81) | 92(66.19) |
| 4-6/wk | 20.19 | 16(37.21) | 27(62.79) |
|  | | | | |
| **Fruit** |  | | | |
| 0 | 0.47 | 0(0) | 1(100) | 0.367 |
| Daily | 36.15 | 24(31.17) | 53(68.83) |
| 1-3/wk | 45.07 | 39(40.63) | 57(59.37) |
| 4-6/wk | 18.31 | 11(28.21) | 28(71.79) |
| **Egg** |  | | | |
| Daily | 3.76 | 0(0) | 8(100) | 0.001\* |
| 1-3/wk | 72.30 | 46(29.87) | 108(70.13) |
| 4-6/wk | 6.10 | 6(46.15) | 7(53.85) |
| 0 | 17.84 | 22(57.89) | 16(42.11) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Milk and milk products** |  |  |  |  |
| ≥2/day | 10.33 | 3(13.64) | 19(86.36) | 0.183 |
| Once/day | 62.91 | 50(37.31) | 84(62.69) |
| ≤1/wk | 18.78 | 15(37.5) | 25(62.5) |
| 0 | 7.98 | 6(35.29) | 11(64.71) |
| **Green leafy vegetables** |  | | | |
| ≥2/day | 25.82 | 10(18.18) | 45(81.82) | 0.003\* |
| Once/day | 67.61 | 61(42.36) | 83(57.64) |
| Once/wk | 6.57 | 3(21.43) | 11(78.57) |
| **Tea** |  | | | |
| 0 | 17.34 | 9(23.68) | 29(76.32) | 0.012\* |
| 1 | 54.93 | 36(30.77) | 81(69.23) |
| ≥2 | 27.23 | 29(50) | 29(50) |
| **Types of tea** |  | | | |
| Black tea | 40.38 | 27(31.40) | 59(68.60) | 0.084 |
| Milk tea | 41.78 | 38(42.70) | 51(57.30) |
| None | 17.84 | 9(23.68) | 29(76.32) |

**Part V**

**Conclusions and Recommendations**

**5.1 Conclusions**

The results of this study indicate that anemia is still a significant problem among pregnant women of Dharan sub-municipality. Although the prevalence of anemia in present study was found to be low as compare to the national data but still it is very high and there is a need to give special attention to the pregnant women. Commonest form of anemia in this study was mild anemia. The overall prevalence of anemia was 34.74%, In terms of severity, 22.06% were mildly anemic and 12.68% moderately anemic and there was no severe anemia. The current study attempted to assess anemia prevalence and associated risk factors in pregnant women. Demographic characteristics such as caste, religion and family size were found to have no association with anemia (p-value>0.05). While the socio-economic factors like annual income of the family was significantly associated with anemia among pregnant women.

Regarding the sample characteristics, age, MUAC and BMI were significantly associated while factors like education, age at marriage and eating habits had no relation with anemia. Similarly, gestational period, frequency of pregnancy and frequency of ANC visits were also associated with anemia with statistical significance of p-value= 0.00, 0.007 and 0.00 respectively. Knowledge of the study participants about anemia shows no association with anemia whereas the knowledge about balanced was significantly associated with anemia among pregnant women with p-value=0.001. Looking through the nutritional factors, frequency of meal consumption had no association with anemia. Chi-square test of association showed that frequency of meat, fruits and milk & milk products consumption had no relation with the anemia or hemoglobin level of the participants (p-value > 0.05), whereas, frequency of egg and green leafy vegetables consumption were significantly associated with anemia among participants (p-value <0.05). Similarly, significant relation was observed between frequency of tea consumption and anemia. However, there was no any relation of types of tea consumption and anemia prevalence.

The present study outlines the key components for the control of Anemia in pregnant women and provides a comprehensive strategic framework for future programme strengthening and implementation. The results of this study can be helpful to the local government authority and help to conduct different programs related to this field through national and local level.

**5.2 Recommendation**

a. The results of the study can be helpful for the planning and formulation of policy regarding pregnant women, as well as to conduct different interventions and programmes to improve status of anemia among pregnant women.

b.A study can be replicated on a larger sample to determine the prevalence of anemia in the general population.

c. Other interventional measures and programs to educate the mothers on the need to initiate antenatal care early should be instituted.

d. Screening and treatment of parasitic infections should be encouraged.

e. The study suggests that a well and clear health education sessions strategy regarding anemia needs to be more effective.

f. There is a need to revitalize and strengthen the nutrition education component of Government programmes.

**Part VI**

**Summary**

Anemia is a condition in which there is diminished oxygen-carrying capacity of the blood, as a result of reduction in total circulating hemoglobin and/or reduction in red cell mass. Anemia is an indicator of both poor nutrition and poor health. It affects all ages of the population with its highest prevalence among children under five years of age and pregnant women. Pregnancy is a period of increased metabolic demands, with changes in the woman's physiology and the requirements of a growing. Pregnant women are more vulnerable to iron deficiency anemia due to accelerated increase in iron requirements, poor dietary intake of iron, high rate of infection and worm infestation as well as other social factor. Present study is mainly focused to assess the prevalence of anemia and factors associated among pregnant women (15-49years) of Dharan sub-metropolitan city.

A hospital based cross-sectional study was conducted among pregnant women attending antenatal care at primary health care centre, Family Planning Association of Nepal (FPAN), B.P. Koirala Institute of Health Sciences (BPKIHS) of in Dharan Sub-metropolitan City to assess prevalence of anemia and factors associated with anemia. The cyanmethemoglobin method was used to determine hemoglobin concentration. Anthropometric measurement was used to determine BMI and MUAC. A well structured questionnaire was used to obtain information regarding socio demographic and economic variables, maternal and nutritional variables. All the data were first coded and entered into SPSS version 20.0. Chi-square test of significance was performed to find out the factors associated with anemia at 95% confidence interval.

The results of this study showed that overall prevalence of anemia was 34.74%, In terms of severity, 22.06% were mildly anemic and 12.68% moderately anemic and there was no severe anemia. The mean Hb level of pregnant women was 11.12 gm/dl and the median was 11.10gm/dl. Similarly, the maximum and minimum values were 15.5 gm/dl and 8.00 gm/dl respectively. the majority of the participants belonged to Janjati community (52.11%) followed by Brahmin/Chhetri (33.80%), Dalit (9.39%) and Madhesi (4.70%). Similarly, the majority of the participants were Hindus (79.34%) followed by Buddhists (10.80%), others (5.16%) and Christians (4.70%). The study shows that most of the participants (55.40%) were from the family with members <5 and 44.60% of participants belongs to families with ≥5 members. Chisquare test showed there was no significant association of caste, religion and family size with anemia (p-value >0.05).

The annual income of the family was categorized into three groups: income less than 2 lakhs per year, between 2-5 lakhs per year and 5 lakhs or more than 5 lakhs per year with their target population found to 47.42%, 48.36% and 4.22%. The mean and median ages of the participants were 24.49 and 24 years with the minimum age of 17 years and maximum age of 40 years. 52.11% of participants were from age group 15-24, 45.07% from 25-34 and 2.82% were from 35 and above. The present study shows significant association of anemia with economic status and age of the participants.

More of the participants (84.04%) had MUAC of ≥23 cm and the remaining (15.96%) had MUAC <23 cm. (81.69%) of the participants had normal BMI for age followed by overweight or obese (11.27%) and underweight (7.04%). Highest percentage of participants (53.99%) studied up to secondary level, 43.66% were 21 or more than 21 years at marriage, 54.93% of the participants were in first trimester, 54.93% reported their first pregnancy, 60.56% had their 2 or 3 ANC check-up, 68.54% had not taken deworming tablets and 94.84% of the participants were non-vegetarians. The factors like MUAC, BMI, gestational period, no, of ANC checkup and intake of deworming tablets were significantly associated with anemia whereas education level, age at marriage and types of consumers had no relation with anemia.

