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**EFFECT OF ANEMIA DURING PREGNANCY ON MATERNAL
AND NEONATAL HEALTH OUTCOME AT HOSPITAL
SETTINGS: A CROSS-SECTIONAL STUDY**

A Project Report

By

AFIA ANTARA

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of BSc in Nutrition and Food Engineering

Supervised By

Akibul Islam Chowdhury

Lecturer

Department of Nutrition and Food Engineering

FACULTY OF HEALTH AND LIFE SCIENCES

DAFFODIL INTERNATIONAL UNIVERSITY

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APPROVAL

This project, “Effect of anemia during pregnancy on maternal and neonatal health outcome at hospital settings: A cross sectional study” has been turned in by Afia Antara to the Department of Nutrition and Food Engineering at Daffodil International University. It has been accepted as a partial fulfillment of the requirements for the degree of B.Sc. in Nutrition and Food Engineering and approved for its style and content.

EXAMINING COMMITTEE

Chairman of the Board	_____	_____
External Member	_____	_____
Internal Member-1	_____	_____
Internal Member-2	_____	_____

Dr. Nizam Uddin

Associate Professor and Head

Department of Nutrition and Food Engineering

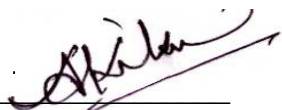
Faculty of Health and Life Sciences

Daffodil International University

DECLARATION

The project was completed under the supervision of **Akibul Islam Chowdhury, Lecturer, Department of Nutrition and Food Engineering** at Daffodil International University. I also affirm that neither this project nor any portion of this project has been submitted elsewhere for the purpose of earning a degree or certificate.

Supervised by:



Akibul Islam Chowdhury

Lecturer

Department of Nutrition and Food Engineering

Faculty of Health and Life Sciences

Daffodil International University

Submitted by:



Afia Antara

Id: 201-34-1067

Department of Nutrition and Food Engineering

Faculty of Health and Life Sciences

Daffodil International University

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ABSTRACT

Pregnancy-related anemia in the mothers is deleterious to simultaneously the mother and an unborn child. The intent of the investigation is to gauge the way anemia influence the overall wellness of newborns and the curriculum of pregnancies. A cross-sectional research investigation occurred at a private health care facility in Dhaka comprising 150 postpartum women. Data were collected through questionnaire and data analysis through SPSS software version 27.0. Anemia in mother was identified through hemoglobin level during pregnancy and if the hemoglobin level was less than 11g/dl then it was considered anemic where anemia prevalence was 72% and 28% were normal. Though mortality rate of babies was 2.7% among babies there were various risk factors associated with anemia on pregnancy. Transfusion (30.7%) and caesarian delivery (94%) among mother was high and other outcomes of mother were not that significant factor but it may impact on mothers. There were several neonatal outcomes but which affects mostly and was significant in this study and correlated with anemia was preterm delivery and low birth weight. 41.3% neonatal had preterm delivery. About 46.7% of babies' weight was below 2500g which shows low birth weight. Overall the study elaborates maternal anemia prevalence is really high among pregnant women for lack of knowledge as the education of mother and husband doesn't meet it's need and for lack of knowledge mother did not get proper prenatal care. One prenatal visit during pregnancy within a month is ideal but in 28-36 weeks one prenatal visit in every two weeks and in 36-40 weeks pregnant one prenatal visit every week is needed where 52.7% mother only visit hospital for less than four times. There was a significant relationship identified amongst anemia in pregnancy and low economic status, a lack of understanding and postponed visits to the antenatal clinic. Therefore, initiatives to generate awareness and enlighten the general population about anemia, its consequences during pregnancy, and measures to prevent it should be implemented. An increased likelihood of severe maternal outcomes was discovered to be independently attributed to mild to moderate anemia while pregnancy. Pregnant women and maternal health care providers ought to focus more on prevention and treatment of anemia during pregnancy. In order to determine if whether women with mild to moderate anemia are more susceptible to any negative effects, additional research must be conducted to validate such findings on a larger sample of women.

Keywords: Anemia, Maternal Health, Neonatal Health, Pregnancy, Women's health.