It was found that most of the participants (83.57%) were aware about balanced diet but only (16.43%) had knowledge about anemia. There was no significant relation between knowledge about anemia and Hb level of the pregnant women. Whereas the knowledge about balanced diet and anemia was found to have statistical association with P-value = 0.001. Looking through the nutritional factors, frequency of meal consumption had no association with anemia. Chi-square test of association showed that frequency of meat, fruits and milk & milk products consumption had no relation with the anemia or hemoglobin level of the participants (p-value > 0.05), whereas, frequency of egg and green leafy vegetables consumption were significantly associated with anemia among participants (p-value <0.05). Similarly, significant relation was observed between frequency of tea consumption and anemia. However, there was no any relation of types of tea consumption and anemia prevalence.

Dharan being one of the developed cities of Nepal, the prevalence of anemia is still high and there is a need to give special attention to the pregnant women. Effective health education sessions strategy regarding anemia and early initiation of antenatal care should be carried out to overcome this problem.

**References**

Abouzahr, C. and Royston, E. (1991). Maternal mortality: a global factbook [Report]. WHO. Geneva, Switzerland.

Abriha, A., Yesuf, M. E. and Wassie, M. M. (2014). Prevalence and associated factors of anemia among pregnant women of Mekelle town: a cross sectional study. *BMC Research Notes*.**7** (888), 1-6.

Abu-Hasira, A. W. M. (2007). Iron Deficiency Anemia among Pregnant Women in Nablus District; Prevalence, Knowledge, Attitude and Practices*.* M. PH Thesis. An-Najah National Univ., Palestine

Adam, I., Khamis, A. H. and Elbashir, M. I. (2005). Prevalence and risk factors for anaemia in pregnant women of Eastern Sudan. **99**, 739—743.

Aikawa, R., Khan, N. C., Sasaki, S. and Binns, C. W. (2006). Risk factors for iron-deﬁciency anaemia among pregnant women living in rural Vietnam. *Public Health Nutrition*.**9** (4), 443–448.

Alem, M., Enawgaw, B., Gelaw, A., Kena, T., Seid, M. and Olkeba, Y. (2013). Prevalence of anemia and associated risk factors among pregnant women attending antenatal care in Azezo Health Center Gondar town, Northwest Ethiopia. *J Interdiscipl Histopathol*.**1** (3), 137-144.

Alene, K. A. and Dohe, A. M. (2014). Prevalence of Anemia and Associated Factors among Pregnant Women in an Urban Area of Eastern Ethiopia. *Anemia*.**2014**, 1-7.

Allen, L. H. (2000). Anemia and iron deficiency: effects on pregnancy outcome. *ajcn*.

Alvarez-Uria, G., Naik, P. K., Midde, M., S.Yalla, P. and Pakam, R. (2014). Prevalence and Severity of Anaemia Stratified by Age and Gender in Rural India. *Anemia*.**2014**, 1-5.

Amengor, M. G., Owusu, W. B. and Akanmori, B. D. (2005). Determinants of anemia in pregnancy in Sekyere West District, Ghana. *GMJ*.**39** (3), 102-107.

Antia, F. P. and Abraham, P. (2002). "Clinical Dietetics and Nutrition" (4th ed.). Oxford University Press. New Delhi, India.

Awasthi, S., Verma, T. and Virb, S. (2005). Effectiveness of Biweekly Versus Daily Iron–Folic Acid Administration on Anaemia Status in Preschool Children. *Journal of Tropical Pediatrics*.**51** (2), 67-71.

Bahwere, P., Deconinck, H., Banda, T., Mtimuni, A. and Collins, S. (2011). Impact of household food insecurity on the nutritional status and the response to therapeutic feeding of people living with human immunodeficienncy virus *Patient Preference and Adherence*.**5**, 619-627.

Baig-Ansari, N., Badruddin, S. H., Karmaliani, R., Harris, H., Jehan, I., Pasha, O., Moss, N., McClure, E. M. and Goldenberg, R. L. (2008). Anemia prevalence and risk factors in pregnant women in an urban area of Pakistan. *Food and nutrition bulletin*.**29** (2), 132-139.

Balarajan, Y., Ramakrishnan, U., Özaltin, E., Shankar, A. H. and Subramanian, S. V. (2011). Anaemia in low-income and middle-income countries. *Lancet*.**378**, 2123-2135.

Bassi, A. P., Idoko, L. O., Dibigbo, N. M. I., Adeniyi, O. G., Ramyil, S. M.-C., Ogundeko, T. O., Pisagih, J. K., Offiah, V. N., Olorunfunmi, J. S., Amuta, W. E., Alu, V. O., Ajala, E. K. and Olorundare, O. O. (2016). Prevalence of Anaemia in Pregnancy Among Women Visiting Antenatal Clinic in Bingham University Teaching Hospital Jos, Nigeria. *J. Clinical Medicine Research*.**5** (3), 52-62.

Benoist, B. d., McLean, E., Egli, I. and Cogswell, M. (2008). Worldwide prevalence of anaemia 1993–2005 : WHO global database on anaemia. WHO. Retrieved from <http://www.who.int/>.

Bentley, M. E. and Grifﬁths, P. L. (2003). The burden of anemia among women in India. *European Journal of Clinical Nutrition* **57**, 52–60

Bhandary, S. and Shrestha, A. (2011). Prevalence of anemia among non-pregnant andpregnant women of reproductive age in Nepal. *JGPEMN*. 21-26.

Bivalkar, N. Y., Wingkar, K. C., Joshi, A. G. and Jagtap, S. (2014). Assessment of severity & types of anemia during pregnancy in rural population in western Maharashtra. *Indian Journal of Basic and Applied Medical Research*.**4** (1), 160-163.

Bondevik, G. T., Ulstein, M., Lie, R. T., Rana, G. and Kvåle, G. (2000). The prevalence of anemia in pregnant Nepali women–a study in Kathmandu. *Acta Obstet Gynecol Scand*.**79**, 341–349.

Branca, F., Piwoz, E., Schultink, W. and Sullivan, L. M. (2015). Nutrition and health in women, children, and adolescent girls. *BMJ*.**351**, 27-31.

Butler, N. (2017). Nutritional Deficiencies (Malnutrition). Healthline Media. Retrieved from <http://www.healthline.com/health/malnutrition>. [Accessed 2 January, 2017].

CBS. (2011). "Nepal Living Standards Survey". National Planning Commission (Government of Nepal), Nepal. p. 43.

CDC. (2015). About Adult BMI. Center for Disease Control and Prevention. Retrieved from https://[www.cdc.gov/healthyweight/assessing/bmi/adult\_bmi](http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi).

Chauhan, M. and Tomar, S. (2013). Anaemia in Pregnancy a Prospective Observational Study in Tertiary Care teaching hospital of North India *JMSCR*.**1** (4), 195-198.

Collins, S., Dent, N., Binns, P., Bahwere, P., Sadler, K. and Hallam, A. (2006). Management of severe acute malnutrition in children. *Lancet*.**368** (9551), 1992-2000.

Crane, J. M. G., White, J., Murphy, P., Burrage, L. and Hutchens, D. (2009). The effect of gestational weight gain by body mass index on maternal and neonatal outcomes *JOGC*.**31** (1), 28-35.

Dayal, S. and Dayal, A. (2014). Prevalence & Consequences of Anaemia in Pregnancy. *Int J Med Res Rev*.**2** (4), 296-299.

Disler, P. B., Lynch, S. R., Charlton, R. W., Torrance, J. D., Bothwell, T. H., Walker, R. B. and Mayet, F. (1975). The effect of tea on iron absorption. *BMJ*.**16**, 193-200.