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CHAPTER 1

INTRODUCTION

1.1 Background

Pregnant women are regarded as anemic if their hemoglobin concentration is below 11 gm/dl in the first and third trimester or is lower than 10.5 gm/dl in the later trimester. Based to the World Health Organization, 35% to 75% (56% on average) of pregnant women in nations that are underdeveloped and 18% of women in countries with advanced economies are anemic (World Health Organization, 1992). Anemia is interpreted by possessing a hemoglobin content that is beneath 11 g/dL in the initial and subsequent stages of pregnancy and lower below 10.5 g/dL in the third phase of pregnancy, according to data compiled from the institutes for Disease Control in 1989 (Steer P, Alam M A, *et al.*, 1995). Anemia, which affects approximately 32 million pregnant women across the globe, is recognized in roughly half of all pregnant women in lower and middle-income regions (Balarajan Y., *et al.*, 2011). Maternal anemia, characterized by a hemoglobin concentration <110 g/dl throughout pregnancy, is a prominent condition that affects approximately 25 percent of women around the world (Gardner W *et al.*, 2020). It is drastically more widespread in low-income regions (low- and middle-income countries), at 42%, especially among South Asia (52%) and the west and central African regions 56% (Kinyoki D, *et al.*, 2021). Anemia in females of age for reproduction can be triggered by deficiency with particular nutrients, lower socioeconomic standing, multi-parity, or any other health condition (Pathan *et al.*, 2021, Shah *et al.*, 2020). Certain unpleasant implications for mother health and childbirth have been observed indicated to be correlated with a growing incidence of maternal anemia in LMICs. In particular, anemia during pregnancy has been estimated to be responsible for of roughly 20 percent of all maternal deaths reported nationwide (Young MF, Singal N, *et al.*, 2018). Furthermore, anemia has been determined to be a global factor of 591,000 newborn deaths (Kejela G, *et al.*, 2020). In affluent nations which include Australia, the United States, the UK, and Germany, the overall incidence of anemia across women who are expecting fluctuates from 9% to 51% (Stevens G.A., *et al.*, 2013). The statistics are in contradiction to those of nations with developing economies where the average incidence of anemia fluctuate between 44% to 81%, which include Ghana, Sudan, Nepal, Bangladesh, Pakistan, and India (Sohail M., *et al.*, 2015). Anemia has a number of contributing factors including poor nutritional status, poor diet, poor antenatal care service, socio-demographics, genetic, abortions, infectious disease, frequent labor and multi-parity (Shams S., *et al.*, 2018). Severe anemia has been demonstrated to have detrimental effects on the mother and the unborn child. The severity of the anemia and the perinatal time might influence the negative effects. Complications like as infections, heart failure, premature births, very small for gestational age newborns, stillbirths, and neonatal mortality may be driven by anemia. There isn't ample research linking maternal anemia to unfavorable pregnancy outcomes in terms of newborn parameters. The literature is devoid of information addressing how maternal anemia influences the fetus. (Koura JK, *et al.*, 2012). Preterm birth, a high blood pressure low birth weight, small-for-gestational-age (SGA) deliveries and anemia across pregnancy have all

been associated with elevated rates of mortality among mothers and babies, as well as deliveries by caesarean section (Stoltzfus R, *et al.*, 2004). Women with a hemoglobin concentration beneath 7 g/dL exhibit a considerably greater likelihood of preterm birth and low birth weight; this possibility may be inversely correlated with the extent of anemia (Kidanto HL, *et al.*, 2009). Due to interrupted immunity and imbalances in hormonal control, anemia during pregnancy as well as delivery elevates the potential of infection between the mother and the developing embryo. It additionally elevates the chance of hemorrhage, labor obstacles and unexpected delivery (Figueiredo A.C.M.G., *et al.*, 2018). Poor hemoglobin levels may lead to undesirable results such as poor Apgar evaluations, inadequate birth weights, and small for gestational age (SGA) premature babies, premature labor, growth retardation inside the womb, or intrauterine mortality. Anemia is not the only risk that mothers face (Shah *et al.*, 2020). An estimated 20 million premature infants and 15 million preterm infants are born on an annual basis, and their prevalence is an international health emergency, especially among developing nations. Despite prominent coordinated measures and improved health care for mothers and children interventions all over the world, these instances are still rising (Iams J.D., *et al.*, 2008). Numerous individual and household level variables correlated with maternal anemia have been examined evaluated in previous investigations carried out within Bangladesh and LMICs. However, whether in Bangladesh neither in LMICs, the detrimental effects of maternal anemia on health as well as birth outcomes have drawn considerable attention up to the present moment. The vast majority of the investigation that is currently available has targeted at how maternal anemia promotes small gestational age, preterm birth, and low birth weight, however the outcomes have been mixed (Rahman MA, *et al.*, 2020). This study is conducted to explore the prevalence of anemia and relation between maternal anemia and pregnancy outcome and various impact on newborn.

1.2 Research Question

What are the effects of anemia during pregnancy on maternal and neonatal health?

1.3 Rationale of the Study

There is barely any proof, despite a substantial amount of anemia research, correlating the severity of anemia to the health of the pregnant woman and fetus. This study aims at Pregnant women's anemia prevalence is to be predicted, and the associations between maternal anemia and maternal features, outcomes for mothers during pregnancy and delivery, and newborn outcomes must be addressed.

Pregnancy-related anemia is frequently linked to unfavorable pregnancy outcomes and can lead to complications that endanger the lives of the mother and fetus. The intent of this study intended to investigate the prevalence, influencing causes, and unsatisfactory perinatal outcomes of anemia in mothers during pregnancy and outcome of the newborn.

1.4 Objective

1.4.1 General Objective

The present research attempts to gauge the detrimental impacts of anemia whilst pregnant on newborns as well as mothers, alongside the number of cases of anemia in pregnant women and its influence on the developing child.

1.4.2 Specific Objective

1. In order to assess the incidence of anemia is in mothers who are expecting
2. To gauge their influence of anemia intensity on infant and the outcomes of mothers.
3. To ascertain how much implications for offspring and mothers with anemia are interconnected.
4. To delves into the correlation amongst the extent of anemia throughout pregnancy and a probability of negative consequences for the mother and the developing baby.

CHAPTER- 2

LITERATURE REVIEW

2.1 Maternal Anemia and Associated Risk Factors

Pregnant women in underdeveloped nations tend to suffer from anemia, a nutritional deficiency condition that is especially prevalent in India, where the incidence ranges from 65 to 75 percent. Pregnant women's significant anemia prevalence demonstrates that anemia continues to remain an important problem for public health in India's rural areas. Pregnancy-related anemia poses potential risks regarding the mother and the fetus. In conjunction with female literacy, gravida phase and inadequate reproductive history were critical risk factors for anemia in women who were expecting (Suryanarayana R, *et al.*, 2017). Pregnancy-related anemia is a prominent global health phenomenon that range in severity. Based on the amount of anemia, severe maternal outcomes which are deemed as life-threatening situations were explored from eighteen hospitals in southern China. The possibility of unsatisfactory maternal effects climbed with the level of severity of hemorrhaging with those in the population with a higher incidence of severe anemia witnessing this association. It emerged that even in the event of significant demand for blood transfusions, moderate to severe anemia throughout pregnancy had been linked with a higher probability for undesirable maternal outcomes (Li J., Fang J., *et al.*, 2022).

Worldwide, anemia is a significant nutritional deficiency within expectant mothers, but limited has been researched about the adverse effects of severe anemia on the health of the mother and fetus. Placental abruption, preterm birth, severe postpartum bleeding shock, ICU being hospitalized and maternal mortality included among the different maternal outcomes assessed; fetal growth restriction, deviations, and stillbirth were between the newborn's outcomes. Especially contrasted to not existing anemia, the severity of anemia corresponded with a greater possibility of adverse complications like placental abruption, preterm birth, severe postpartum bleeding and developmental deformity. Mild anemia during pregnancy exhibited a decreased likelihood of maternal and perinatal mortality. Severe anemia has been associated with morbidity related to the placenta (Shi H., *et al.*, 2022).

In Bangladesh, anemia while pregnant is ubiquitous, with an average incidence estimated to be 44%. It was previously revealed that maternal anemia corresponds to a greater possibility of difficulties during pregnancy and a lower probability of diabetes, hypertension, and menstruation that is irregular. In addition, it became apparent that premature babies of anemic mother women exhibited higher possibilities of preterm delivery, perinatal death, and early neonatal mortality as opposed to those of non-anemic mother women. This indicates that one of the biggest barriers towards improving the health of mothers and babies and lowering the serious risks associated with it is maternal anemia (Kabir MA, *et al.*, 2022).

2.2 Effect of Anemia on Maternal Health

Maternal outcomes connected with anemia include hemorrhage after delivery in women with moderate anemia and emergency caesarean sections in moms with mild anemia. These outcomes highlight how essential it is to pinpoint the underlying causes and risk factors of anemia during pregnancy to attempt to mitigate the adverse impacts that it has on expectant mothers and their unborn children (Bukhari IA, *et al.*, 2022). Maternal anemia also places the mother at increased risk of death during and after childbirth. Severe anemia can lead to circulatory decompensation, increased cardiac output, an increased risk of hemorrhage, and decreased ability to tolerate blood loss, leading to circulatory shock and death (Young MF *et al.*, 2018).

Anemia during pregnancy is particularly common, as illustrated in many research by the staggering statistic that approximately 50% of moms encountered anemia at various times all throughout the duration of the pregnancy, and 39% stayed anemic all through their pregnancy (Kumar KJ, *et al.*, 2013). In addition to the several morbidities that anemia has been connected to, further healthcare needed to be provided, including emergency care for the mother and the newborn. Anemic women encountered a greater probability of placentally mediated antepartum morbidity, notably preeclampsia, in addition to a higher burden of illnesses. Anemia has been linked with greater rates of blood transfusions, cesarean deliveries, and stimulation of labor during the intrapartum period. Furthermore, anemic women had extensively higher rates of infectious morbidity during both the intrapartum and postpartum periods (Smith, Catherine MSc, MD; Teng, Flora MD, *et al.*, 2019)

This could reflect enhanced prenatal care and wellness in general for the mother in this circumstance, as well as improved nutrition. The government has made improvements to prenatal care (ANC) services as time passed, and all expectant mothers nowadays obtain mosquito nets, deworming, iron supplements in order to avoid anemia, and malaria prophylaxis. Pregnant women are now required to take deworming treatments and malaria prophylaxis in their presence with the healthcare professional. This boosts the absorption of medication and fend against anemia that could have been triggered on by helminthes or mosquitoes. As per reports from other experts, the prevalence of anemia during pregnancy might range from 32% to 62.2% (Stephen G., *et al.*, 2018) Early-stage maternal anemia during pregnancy was linked to an increased risk of Small for gestational age, low birth weight, and premature delivery. Additionally, non-linear relationships between mother Hb concentrations and the likelihood of preterm birth, low birth weight, and small for gestational age in offspring were noted. Anemia during the first trimester of pregnancy was not linked to an increased risk of congenital abnormalities (Chen Y, *et al.*, 2024).

Maternal Outcomes	Fetal Outcomes
Abortion	Prematurity
Stillbirth	Low birthweight
Maternal death	Intrauterine growth restriction
Painful crisis	Stillbirth
Acute chest syndrome	Neonatal death
Severe anemia	5 Minute APGAR < 7
Jaundice	
Infections	
Preeclampsia	
Low transverse cesarean birth	

Figure 1: Adverse Maternal and Fetal Outcomes of Anemia in Pregnancy (Stanley A. et al., 2021)

Pregnancy-related anemia raises the risk of obstetric hemorrhage, infection rate, obstetric shock, and trauma from labor complications, among other things. The likelihood of maternal death rises fivefold in comparison to women who are not anemic. Similarly, the risk of high cardiac output failure increases markedly in patients with severe anemia and hemoglobin levels of less than or equal to 6 gm/100 ml, particularly in situations of hypertension and pre-eclampsia. Patients with mild to moderate anemia are less likely to experience these consequences. However, in these patients with mild to moderate anemia, the kid may experience behavioral or speech issues (Adnan Z, *et al.*, 2018)

2.3 Effect of Anemia on Neonatal Health

Anemia while pregnant can have negative implications on both the mother and the developing baby. These implications may consist of overall fatigue low birth weight, preterm delivery, higher likelihood of hemorrhaging after delivering birth, intrauterine growth restriction, stillbirth, perinatal mortality, shortness of breath, diminished immunity to infections, and lowered physical and mental performance (Vanamala VG, Frayne J, *et al.*, 2018). The hemoglobin content greatly improved during follow-up, as indicated by many studies, women indicating maternal or fetal morbidity, with anemia being a frequently occurring effects. Low birth weight, preterm delivery, and birth asphyxia were the most prevalent fetal problems (Suryanarayana R, *et al.*, 2017).