Dreyfuss, M. L., Stoltzfus, R. J., Shrestha, J. B., Pradhan, E. K., LeClerq, S. C., Khatry, S. K., Shrestha, S. R., Katz, J., Albonico, M. and West, K. P. (2000). Hookworms, Malaria and Vitamin A Deﬁciency Contribute to Anemia and Iron Deﬁciency among Pregnant Women in the Plains of Nepal. *J Nutr*.**130**, 2527-2536.

Driskell, J. A. (2008). Nutritional Anemia:The Guidebook: Nutritional Anemia. *jama*.**299** (22).

Dutra-de-Oliveira, J. E., Marchini, J. S., Lamounier, J. and Almeida, C. A. N. (2011). Iron fortified drinking water studies for the prevention of childrens anemia in developing countries. *Anemia*.**2011**, 1-5.

Elashiry, A., S, G. E. and Habil, I. (2014). Prevalence and determinants of anaemia in third trimester pregnancy in fayoum governorate-Egypt. *Acta Medica Mediterranea*.**30** (5), 1045-1051.

Fishman, S. M., Christian, P. and West, K. P. (2000). The role of vitamins in the prevention and control of anemia. *PHN*.**3**, 125-150.

Gabrielli, G. B. and Sandre, G. D. (1995). Excessive tea consumption can inhibit the efficacy of oral iron treatment in iron-deficiency anemia. *Haematologica*.**80** (6), 518-520.

Gebremedhin, S. and Enquselassie, F. (2011). Correlates of anemia among women of reproductive age in Ethiopia: Evidence from Ethiopian DHS 2005. *Ethiop J Health Dev*.**25** (1), 22-30.

Gedefaw, L., Ayele, A., Asres, Y. and Mossie, A. (2015). Anemia and associated factors among pregnant women attending antenatal care clinic in wolayita sodo town, southern ethiopia *Ethiop J Health Sci*.**25** (2), 155-162.

Gogoi, M. and Prusty, R. K. (2013). Maternal Anaemia, Pregnancy Complications and Birth Outcome: Evidences from North-East India. *Journal of North East India Studies*.**3** (1), 74-85.

Gupta, P., Mishra, S., Bhardwaj, P., Sachan, B., Srivastav, J. P. and Mishra, A. N. (2016). Effect of antenatal services during pregnancy on prevalence of anemia amongst pregnant women in Lucknow. *Ind J of Med Sci*.**68** (1), 17-20.

Haidar, J. A. and Pobocik, R. S. (2009). Iron deficiency anemia is not a rare problem among women of reproductive ages in Ethiopia: a community based cross sectional study. *BMC Blood Disorders*.**9** (7), 1-8.

Haniff, J., Das, A., Onn, L. T., Sun, C. W., Nordin, N. M., Rampal, S., Bahrin, S., Ganeslingam, M., Kularatnam, K. I. K. and Zaher, Z. M. M. (2007). Anemia in pregnancy in Malaysia: a cross-sectional survey *Asia Pac J Clin Nutr* **16** (3), 527-536

Hinderaker, S. G., Olsen, B. E., Bergsjø, P., Lie, R. T., Gasheka, P. and Kvåle, G. (2001). Anemiainpregnancyinthehighlandsof Tanzania. *Acta Obstet Gynecol Scand* **80**, 18-26.

Huang, L., Purvarshi, G., Wang, S., Zhong, L. and Tang, H. (2015). The Influence of Iron-deficiency Anemia during the Pregnancy on Preterm Birth and Birth Weight in South China. *Journal of Food and Nutrition Research*.**3** (9), 570-574.

Huffman, S. I., Baker, J., Shumann, M. A. and Zehner, E. R. (1998). The case for promoting Multiple Vitamin/ Mineral supplements for Women of reproductive age in developing countries [Report]. The Linkages Project. Washington, DC,

Jaleel, R. and Khan, A. (2008). Severe anemia and adverse pregnancy outcome. *Journal of Surgery Pakistan*.**13** (4), 147-150.

Jeyakumar, A., Ghugre, P. and Gadhave, S. (2013). Mid-Upper-Arm Circumference (MUAC) as a simple measure to assess the nutritional status of adolescent girls as compared with BMI. *ICAN*.**5** (1), 22-25.

Jiang, T., Christian, P., Khatry, S. K., Wu, L. and West, K. P. (2005). Micronutrient Deﬁciencies in Early Pregnancy Are Common, Concurrent, and Vary by Season among Rural Nepali Pregnant Women. *J Nutr*.**135**, 1106–1112.

Kalaivani, K. (2009). Prevalence & consequences of anaemia in pregnancy. *ijmr*.**130**, 627-633.

Kanodia, P., Bhatta, M., Singh, R. R., Bhatta, N. K. and Shah, G. S. (2016). A study of anemia among adolescent girls in eastern part of Nepal. *Journal of College of Medical Sciences-Nepal*.**12** (1), 19-22.

Karaoglu, L., Pehlivan, E., Egri, M., Deprem, C., Gunes, G., Genc, M. F. and Temel, I. (2010). The prevalence of nutritional anemia in pregnancy in an east Anatolian province, Turkey. *BMC Public Health*.**10** (329), 1-12.

Kaur, K. (2014). Anaemia ‘a silent killer’ among women in India: Present scenario. *European Journal of Zoological Research*.**3** (1), 32-36.

Khader, A., Madi, H., Riccardo, F. and Sabatinelli, G. (2009). Anaemia among pregnant Palestinian women in the Occupied Palestinian Territory. *Public Health Nutrition*.**12** (12), 2416–2420.

Khadka, D. B. (2012). Iron Deficiency Anaemia: Problem, Causes and Solution. *Food Wave*.**9**, 21-30.

King, J. C. (2000). Physiology of pregnancy and nutrient metabolism. *ajcn*.**71**, 1218-1225.

Kumari, S. and Priya, J. (2016). Prevalence of Anemia Risk Factors in Pregnant Women. *International Journal of Science and Research* **5**(4), 2107-2108.

Larocque, R., Casapia, M., Gotuzzo, E. and Gyorkos, T. W. (2005). Relationship between intensity of soil-transmitted helminth infections and anemia during pregnancy. *Am. J. Trop. Med. Hyg*.**73** (4), 783–789

lealem, G., Ayele, A., Asres, Y. and Mossie, A. (2015). Anemia and associated factors among pregnant women attending antenatal care clinic in Wolayita Sodo town, Southern Ethopia. *EJHC*.**25** (2), 155-162.

Lelissa, D., Yilma, M., Shewalem, W., Abraha, A., Worku, M., Ambachew, H. and Birhaneselassie, M. (2015). Prevalence of Anemia Among Women Receiving Antenatal Care at Boditii Health Center, Southern Ethiopia. *JCMR*.**4** (3), 79-86.

Lokare, P. O., Karanjekar, V. D., Gattani, P. L. and Kulkarni, A. P. (2012). A study of prevalence of anemia and sociodemographic factors associated with anemia among pregnant women in Aurangabad city, India. *Annals of Nigerian Medicine*.**6** (1), 30-34.

Lone, F. W., Qureshi, R. N. and Emmanuel, F. (2004). Maternal anaemia and its impact on perinatal outcome in a tertiary care hospital in Pakistan *Eastern Mediterranean Health Journal*.**10** (6), 801-807.

Lover, A. A., Hartman, M., Chia, K. S. and Heymann, D. L. (2014). Demographic and Spatial Predictors of Anemia in Women of Reproductive Age in Timor-Leste: Implications for Health Program Prioritization. *PLoS ONE*.**9** (3), 1-10.

MacPhail, P. and bothwell, T. (1992). "The prevalence and cause of nutritional iron deficiency anaemia". Raven Press. New York.

Mahmood, A., Dars, S. and Memon, A. R. (2014). Anemia in pregnancy: A survey of pregnant women in Hyderabad, Sindh. *Rep Opinion*.**6** (5), 1-3.