Research shows developing anemia throughout the first trimester of pregnancy where the effects are low birth weight at delivery, preterm delivery, and small for gestational age (SGA) infant rates have been associated with the intensity of maternal anemia. More severe

anemia has been connected to elevate the potential of preterm birth, low birth weight, and small for gestational age, as indicated by adjusted odds ratios (AOR). The levels of hemoglobin or early pregnancy anemia didn't correlate significantly with the probability of congenital birth defects. Sensitivity analysis demonstrated that the study's findings were robust. No matter the extent that the anemia is during the initial weeks of pregnancy, it significantly boosts the risk for undesirable neonatal outcomes, such as preterm birth, low birth weight, and small for gestational age (SGA) babies (Chen , Zhong T, Song X, *et al.*, 2024).

Many research investigations have proven the highly prominent nature of anemia in in general, and its correlation with preterm birth and low birth weight babies points to that all delivering women possess an elevated danger for poor birth outcomes such as perinatal mortality in general and preterm birth and low birth weight in particular. This indicated an alarming condition of matters for the management of community reproductive medical services around the examined region, where the health of mothers has been negatively affected by poverty, illiteracy, geographic variety, socioeconomic disparities, and multiple pregnancies. The worst possible health situation becomes apparent by the findings of preterm birth and low birth weight attributed to anemia (Kumari S, *et al.*, 2019).

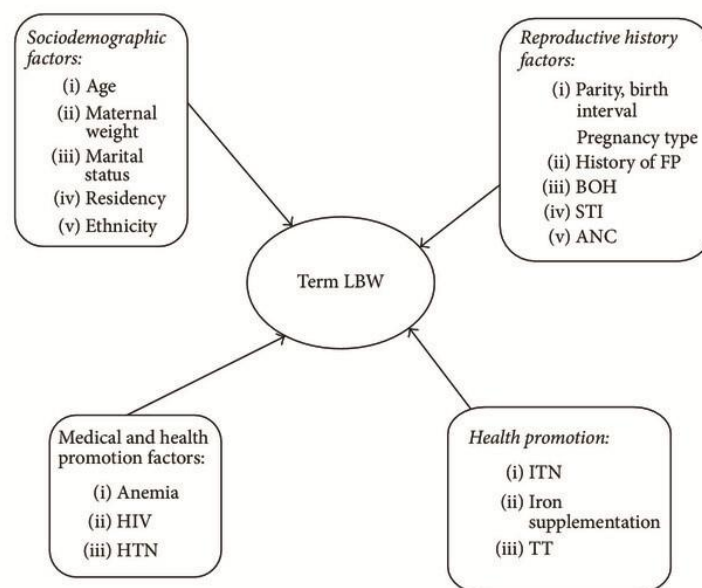


Figure 2: Risk factors of associated with low birth weight (Yisak G *et al*, 2017)

Several meta-analysis concluded that anemic mother had, on typical, considerably greater risks than their non-anemic counterparts of undesirable birth and maternal obstetric consequences, such as LBW, PTB, and perinatal mortality. Pregnancy-related anemia in the mother raises the potential of low birth weight (LBW), a known risk factor and common deprived birth outcome in South Asian nations. The physiological reduction of hemoglobin levels during pregnancy, that ends up in an increase in red cell mass and normal plasma volume, is speculated to be responsible for of an association between maternal anemia

during pregnancy and an increased risk of low birth weight (LBW). The variability in hemoglobin concentration has been affected by those alterations. The fetal birth weight could then be influenced by the drop in the mother's hemoglobin content (Rahman MA, *et al.*, 2020)

2.4 Factors associated with Maternal Anemia

Pregnant women exhibited a high general rate of anemia, with the vast majority of cases having been classified as intermediate concentrations degree by the World Health Organization. Prevalent anemia in pregnancy has been determined to be significantly linked with covariates such as the exact moment of the first maternal appointment, gravida, and socioeconomic standing. Unaffected by age, religion, education level, or work, thereby the study demonstrated an alarming incidence of anemia in pregnancy, implying a widespread issue. Anemia prevalence in pregnancy has been demonstrated to be significantly correlated with parameters including socioeconomic status, gravida, and the exact moment of the first antenatal being appointed. The lack of government policies to properly tackle anemia, adherence with iron and folic acid medications, and insufficient comprehension of the health advantages of supplementation have all been identified as obstacles to treating anemia. Prevalent anemia in pregnancy is additionally brought on by other conditions, which include as infections, malaria, and hookworm infestations (Sinha A, *et al.*, 2021). Pregnancy-related anemia was also attributed to covariates such as low levels of education and being recruited into clinic. The pregnant woman's location of residence and higher education were discovered to be risk factors for anemia. The used approach optimizes the reliability and accuracy of the study via guaranteeing the objective proper identification of anemia cases. adverse pregnancy outcomes may be the result experienced by women who missed the opportunity to follow-up, which should have caused a low estimate of the incidence of unsatisfactory birth outcomes (Stephen G., *et al.*, 2018).

Due to an assortment of sociocultural difficulties which include a lack of iron, folate, vitamins, impoverished conditions, unhealthy eating habits, parasitic infestation, acute or prolonged blood loss, HIV/AIDS, tuberculosis, malaria, short inter-pregnancy periods, high parity, cultural customs and values concerning nutrition, non-usage of an insecticide-treated bed net, and late scheduling of pregnant women at antenatal care (ANC) units, anemia in pregnant women keeps on to be one of the most mandatory major public health problems. These concerns are especially frequent in developing nations. (Adam I, *et al.*, 2017).