Makhoul, Z. (2007). Anemia and Iron Deficiency in Rural Nepali Pregnant Women: Risk Factors, Effect of Vitamin A Supplementation and Their Association with Birth Outcomes Ph.D Dissertation. The Univ. of Arizona, USA.

Malik, K. (2013). Human Development Report 2013 [Report]. Retrieved from hdr.undp.org/sites/default/files/reports/14/hdr2013\_en\_complete.pdf. [Accessed 3rd january 2017].

Mamta and Devi, L. T. (2014). Prevalence of Anemia and Knowledge Regarding Anemia among Reproductive Age Women. *IOSR Journal of Nursing and Health Science*.**3** (2), 54-60.

Marahatta, R. (2008). Study of anaemia in pregnancy and its outcome in Nepal Medical College Teaching Hospital, Kathmandu, Nepal. *Pubmed*. 1-5.

Maskey, M., Jha, N., Poudel, S. I. and Yadav, D. (2014). Anemia in pregnancy and its associated factors: A study from Eastern Nepal. *Nepal Journal of Epidemiology*.**4** (4), 386-392.

Mbule, M., Byaruhanga, Y., Kabahenda, M. and Lubowa, A. (2012). Determinants of anaemia among pregnant women in rural Uganda. *Rural and remote health*.**13** (2259), 1-11.

Mclean, E., Cogswell, M., Egli, I. and Benoist, B. d. (2009). Worldwide prevalence of anaemia, WHO Vitamin and Mineral Nutrition Information System, 1993-2005. *PHN*.**12** (4), 444-454.

Miah, M. S., Rahman, M. N., Prodhan, U. K., Linkon, M. R. and Rahman, M. S. (2014). Prevalence of iron deficiency anemia among adolescents girls and its risk factors in Tangail Region of Bangladesh. *IJRET*.**3** (6), 613-619.

Mihiretie, H., Fufa, M., Mitiku, A., Bacha, C., Getahun, D., Kejela, M., Sileshi, G. and Wakshuma, B. (2015). Magnitude of Anemia and Associated Factors among Pregnant Women Attending Antenatal Care in Nekemte Health Center, Nekemte, Ethiopia. *J Med Microb Diagn*.**4** (3), 1-4.

Misra, A., Vikram, N. K., Pandey, R. M., Dwivedi, M. and Ahmed, F. U. (2002). Hyperhomocysteinemia, and low intakes of folic acid and vitamin B12in Urban North India. *EJN*.**41**, 68-77.

MoH. (2002). National Strategy For the Control of Anemia among Women and Children in Nepal. Department of Health Services. Retrieved from <http://www.dohs.gov.np/>.

MOHP, ERA, N. and International, I. (2012). "Nepal Demographic and Health Survey 2011". Population Division (Ministry of Health and Population ), Nepal. Retrieved from <http://dhsprogram.com>. [Accessed 5 January, 2017].

Murteli, V. B. and Patil, M. S. (2015). Prevalence of Anaemia Among Adolescent Girls in Rural Area, Bijapur.a Cross Sectional Study. *Indian J of Applied Research*.**5** (6), 508-509.

Nduhiu-Githinji, C. W. (2010). Prevalence of anemia among pregnant women attending antenatal clinic at Mbagathi district hospital*.* MMed in Obstetrics and Gynecology Dissertation Univ. of Nairobi, Kenya.

Noronha, J. A., Khasawneh, E. A., Seshan, V., Ramasubramaniam, S. and Raman, S. (2012). Anemia in pregnancy- consequences and challenges: A review of literature. *JSAFOG*.**4** (1), 64-70.

Pokharel, R. K., Maharjan, M. R., Mathema, P. and Harvey, P. W. J. (2011). Success in Delivering Interventions to Reduce Maternal Anemia in Nepal: A Case Study of the Intensification of Maternal and Neonatal Micronutrient Program [Report]. USAID, A2Z project, FHI 360 Nepal, Retrieved from <http://www.spring-nutrition.org/>. [Accessed 9 january, 2017].

Pomeroy, A. and Jolene, W. (2014). Snapshots of Nutrition in Nepal: 2014 Compendium [Report]. USAID/Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) Project. Arlington, VA, , USA. Retrieved from https://[www.secureplatform.org/](http://www.secureplatform.org/).

Prakash, S. A., K, R. and Rasquinha, S. (2016). Prevalance And Outcome Of Anaemia In Pregnancy. *IJIRAS*.**3** (8), 131-134.

Ransom, E. I. and Elder, L. K. (2003). Nutrition of Women and Adolescent Girls: Why It Matters. Population Reference Bureau. Retrieved from <http://www.prb.org/Publications/Articles/>.

Raut, B. K., Jha, M. K., Shrestha, A., Sah, A., Sapkota, A., Byanju, S. and Malla, S. S. (2014). Prevalence of iron deficiency anemia among pregnant women before iron supplementation in Kathmandu university Hospital/Dhulikhel Hospital. *Journal of Gynecology and Obstetrics*.**2** (4), 54-58.

Salhan, S., Tripathi, V., Singh, R. and Gaikwad, S. H. (2012). Evaluation of Hematological Parameters in Partial Exchange and Packed Cell Transfusion in Treatment of severe anemia in pregnancy. *Anemia*.**2012**, 1-7.

Scholl, T. O. and Johnson, W. G. (2000). Folic acid: influence on the outcome of pregnancy. *AJCN*.**71**, 1295-1303.

Sciences, N. M. L. (2013). New report on global prevalence of anemia. Retrieved from <http://www.news-medical.net/>. [Accessed 15 january,2017 ].

Semba, R. D. and Victora, C. G. (2008). Low birth weight and Neonatal Mortality. 63-86. [Cited in R. D. Semba, M. W. Bloem and P. Piot. "Nutrition and Health in Developing Countries". Humana Press. Totowa, NJ].

Seshadri, S. (2001). Prevalence of micronutrient deficiency particularly of iron, zinc and folic acid in pregnant women in South East Asia. *British Journal of Nutrition*.**85** (2), 87-92.

Shahani, R. A., Shahani, S. and Kazi, N. (2012). Prevalence of anemia during pregnancy in Rural Sindh. *ISRAMJ*.**4** (2), 96-99.

Singh, P., Khan, S. and Mittal, R. K. (2013). Anemia during pregnancy in the women of western Nepal. *Bali Medical Journal*.**2** (1), 14-16.

Srilakshmi, B. (2014). "Dietetics" (7th ed.). New Age International (P) Ltd Publishers. New Delhi, India.

Stevens, G. A., Finucane, M. M., De-Regil, L. M., Paciorek, C. J., Flaxman, S. R., Branca, F., Peña-Rosas, J. P., Bhutta, Z. q. A. and Ezzati, M. (2013). Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. *Lancet Glob Health*.**1** (1), 16-25.

Swaminathan, D. M. (2008). "Food and Nutrition" (second ed.). Vol. 2. The Bangalore printing and publishing Co. Ltd. Mysore road, Bangalore-560-018.

Tadesse, S. E., Seid, O., G/Mariam,Y., Fekadu, A., Wasihun,Y., Endris, K., Bitew, A. (2017). Determinants of anemia among pregnant mothers attending antenatal care in Dessie town health facilities, northern central Ethiopia, unmatched case -control study. **12** (3).

Tang, A. M., Dong, K., Deitchler, M., Chung, M., Maalouf-Manasseh, Z., Tumilowicz, A. and Wanke, C. (2013). Use of Cutoffs for Mid-Upper Arm Circumference (MUAC) as an Indicator or Predictor of Nutritional and HealthRelated Outcomes in Adolescents and Adults: A Systematic Review [Report]. Food and Nutrition Technical Assistance III Project (FANTA), FHI 360. Washington, DC, USA, Retrieved from <http://www.fantaproject.org/>. [Accessed 10 January, 2017].

Tolentino, K. and Friedman, J. F. (2007). An Update on Anemia in Less Developed Countries. *Am. J. Trop. Med. Hyg*.**77** (1), 44-51.

Tunkyi, K. and Moodley, J. (2016). Prevalence of anaemia in pregnancy in a regional health facility in South Africa *S Afr Med J*.**106** (1), 101-104.

Ullah, I., Zahid, M., Khan, M. I. and Shah, M. (2013). Prevalence of anemia in pregnant women in district Karak, Khyber Pakhtunkhwa, Pakistan. *Int. J. Biosci.* **3** (11), 77-83.

UMMC. (2015). Sickle Cell Disease [Report]. University of Maryland Medical Center. Greene Street, Baltimore, USA.

UNICEF. (2002). Prevention and Control of Nutritional Anaemia: A South Asia Priority [Booklet]. pp. 1-13. Retrieved from https://[www.unicef.org/rosa/Anaemin.pdf](http://www.unicef.org/rosa/Anaemin.pdf). [Accessed 13 january, 2017].

UNICEF. (2016). "MID-UPPER ARM CIRCUMFERENCE (MUAC) MEASURING TAPES". UNICEF. Retrieved from https://[www.unicef.org/](http://www.unicef.org/). [Accessed 25 december, 2016].

VanderJagt, D. J., Brock, H. S., Melah, G. S., El-Nafaty, A. U., Crossy, M. J. and Glew, R. H. (2007). Nutritional Factors Associated with Anaemia in Pregnant Women in Northern Nigeria. *J Health Popul Nutr*.**25** (1), 75-81.

WFP, C. (2004). "A Manual: Measuring and Interpreting Malnutrition and Mortality". World Food Programme and Centers for Disease Control and Prevention.

WHO. (1992). "The Prevalence of Anemia in Women" (2nd ed.). Retrieved from <http://www.who.int/>.

WHO. (2000). "The world health report 2000 - Health systems: improving performance". Geneva, Switzerland. World Health Organization. Retrieved from <http://www.who.int/>.

WHO. (2001a). "Iron Deficiency Anaemia Assessment, Prevention, and Control: A guide for programme managers". Retrieved from <http://www.who.int/>. [Accessed 17 december 2016].

WHO. (2001b). Iron Deficiency Anaemia Assessment, Prevention, and Control: A guide for programme managers. World Health Organisation. Retrieved from <http://www.who.int/nutrition/publications/micronutrients/anaemia_iron_deficiency/WHO_NHD_01.3/en/>. [Accessed 17 December, 2016].

WHO. (2011). "Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity ". Geneva. Retrieved from <http://www.who.int/vmnis/indicators/haemoglobin.pdf>. [Accessed 14 January 2017].

WHO. (2014). "Global nutrition targets 2025: anaemia policy brief ". Retrieved from <http://www.who.int/nutrition>. [Accessed 17 December 2016].

WHO. (2015). "The global prevalence of anaemia in 2011". Geneva, Switzerland. World Health Organization. Retrieved from <http://www.who.int/nutrition>.

Wikipedia. (2017). Malnutrition in South Africa. Retrieved from https://en.wikipedia.org/. [Accessed 9 February, 2017].

Willows, N. D. (2000). Anemia in James Bay Cree Infants Of Northern Quebec*.* Ph.D Thesis. McGill Univ., Canada.

**Appendices**

**Appendix-A**

**k|ZgfjnL**

**s\_ ;fdfGo hfgsf/L**

!\_ sf]8 g+============= cGt/jftf{ ldlt M====================……………

@\_ ;xefuLsf] gfd M========================================================================================

#\_ pd]/ M====================

$\_ 7]ufgf M=====================================================================================================

%\_ ;Dks{ g+==============================================

^\_ x]df]Unf]ljgsf] dfqf M=====================================================

**v\_ Anthropometric measurements -zf/Ll/s gkfO{\_\_**

!\_ tf}n (kg) @\_ prfO{ (cm) #\_ MUAC (cm)

$\_ BMI (kg/m2)

%\_ BMI sf] juL{s/0f

(i) Overweight (ii) Obese (iii) Underweight iv) Normal

**u\_ hg;f+lVos÷;fdflhs tyf cfly{s cj:yf**

!\_ tkfO{+sf] kl/jf/df slt hgf ;b:ox? x'g'x'G5 <

(ii) # (iii) $ (iv) % (v) % eGbf dfly =================

@\_ tkfO{+sf] kl/jf/df slt–slt hgf dlxnf tyf k'?if ;b:ox? x'g'x'G5 <

(i) dlxnf÷x? (ii) k'?if÷x?

#\_ tkfO{+ s'g hftLo ju{df kg'{x'G5 <

(i) a|fDx0f÷If]qL (ii) hghflt (iii) dw];L (iv) blnt

(v) cGo ====================

$\_ tkfO{+ s'g wd{ dfGg'x'G5 <

(i) lxGb' (ii) af}4 (iii) lqmlZrog (iv) O:nfd

(v) cGo ============================

%\_ tkfO{+sf] z}lIfs of]Uotf slt 5 <

(i) k|fylds (ii) dfWolds (iii) pRr dfWolds

(iv) :gfts tyf ;f] eGbf dfly (v) lg/If/

^\_ tkfO{+sf] >Ldfg\sf] z}lIfs of]Uotf slt 5 <

(i) k|fylds (ii) dfWolds (iii) pRr dfWolds

(iv) :gfts tyf ;f] eGbf dfly (v) lg/If/

&\_ tkfO{+sf] k];f s] xf] <

(i) 3/u[lx0fL (ii) Joj;fo (iii) gf]s/L (iv) s[lif

(v) cGo========

\*\_ tkfO{+sf] >Ldfg\sf] k];f s] xf] <

(i) Joj;fo (ii) gf]s/L (iii) s[lif (iv) cGo=========

(\_ tkfO{+sf] kl/jf/df k|d'v cfDbfgLsf] ;|f]t s] xf] <

(i) Joj;fo (ii) gf]s/L (iii) s[lif (iv) cGo============

!)\_ tkfO{+sf] kl/jf/df jflif{s cfDbfgL slt x'G5 <

(i) @ nfveGbf sd (ii) @ b]lv % nfv (iii) % nfv eGbf a9L

!!\_ tkfO{+sf] 3/df vfgf ksfpg] OGwgsf] ;|f]t s] xf] <

(i) Pn=lk=lh= UofF; (ii) d6\6Lt]n (iii) bfp/f (iv) uf]a/ Uof;

(v) cGo=============

!@\_ tkfO{+sf] 3/df s:tf] k|sf/sf] rkL{ k|of]u ug'{x'G5 <

(i) v'nf d}bfg (ii) vfN8f] (iii) ef/tLo rkL{ (iv) o"/f]k]nL rkL{

!#\_ tkfO{+sf] 3/ s:tf] k|sf/ 5 <

(i) 5fk|f] (ii) slRr (iii) kSsf

**-3\_ dft[Tj cj:yf**

-!\_ tkfO{+sf] ljjfx x'Fbf pd]/ slt lyof] <

(i) <!\* (ii) !\* b]lv @) (iii) > @!

-@\_ tkfO{+sf] ue{ cjlw (gestational period) slt xf] <

(i) klxnf] tLg dlxgfsf] cjlw (ii) bf];|f] tLg dlxgfsf] cjlw

(iii) t];|f] tLg dlxgfsf] cjlw

-#\_ tkfO{+sf] of] klxnf] uef{j:yf xf] <

(i) xf] (ii) xf]Og

(I) olb xf]Og eg], tkfO{+sf] pd]/ klxnf] uef{j:yfdf slt lyof] <

(i) < !( (ii) !( b]lv @! (iii) > @@

(II) tkfO{+sf] of] sltof}+ uef{j:yf xf] <

(i) < # (ii) # b]lv % (iii) > ^

(III) tkfO{+sf] of] sltof}+ ;'Ts]/L (Deliveries) xf] <

(i) ! (ii) @ b]lv $ (iii) > %

(IV) tkfO{+sf] hLljt slt–slt hgf s]6L tyf s]6f aRrf÷x? 5g\ <

(i) s]6L÷x? (ii) s]6f÷x?