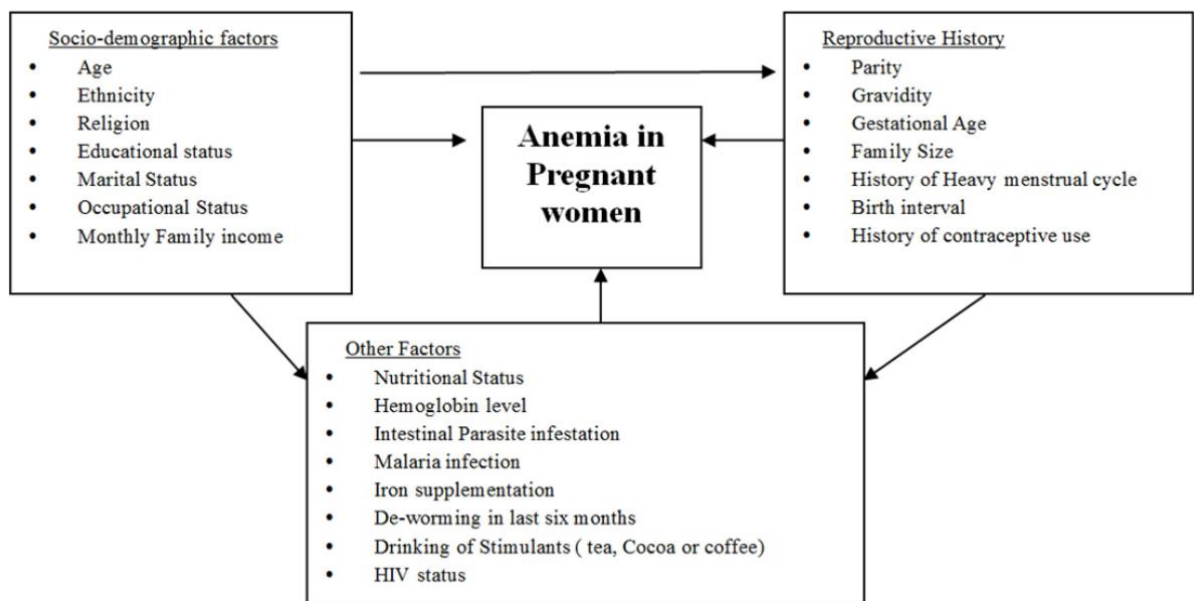


Figure 3: Conceptual framework developed based on review of literatures to assess factors associated with anemia among pregnant women in Adama town, Ethiopia (Mohammed E *et al.*, 2018).

Sociodemographic, obstetric, and nutritional factors were significantly associated with both the knowledge and prevention strategies of anemia. Pregnant women with smaller families and those who become pregnant for the first time may have sufficient resources to feed themselves and their children. Affluent families were more likely to follow anemia prevention strategies. Maternal age, residence, maternal educational status, gravidity, history of abortion, trimester of pregnancy, history of vaginal bleeding in the current pregnancy, and anemia status of the mothers were significantly associated with knowledge of anemia (Balcha WF, Eteffa T, Tesfu AA, Alemayehu BA, 2023). The pregnant woman's location of residence and higher education were discovered to be risk factors for anemia, which the study assessed as a mild problem of public health in Northern Tanzania. This underscores how crucial it is to provide adapted therapies for at-risk audiences in order to effectively combat anemia during pregnancy. The participants' demographic information was made publicly available, confirming that the vast majority of the women were unemployed, married or cohabiting, and had monthly incomes of below 60,000 (Stephen G., *et al.*, 2018).

CHAPTER- 3

MATERIALS AND METHODS

3.1 METHODOLOGY

3.1.1 Study design

It was a cross-sectional survey.

3.1.2 Study population

Study population was hospital patients who were newly mother with newborn babies.

3.1.3 Study area

The study is conducting in a private hospital named BAVS Maternity Hospital located in Mirpur-2, Dhaka-1216.

3.1.4 Sample size calculation

The sample size calculation was estimated using the cochrane's formula:

$$n = \frac{z^2 pq}{d^2}$$

Here z is the critical value at 95% confidence interval which is 1.96.

p is the prevalence of anemia among pregnant mothers which is 50% (Ara et al, 2024)

d is the marginal error which is considered as 5%.

The calculated sample size required for the study was 384. However, due to time limitation and financial issues, we have collected 150 samples from hospital settings.

3.1.5 Sampling method

Simple random selection of newly mothers who gave birth or mothers with babies aged between 1 or 2 months, in which mothers will provide information about hemoglobin rate according to WHO Hemoglobin beliefs less than 11.0 g/dL whilst pregnant are deemed anemia, and might be subdivided as follows: three sensitivity readings: mild anemia (Hb levels 9 to 10.9 g/dL), moderate anemia (Hb levels 7 to 8.9 g/dL), and extreme or severe anemia (Hb levels fewer than 7 g/dL) (Goonewardene M, Shehata M, Hamad A., 2012), age, education, characteristics or obstacles that they had gone through during pregnancy and the current situation of the mothers and the newborn babies.

3.1.6 Inclusion and Exclusion criteria

Inclusion criteria:

1. Only include those women who newly gave birth or been mother to newborns for about 1 or 2 months.
2. Identify the participant's hemoglobin rate which is mostly lower than 11 g/dL which will indicate if they had anemia.
3. To obtain a thorough knowledge of maternal anemia, ensure demographics like age, hemoglobin level, education, occupation, residence, parity, BMI etc.
4. Include only those individuals who give informed permission for taking a part in the study.
5. Information on the maternal anemia and outcome of participants should be willingly provided.