$\_ clxn]sf] uef{j:yfdf tkfO{+n] 8fS6/L hfFr (Antenatal Care) ub}{ x'g'x'G5 <

(i) u/]sf] 5' (ii) u/]sf] 5'Og

(I) olb ug'{x'G5 eg], tkfO{+ sltof}+ k6s 8fS6/L hfFrsf] nflu hfg'eof] <

(i) ! (ii) @ (iii) # (iv) $ (v) $ eGbf Hofbf

**-ª\_ :jf:Yo, 1fg tyf cEof;sf] cj:yf**

-!\_ kl5Nnf] tLgb]lv ^ dlxgf;Dd tkfO{+nfO{ s'g} ladf/ ePsf] lyof] <

(i) lyof] (ii) lyPg

(I) olb lyof] eg], s'g ladf/===============================================================

-@\_ tkfO{+n] h'sfsf] cf}iflw ev([Tadesse](#_ENREF_95)) lng' ePsf] 5 <

(i) 5 (ii) 5}g

-#\_ tkfO{+nfO{ /QmcNktfsf] af/]df yfxf 5 <

(i) 5 (ii) 5}g

-I\_ olb 5 eg] tkfO{+nfO{ /QmcNktfsf] nIf0faf/] s'g} hfgsf/L 5 <

(i) /QmcNktfsf] nIf0faf/] s'g} klg hfgsf/L 5}g

(ii) /QmcNktfsf] nIf0faf/] s]xL hfgsf/L 5

(II) tkfO{+nfO{ /QmcNktfsf] gsf/fTds kl/0ffd af/] hfgsf/L 5 <

1. gsf/fTds kl/0ffd af/] s'g} klg hfgsf/L 5}g
2. gsf/fTds kl/0ffd af/] s]xL hfgsf/L 5

-$\_ tkfO{+nfO{ ;Gt'lnt ef]hgaf/] hfgsf/L 5 <

(i) 5 (ii) 5}g

-%\_ tkfO{+ la/fdL x'Fbf sxfF hfg'x'G5 <

(i) wfdL÷emfFqmL (ii) c:ktfn (iii) cfkm\gf] lgb]{zgdf (iv) cGo======

-^\_ tkfO{+sf] lkpg] kfgLsf] d'Vo ;|f]t s] xf] <

(i) 3/df ePsf] wf/f (ii) ;fj{hlgs wf/f (iii) sn (iv) Ogf/

(v) cGo==============

-&\_ tkfO{+n] lkpg] kfgLsf] z'4Ls/0f ug'{x'G5 <

(i) u5'{ (ii) ulb{g

(I) olb ug'{x'G5 eg], tkfO{+ k|fo sltk6s;Dd ;'4Ls/0f ug'{x'G5 <

(i) ;w}F (ii) slxn]–slxn] (iii) slxNo} klg ulb{g

(iv) rflxPsf] a]nfdf

(II) tkfO{+ s;/L lkpg] kfgLsf] z'4Ls/0f ug'{'x'G5 <

(i) 5fg]/ (ii) pdfn]/ (iii) ;f]l8; (iv) cGo=======

**r\_ ef]hg jf ;f];“u ;DalGwt afgL a]xf]/f]sf cj:yf**

!\_ tkfO{+ s'g k|sf/sf] vfgf vfg' x'G5 <

(i) zfsfxf/L vfgf (ii) df+;fxf/L vfgf (iii) b'j}

@\_ tkfO{+sf] k|d'v vfgfsf] ;|f]t s] xf] <

(i) rfdn (ii) ux'F (iii) ds} (iv) sf]bf]

v) cGo=======

#\_ tkfO{+sf] s'g k|sf/sf] g'g k|of]u ug'{x'G5 <

(i) l9s] g'g (ii) cfof]l8g o'Qm g'g (iii) cGo

$\_ tkfO{+ lbgdf slt k6s;Dd vfgf lng'x'G5 <

(i) ! k6s (ii) @ k6s (iii) # k6s (iv) # k6s eGbf Hofbf

%\_ tkfO{+ df;' k|fo slt k6s;Dd lng'x'G5 <

(i) ;w}+ (ii) xKtfsf] ! b]lv # k6s (iii) xKtfsf] $ b]lv ^ k6s

^\_ tkfO{+ kmnkm"n k|fo slt k6s;Dd lng'x'G5 <

(i) ;w}+ (ii) xKtfsf] ! b]lv # k6s (iii) xKtfsf] $ b]lv ^ k6s

&\_ tkfO{+ c08f k|fo slt k6s;Dd lng'x'G5 <

(i) ;w}+ (ii) xKtfsf] ! b]lv # k6s (iii) xKtfsf] $ b]lv ^ k6s

\*\_ tkfO{+ b"w tyf b"waf6 aGg] kbfy{ k|foM slt k6s;Dd lng'x'G5 <

(i) lbgdf b'O{ jf b'O{eGbf Hofbf (ii) lbgdf Ps k6s (iii) xKtfdf Ps k6s

(iv) xKtfdf Ps k6s eGbf sd

(\_ tkfO{+ xl/of] ;fu, ;AhL k|foM slt k6s;Dd lng'x'G5 <

(i) lbgdf b'O{ jf b'O{eGbf Hofbf (ii) lbgdf Ps k6s (iii) xKtfdf Ps k6s

(iv) xKtfdf Ps k6s eGbf sd

!)\_ tkfO{+nfO{ uef{j:yfdf s'g} lgif]lwt vfgf 5 <

(i) 5 (ii) 5}g

!!\_ tkfO{+ uef{j:yfdf cvfB s'/f -h:t} df6f], 9'ª\uf\_ vfg' x'G5 <

(i) vfG5' (ii) vfFlbg

!@\_ tkfO{+ lrof÷skmL lkpg'x'G5 <

(i) lkpF5' (ii) lkpFlbg

(I) olb lkpg'x'g5 eg], lbgdf slt k6s;Dd lkpg'x'G5 <

(i) Psk6s (ii) b'O{ k6s (iii) tLg k6s (iv) tLg k6seGbf Hofbf

(II) tkfO{+ s:tf] k|sf/sf] lrof÷skmL lkpg'x'G5 <

(i) sfnf] lrof÷skmL (ii) b"w lrof÷skmL (iii) cGo==========

!#\_ tkfO{+ dlb/f lkpg'x'G5 <

(i) lkpF5' (ii) lkpFlbg

(I) olb lkpg'x'g5 eg], slt dfqfdf lkpg'x'G5 <

(i) < 20ml÷lbg (ii) > 20ml÷lbg (iii) ljz]if cj;/df

!$\_ tkfO{+ w'd|kfg ug'{x'G5 <

(i) u5'{ (ii) ulb{g

(I) olb ug'x'G5 eg], lbgdf slt k6s;Dd w'd|kfg ug'{x'G5 <

(i) < % lvln (ii) ^ b]lv !) lvln (iii) !) lvln eGbf Hofbf

**-5\_ @$ 306fsf] vfgfsf] ljj/0f**

* -!\_ lxhf] s'g} ef]h lyof] <

(i) lyof] -cl3Nnf] lbgsf] ljj/0f lbg]\_ (ii) lyPg -tnsf] pQ/ lbg]\_

|  |  |  |
| --- | --- | --- |
| ;do | vfg] s'/fsf] gfd | kl/df0f |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Questionnaire**

1. **General information**
2. Code no. : Date of interview:
3. Name of respondents:
4. Age:
5. Address:
6. Contact no. :
7. Value of hemoglobin level:
8. **Anthropometric measurements**
9. Weight in Kg:
10. Height in cm:
11. Mid-upper arm circumference (MUAC) in cm:
12. Body mass index (BMI) in Kg/m2:
13. Classification of BMI:

a. Normal [ ] b. overweight [ ] c. obese [ ] d. underweight [ ]

1. **Socio-demographic and economic status**
2. How many members are there in your family?

a. 2 [ ] b. 3 [ ] c. 4 [ ] d. 5 [ ] e. above 5 [specify]

1. What is the total number of male/s and female/s?

a. Male/s [ ] b. Female/s [ ]

1. Which ethnic group do you belong?

a. Brahmin/Cheetri [ ] b. Madhesi [ ] c. Janajati [ ] d. Dalit [ ] e. Others [specify]

1. What is your religion?

a. Hindu [ ] b. Buddhist [ ] c. Muslim [ ] d. Christian [ ] e. Others [specify]

1. What is your education level?

a. Primary [ ] b. Secondary [ ] c. Higher secondary [ ] d. Bachelor & above[ ]

f. Illiterate [ ]

1. What is your husband education level?

a. Primary [ ] b. Secondary [ ] c. Higher secondary [ ] d. Bachelor& above [ ]

f. Illiterate [ ]

1. What is your occupation?

a. Housewives [ ] b.Service [ ] c. Business [ ] d. Agriculture [ ] e. Others [specify]

1. What is your husband’s occupation?

a. Service [ ] b. Business [ ] c. Agriculture [ ] d. Others [specify]

1. What is the main source of income of your family?

a. Service [ ] b. Business [ ] c. Agriculture [ ] d. Others [specify]

1. What is your family income per annum?

a. Less than 2 lakh [ ] b. 2 to 5 lakh [ ] c. more than 5 lakh [ ]

1. What is the main source of food in the house?

a. Agriculture [ ] b. From market [ ] c. Donation [ ] d. Others [specify]

1. What is the source of fuel for cooking in the house?

a. Liquid petroleum gas [ ] b. Kerosene [ ] c. Firewood [ ] d. Gobar gas/bio-fuels [ ]

e. Others [specify]

1. What type of toilet is there in your house?

a. Open [ ] b. Pit [ ] c. Indian toilet [ ] d. Europeantoilet [ ]

1. What is the type of your house?

a. Hut [ ] b. Semi-pucca [ ] c. Pucca [ ]

1. **Maternal status**
2. What was your age when you got married?

a. < 16 [ ] b. 16 to 18 [ ] c. ≥ 19

1. What is your gestational period?

a. 1st trimester [ ] b. 2nd trimester [ ] c. 3rd trimester [ ]

1. Is this your first pregnancy?

a. Yes [ ] b. No [ ]

1. If no, what was your age at first pregnancy?

a. <17 [ ] b. 17 to 19 [ ] c. ≥20 [ ]

1. What is the number of pregnancy?

a. <3 [ ] b. 3 to 5 [ ] c. ≥6 [ ]

1. What is the number of deliveries?

a. 1 [ ] b. 2 to 4 [ ] c. ≥5 [ ]

1. How many live children do you have?

a. 1 [ ] b. 2 to 4 [ ] c. ≥5 [ ]

1. What is the total number of your live male/s and female/s children?

a. Male/s [ ] b. Female/s [ ]

1. Have you received antenatal care during current pregnancy?

a. Yes [ ] b. No [ ]

1. What is the frequency of your antenatal care visit?

a. 1 [ ] b. 2 [ ]

1. **Health, knowledge and Practices status**
2. During last three to six months did you have any of the following diseases?

a. Yes [ ] b. No [ ]

1. If yes, then what it is? ………………..
2. Have you taken deworming tablet recently?

a. Yes [ ] b. No [ ]

1. Do you know about anemia?

a. Yes [ ] b. No [ ]

1. If yes, do you have any knowledge about anemia symptoms?

a. Not aware of any anemia symptoms [ ]

b. Aware of some anemia symptoms [ ]

1. Do you have any knowledge about negative outcomes of anemia?

a. No negative outcome known [ ]

b. Some negative outcome known [ ]

1. Do you know about balanced diet?

a. Yes [ ] b. No [ ]

1. Where do you go when you are sick?

a. Shamans [ ] b. Hospital [ ] c. Self-prescription [ ] d. Others [specify]

1. What is the source of your drinking water?

a. Tap in the house [ ] b. Common tap [ ] c. Hand pump/bore well [ ] d. Well [ ]

e. Others [specify]

1. Do you purify your drinking water?

a. Yes [ ] b. No [ ]

1. If yes, how often do you purify your drinking water before drinking?

a. Always [ ] b. Sometimes [ ] c. Most of times [ ] d. Never [ ]

e. When needed [ ]

1. What kind of method do you use for purification of your drinking water?

a. Filtration [ ] b. Boiling [ ] c. Sodis [ ] d. Others [specify]

1. **Dietary habits status**
2. What type of food do you consume?

a. Veg [ ] b. Non- veg [ ] c. Mixed [ ]

1. What is your staple food?

a. Rice [ ] b. Wheat [ ] c. Maize [ ] d. Millet [ ] e. Others [specify]

1. What kind of salt do you used for consumption?

a. Crystal salt [ ] b. Iodized salt [ ] c. Others [specify]

1. How many times do you have meal per day?

a. One time [ ] b. Two times [ ] c. Three times [ ] d. more than three times [ ]

1. How often do you take meat?

a. Everyday [ ] b. 1 to 3 times a week [ ] c. 4 to 6 times a week [ ]

d. Once per month [ ]

1. How often do you take fruit?

a. Everyday [ ] b. 1 to 3 times a week [ ] c. 4 to 6 times a week [ ]

d. Once per month [ ]

1. How often do you take egg?

a. Everyday [ ] b. 1 to 3 times a week [ ] c. 4 to 6 times a week [ ]

d. Once per month [ ]

1. How often do you take milk and milk products?

a. More than two times per day [ ] b. Once per day [ ] c. Once per week [ ] d. Less than once per week [ ]

1. How often do you take green leafy vegetables?

a. Everyday [ ] b. 1 to 3 times a week [ ] c. 4 to 6 times a week [ ]

d. Once per month [ ]

1. Is there any forbidden foods for pregnancy?

a. Yes [ ] b. No [ ]

1. If yes, then what it is? ………………..
2. Do you have pica?

a. Yes [ ] b. No [ ]

1. Do you drink tea/coffee?

a. Yes [ ] b. No [ ]

i. If yes, how often do you drink it?

a. One time [ ] b. Two times [ ] c. Three times [ ] d. more than three times [ ]

ii. What type of tea/coffee do you drink it?

a. Black tea/ coffee [ ] b. Milk tea/coffee [ ] c. Others

1. Do you drink alcohol?

a. Yes [ ] b. No [ ]

1. If yes, how much do you drink it?

a. ≤ 60 ml/day [ ] b. >60ml/day [ ] c. Occasionally [

1. Do you chew tobacco?

a. Yes [ ] b. No [ ]

1. If yes, how often do you chew tobaccco per day?

a. ≤2 [ ] b. 3 to 5 [ ] c. more than 5 [ ]

1. What type of tobacco do you chew?

a. Surti [ ] b. Khaini [ ]

1. Do you smoke cigarette?

a. Yes [ ] b. No [ ]

1. If yes, how many stick/s of cigarette do you smoke per day?

a. ≤5 [ ] b. 6 to 10 [ ] c. more than 10 [ ]

1. **24-hour dietary recall**
2. Did you have any occasion yesterday?
3. Yes (give information of previous day)
4. No (answer the question below)

What foods did you have taken from yesterday morning to today morning?

|  |  |  |
| --- | --- | --- |
| Time | Name of food | Amount |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Appendix-B**