Exclusion Criteria

1. Women who are pregnant but not yet given birth or given birth long time ago should be excluded.
2. Women with hemoglobin rate greater than 12 g/dL should be excluded.
3. Participants who won't participate or provide details about their eating habits should be left out.
4. Participants who didn't agree to participate were excluded.

3.1.7 Study procedure

This cross-sectional study carried out in the month of February- March 2024 at a private Hospital located in Dhaka. Participants were request to answer survey questionnaire. Ethical factors such as participant privacy, confidentiality, and well-being was taken top priority during the whole study.

3.1.8 Field procedure

After developing survey questionnaire data collection was made and collected data from participants according with the variables such as age, education, occupation, religion, parity, BMI, health condition during pregnancy and after pregnancy, mother and newborns outcome.

3.1.9 Questionnaire development

In order to evaluate mother's condition initial questionnaire created with such as education, occupation, religion, residence, number of antenatal care, parity, BMI which have significant influence to mothers and newborns current condition. Secondary questionnaire was mothers previous health record and followed by most important part which will be maternal and neonate outcomes related questionnaire. All the elements were into account

before finalizing the questionnaires. The responder will provide variable permission for the purpose of the interview. It was guaranteed to all participants that their information will be kept private and utilized only for research.

3.1.10 Statistical analysis

Statistical analysis had been done by software and data was analyzed by using SPSS software. Data were presented by frequency, percentages, mean and standard deviation (SD) which was descriptive data and also cross-tabulation and chi-square tests were applied to see significance level and find out the relationship between independent variables and dependent variables. In all analyses, a p-value less than 0.05 was considered statistically significant.

CHAPTER-4

RESULTS

4.1 Descriptive Information

Demographic Characteristics of respondents:

The table illustrates descriptive data of 150 participants where the maximum age of the participants are 26 and 5 years more or less. 42 of the mothers (28%) had normal hemoglobin level during pregnancy and 82 of the participant or mother (56.7%) had mild or minimal anemia during pregnancy and medium or moderate anemia patient was 15.3% during pregnancy. Therefore, more than 60% women were anemic where mild anemia percentage is 56.7% and moderate anemia percentage is 15.3%.

Mother's education where 13.3% managed to study up to primary level, 32.7% managed to study up to secondary level, 40.7% managed to study up to higher secondary level and 13.3% were graduate. A small number of mothers were graduate and more than 80% of the mothers did not have higher education, so that, they had no knowledge about anemia and prevalence and impact or how anemia will affect the mother as well as newborn which maybe a significant factor and maybe lead to anemia. From these mothers 80% mothers were unemployed and 20% were employed. Thus, approximately 80% mothers were dependent and few number of mothers 20% were independent. 18.7% of those mothers have studied up to secondary level, 63 husbands 42% have studied up to higher secondary level 39.3% were graduate.

Table 4.1.1: Distribution of Participants according to Demo-graphical Characteristics

Variables		Frequency	Percentage
Age	Mean $\pm$ SD		26.27 $\pm$ 5.23
Hemoglobin level	Normal	42	28
	Mild	84	56.7
	Moderate	23	15.3
Mother education	Primary	20	13.3
	Secondary	49	32.7
	Higher	61	40.7
	Graduate	20	13.3
Mother occupation	Unemployed	120	80
	Employed	30	20
Husband Education	Primary	0	0
	Secondary	28	18.7

	Higher	63	42.0
	Graduate	69	39.3
Husband Occupation	Unemployed	0	0
	Employed	150	150
Place of Residence	Rural	38	25.3
	Urban	112	74.7
Religion	Islam	128	85.3
	others	22	14.7
Number of Antenatal care	<4	79	52.7
	4 or more	71	47.3
Parity	1-3 children	142	94.7
	>3 children	8	5.3
BMI	Underweight	33	22.0
	Normal	72	48.0
	Overweight	44	29.3
	Obese	1	0.7

25.3% participant lived in rural area while 74.7% lived in urban area and 85.3% participant's religion were Islam and 14.7% religion was others. Women who went to checkup in hospital during pregnancy less than 4 times are 52.7% and women who went to checkup more than 4 times are 47.3%. The table shows most of the mother who didn't have higher education got checkup in the hospital less than 4 times for lack of knowledge about anemia during pregnancy. Most of the participant had 1-3 children which is 94%.

The BMI of the mothers were 48% normal and 22% were underweight, 29.3% were overweight and 0.7% were obese and more than 50% of the women were not in normal weight. Recent study shows association involving underweight and a higher likelihood of anemia indicates an absence in dietary iron uptake may be the cause.

Table 4.1.2 Association of anemia with mother's characteristics during pregnancy

Variables		Anemia			p-value
		Normal	Mild	Moderate	
Taking Folic Acid	Yes	41 (97.6)	82(96.5)	23(100)	0.64
	No	1 (2.4)	3 (3.5)	0(0.0)	
Have Hypertension	Yes	12 (28.6)	28 (32.9)	3 (13.0)	0.17
	No	30 (71.4)	57 (67.1)	20 (87.0)	
Diabetic Status	No Diabetic	37 (88.1)	71(83.5)	19 (82.6)	0.84
	Type 1	1 (2.4)	2 (2.4)	0 (0.0)	
	Type 2	4 (9.5)	12 (14.1)	4 (17.4)	
Other Chronic Disease	Yes	3 (7.1)	0 (0.0)	0 (0.0)	0.020
	No	39 (92.9)	85 (100)	23 (100)	

Previous Attributes of the mother

The table interprets data about pregnant women taking folic acid supplements. Almost every women takes folic acid during pregnancy which is 146 mothers among 150 which was not a significant factor as the p-value is lesser than 0.05. Pregnant non-anemic women with hypertension was 28.6% and without hypertension is 71.4 percent and in mild anemic women having hypertension was 32.9% and without was 67.1% and in moderate anemic mother having hypertension was 13% and not having hypertension was 87% and p-value was 0.17. So, there is no significant association in this study. Women who has type-1 diabetes in normal anemia 2.4%, in mild anemia 2.4% and in moderate anemia 0%. Women who has type-2 diabetes in normal anemia 9.5%. In mild anemia 14.1% and in moderate anemia 17.4% which is a significant factor in this study. The table illustrates only 3 (7.1%) women who is non-anemic has other chronic disease among 150 women which is a significant factor.

4.2 Maternal and Neonatal Outcome Information

Table 4.2.1 Association of Maternal Outcome with Anemia

Variables		Anemia			p-value
		Normal	Mild	Moderate	
Antepartum Hemorrhage	Yes	4 (9.5)	4 (4.7)	3 (13.0)	0.32
	No	38 (90.5)	81 (95.3)	20 (87.0)	
Obstetric Hemorrhage	Yes	3 (7.1)	8 (9.4)	5 (21.7)	0.16
	No	39 (92.9)	77 (90.6)	18 (78.3)	
Postpartum Hemorrhage	Yes	2 (4.8)	12 (14.1)	4 (17.4)	0.21
	No	40 (95.2)	73 (85.9)	19 (82.6)	
Transfusion	Yes	7 (16.7)	28 (32.9)	11 (47.8)	0.02
	No	35 (83.3)	57 (67.1)	12(52.2)	
Gestational Hypertension	Yes	12 (28.6)	26 (30.6)	2 (8.7)	0.10
	No	30 (71.4)	59 (69.4)	21 (91.3)	
Pre-eclampsia	Yes	3 (7.1)	4 (4.7)	7 (30.4)	<.001
	No	39 (92.9)	81 (95.3)	16 (69.6)	
Eclampsia	Yes	7 (16.7)	3 (3.5)	3 (13.0)	0.03
	No	35 (83.3)	82 (96.5)	20 (87.0)	
Post-partum Infection	Yes	6 (14.3)	8 (9.4)	4 (17.4)	0.50
	No	36 (85.7)	77 (90.6)	19 (82.6)	
Mode of delivery	Vaginal	4 (9.5)	5 (5.9)	0 (0.0)	0.004
	Elective C-section	26 (61.9)	40 (47.1)	5 (21.7)	
	Emergency C-section	12 (28.6)	40 (47.1)	18 (78.3)	

Effect of anemia on Maternal Outcome:

The table illustrates maternal outcome among 150 participants during pregnancy and first outcome was antepartum hemorrhage in non-anemic women 9.5%, in mild anemic women 4.7% and in moderate anemic women 13.0% and women who did not have antepartum hemorrhage are in non-anemic women 90.5%, in mild anemic women 95.3%, in moderate anemic women 87.0% and the p-value is 0.32. Obstetric hemorrhage during pregnancy in normal anemic women 7.1%, in mild anemic 9.4%, and in moderate anemic women 21.7% and women who did not have obstetric hemorrhage are in non-anemic women 92.9%, in mild anemic women 90.6%, in moderate anemic women 78.3% and p-value which is 0.16. Postpartum hemorrhage during pregnancy in normal anemic women 4.8%, in mild anemic 14.1%, and in moderate anemic women 17.4% and women who did not have postpartum hemorrhage are in non-anemic women 95.2%, in mild anemic women 85.9%, in moderate anemic women 82.6% and p-value is 0.21. So there is no significant association between hemorrhages with anemic status of mother. Though hemorrhage during pregnancy is not significant factor in this study but antepartum, obstetric and post-partum bleeding is comparatively less in non-anemic women than mild and moderate anemic women.

Transfusion during pregnancy in normal anemic women 16.7%, in mild anemic 32.9%, and in moderate anemic women 47.8% and women who did not need transfusion are in non-anemic women 83.3%, in mild anemic women 67.1%, in moderate anemic women 52.2% and p-value which is 0.02. There is a significant association of blood transfusion with anemic status of mother. Anemic pregnant women are mostly in need of blood transfusion during delivery than non-anemic women. Mostly iron deficiency anemia cause emergency blood transfusion during delivery.

Gestational hypertension during pregnancy in normal anemic women 28.6%, in mild anemic 30.6%, and in moderate anemic women 8.7% and women who did not have gestational hypertension are in non-anemic women 71.4%, in mild anemic women 69.4%, in moderate anemic women 91.3% and p-value was not significant at 0.05.

Preeclampsia in non-anemic women 7.1%, in mild anemic 4.7%, and in moderate anemic women 30.4% and women who did not have preeclampsia are in non-anemic women 92.9%, in mild anemic women 95.3%, in moderate anemic women 69.6% and p-value was <.001 which is a significant factor associated with maternal anemia

Eclampsia in non-anemic women 16.7%, in mild anemic 3.5%%, and in moderate anemic women 13.0% and women who did not have eclampsia are in non-anemic women 83.3%, in mild anemic women 96.5%, in moderate anemic women 87.0% and p-value was 0.03 which is a significant factor associated with anemic status of mother.