**s]lG›o k|ljlw SofDk;**

**xflQ;f/, w/fg**

**/utdf x]df]Unf]lag hfFr u/fpgsf] nflu ;"lrtdGh'/Lgfdfkq**

|  |  |
| --- | --- |
| gfd / y/ M |  |
| pd]/ / ln+u M |  |
| 7]ufgf M |  |
| hfFr u/fPsf] ldlt M |  |

**u/fOg] hfFrx? /cGoljj/0f**M

* x]df]Unf]lagsf] hfFrsfnfluul/g] /utsf] gd'gf
* Vffg] s'/fsf] ljj/0fsf] nfluk|Zgsf] pQ/
* prfO / tf}n

**ljutdfolbtnpNn]lvtdWo]sfs'g} cj:yftkfO ÷tkfO{sf] 5f]/L;+u d]n vfPdf of] hfFr u/fpg' x'b}g .**

* s'g} /f]u k|lt/f]wfTdsIfdtfsdhf]/ agfpg] cf}iflw ;]jg u/]sf] ePdf
* s'g} k|f0f 3fts /f]u nfu]sf] ePdf
* /utsf] dfqf a9fpg] cf}iflw ;]jgub{} u/]sf] ePdf

**a'bfFx?**

* of] k9fO{sf] nfludfqxf]
* of] hfFr u/fpFbfx'g;Sg] ;+efljt c;/x?sf] af/]dfdnfO{ hfgsf/L u/fOPsf] 5 .
* x]df]Unf]lag hfFrsfnfluul/g] /uthfFrsf] af/]dfdflypNn]lvthfgsf/Lx? a'em]/ ;f] hfFr u/fpgsfnflu d ;xdt 5' .
* ;DalGwt ;Dk"0f{ hfFrx? k"0f{tofuf]Ko /flvg]5 .

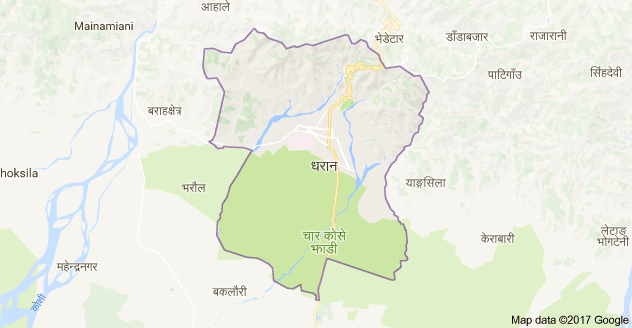
**;xeflu**

b:tvt M ldlt M

hfrlssf] b:tvt / ldlt M kl/0ffd x]g]{ ldltM

**Appendix-C**

**Map of survey site (Dharan sub-metropolitan city)**

****

**Appendix-D**

**Table-8.2**: Distribution of different forms of anemia based on different study variables

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | | **Type of Anemia (%)** | | |
| **Non-anemic** | **Mild** | **Moderate** |
| **Caste** | Brahmin/ Chhetri | 68.06 | 23.61 | 8.33 |
|  | Janjati | 65.77 | 18.92 | 15.32 |
|  | Madhesi | 50 | 30 | 20 |
|  | Dalit | 60 | 30 | 10 |
| **Religion** | Hindu | 65.09 | 23.08 | 11.83 |
|  | Buddhist | 69.57 | 13.04 | 17.39 |
|  | Christian | 10 | 30 | 60 |
|  | Others | 18.18 | 18.18 | 63.64 |
| **Family size** | <5 | 70.34 | 17.80 | 11.86 |
|  | ≥5 | 58.95 | 27.37 | 13.68 |
| **Family income** | <2 lakhs | 55.45 | 24.75 | 19.80 |
|  | 2-5 lakhs | 73.79 | 19.42 | 6.79 |
|  | >5 lakhs | 77.78 | 22.22 | 0 |
| **Education level** | Primary | 84.21 | 15.79 | 0 |
|  | Secondary | 65.22 | 20.87 | 13.91 |
|  | Higher secondary and above | 59.46 | 27.03 | 13.51 |
|  | Illiterate | 80 | 0 | 20 |
| **Age** | 15-24 | 55.86 | 27.92 | 16.22 |
|  | 25-34 | 77.08 | 14.59 | 8.33 |
|  | ≥35 | 50 | 33.33 | 16.67 |
| **MUAC (cm)** | <23 | 50 | 23.53 | 26.47 |
|  | ≥23 | 68.16 | 21.79 | 10.05 |
| **BMI** | Underweight | 20 | 46.67 | 33.33 |
|  | Normal | 66.67 | 21.26 | 12.07 |
|  | Overweight & obese | 83.33 | 12.50 | 4.17 |
| **Gestational period** | First trimester | 52.99 | 28.21 | 18.80 |
|  | Second trimester | 80.21 | 14.58 | 5.21 |
| **Age at marriage** | <18 | 60.61 | 27.27 | 12.12 |
|  | 18-20 | 67.82 | 18.39 | 13.79 |
|  | ≥21 | 64.52 | 23.65 | 11.83 |
| **Frequency of pregnancy** | 1 | 57.26 | 24.79 | 17.95 |
|  | 2-3 | 75 | 18.75 | 6.25 |
| **Frequency of ANC visit** | 1 | 48.81 | 28.57 | 22.62 |
|  | 2-3 | 75.97 | 17.83 | 6.20 |
| **Deworming tablets** | No | 57.53 | 25.34 | 17.13 |
|  | Yes | 82.09 | 14.92 | 2.99 |
| **Knowledge about anemia** | No | 66.29 | 19.10 | 14.61 |
|  | Yes | 60 | 37.14 | 2.86 |
| **Knowledge about balanced diet** | No | 43.90 | 34.15 | 21.95 |
|  | Yes | 70.35 | 19.18 | 10.47 |
| **Types of consumers** | Vegetarian | 45.45 | 18.18 | 36.37 |
|  | Non-vegetarian | 66.34 | 22.28 | 11.38 |
| **Frequency of meal** | 1-2 | 63.91 | 20.71 | 15.38 |
|  | ≥3 | 70.45 | 27.28 | 2.27 |
| **Frequency of meat** | 0 | 38.46 | 30.77 | 30.77 |
|  | Daily | 83.33 | 11.11 | 5.56 |
|  | 1-3/wk | 66.19 | 21.58 | 12.23 |
|  | 4-6/wk | 62.79 | 25.58 | 11.63 |
| **Frequency of fruits** | 0 | 100 | 0 | 0 |
|  | Daily | 68.83 | 19.48 | 11.69 |
|  | 1-3/wk | 59.38 | 27.08 | 13.54 |
|  | 4-6/wk | 71.79 | 15.39 | 12.82 |
| **Frequency of egg** | Daily | 100 | 0 | 0 |
|  | 1-3/wk | 70.13 | 19.48 | 10.39 |
|  | 4-6/wk | 53.85 | 38.46 | 7.69 |
|  | 0 | 42.11 | 31.58 | 26.31 |
| **Frequency of milk and milk products** | ≥2/day | 86.36 | 9.09 | 4.55 |
|  | Once/day | 62.69 | 23.13 | 14.18 |
|  | Once/wk | 62.50 | 27.50 | 10 |
|  | 0 | 64.70 | 17.65 | 17.65 |
| **Frequency of green leafy vegetables** | ≥2/day | 81.82 | 14.54 | 3.64 |
|  | Once/day | 57.64 | 25 | 17.36 |
|  | Once/wk | 78.57 | 21.43 | 0 |
| **Frequency of tea** | 0 | 76.32 | 18.42 | 5.26 |
|  | 1 | 69.23 | 19.66 | 11.11 |
|  | ≥2 | 50 | 29.31 | 20.69 |
| **Types of tea** | Black tea | 68.60 | 18.61 | 12.79 |
|  | Milk tea | 57.30 | 26.97 | 15.73 |
|  | None | 76.32 | 18.42 | 5.26 |

**Photo Gallery**