Post-partum infection in non-anemic women was 14.3%, in mild anemic 9.4%%, and in moderate anemic women 17.4% and women who did not have post-partum infection are in non-anemic women 83.3%, in mild anemic women 85.7%, in moderate anemic women 82.6% and p-value was 0.50.

The last but most important outcome of the mother is mode of delivery where most of the mother gave birth through elective or emergency C-section. Mother who gave birth in vaginal mode is 9.5% in non-anemic mother, 5.9% in mild anemic mother. Mothers who undergo elective C-section are 61.9% in non-anemic women, 47.1% in mild anemic women, 21.7% moderate anemic women. Mothers who undergo emergency C-section are 28.6 in non-anemic women, 47.1 in mild anemic women, 78.3% moderate anemic women. The table exhibit only 9 mothers has given birth in vaginal mode among 150 women and p-value was 0.004. So, there is a significant association between caesarean deliveries with anemic status of mother. So, Anemia is highly associated with caesarean delivery as almost every anemic mother gave birth either in elective C-section or emergency C-section.

Table 4.2.2 Association of Neonatal Outcome with Anemia of Mothers during Pregnancy

Variables		Anemia			p-value
		Normal	Mild	Moderate	
Living status	Alive	42 (100)	83 (97.6)	21 (91.3)	0.11
	Death	0 (0.0)	2 (2.4)	2 (8.7)	
Still Birth	Yes	0 (0.0)	2 (2.4)	2 (8.7)	0.11
	No	42 (100)	83 (97.6)	21 (91.3)	
Pre-term Delivery	Yes	10 (23.8)	37 (43.5)	15 (65.2)	0.004
	No	32 (76.2)	48 (56.5)	8 (34.8)	
Birth Weight	>2500	25 (59.5)	45 (52.9)	10 (43.5)	0.67
	1500-2500	16 (38.1)	36 (42.4)	11 (47.8)	
	<1500	1 (2.4)	4 (4.7)	2 (8.7)	
NICU Admission	Yes	6 (14.3)	14 (16.5)	5 (21.7)	0.74
	No	36 (85.7)	71 (83.5)	18 (78.3)	
Early Neonatal Death	Yes	0 (0.0)	2 (2.4)	2 (8.7)	0.11
	No	42 (100)	83 (97.6)	21 (91.3)	

Association of Neonatal Outcome with anemia

The table shows neonatal outcome where the first outcome is living status where normal anemic mother's newborns were alive 100%, mild anemic mother's newborns were alive 97.6%, and moderate anemic mother's newborns were alive 91.3%. In mild anemic women 2 babies were dead due to pregnancy complication and as well as in moderate anemic women 2 babies were dead. Also still birth outcome was same as living status of newborn 2 babies from mild anemic and 2 babies from moderate anemic mother among 150 babies did have still birth where the babies were dead in the womb or during delivery. Also early neonatal death was same as the still birth outcome where 2 babies from mild anemic and 2 babies from moderate anemic was early died. Those are not significant factor (0.11) associated with anemic status of mother in this study.

Women who undergoes caesarean delivery has delivered earlier than due date which is called preterm delivery. In normal anemic women preterm delivery outcome was 23.8% and in mild anemic women 43.5% and in moderate anemic 65.2%. Mothers who did not have preterm delivery are 76.2% in normal anemic women, 56.5% in mild anemic women, and 34.8% in moderate anemic women. The p-value was 0.004 which shows a significant association between maternal anemia with preterm delivery.

Birth-weight of the newborn above 2500g in normal anemic women was 59.5%, in mild anemic 52.9% and in moderate anemic women 43.5%. Birth-weight about 1500-2500g in normal anemic women was 38.1%, in mild anemic 42.4% and in moderate anemic women 47.8%. Birth-weight of newborn less than 1500g in normal anemic women was 2.4%, in mild anemic 4.7% and in moderate anemic women 8.7%. The p-value was 0.67 which is not a significant factor in this study as most of the baby was healthy and more than 50% of the baby had normal weight.

Newborns who has to be admitted in NICU are in normal anemic women was 14.3%, in mild anemic 16.5% and in moderate anemic women 21.7%. Newborns who did not admitted in NICU are in normal anemic women was 85.7%, in mild anemic 83.5% and in moderate anemic women 78.3% and the p-value was 0.11 which is not a significant factor.

CHAPTER-5

DISCUSSION

In this study we can see, occupation, monthly family income, less antenatal care, birth interval are not main focus factors for anemia on mother's health and neonatal health. Study at tertiary hospital in Bangladesh shows sixty-four percent of pregnant women were anemic. In accordance of the study, 37% of women who were pregnant knew that consistent visits for antenatal care are crucial but their implementation of the information was also unsatisfactory because of their poor socioeconomic status. Pregnant women who additionally knew absolutely nothing about anemia in pregnancy accounted for just slightly more than 67%. (Sultana F. *et al.*, 2019). According to numerous studies, anemia affected almost one in four pregnant women; its prevalence was influenced by family size, place of residence, and educational attainment (Geta TG, *et al.*, 2022). Recent study shows the risk of anemia was higher in underweight women and diminished in obese/overweight women. The significantly reduced possibility of anemia among the most prosperous women implies that obese/overweight women potentially receive sufficient dietary iron (Kamruzzaman M. 2021).

Though there is no significant association between hypertension and diabetes with maternal anemia in this study but many research papers have elaborate that anemic pregnant women with hypertension had impact on maternal and neonatal outcome. Anemia and hypertension elevate the probability of abnormalities such as placental demise and destruction to the mother's body parts, and they also trigger the more serious forms of preeclampsia in anemic women. Furthermore, poor fetal development and expansion caused upon by the combination of anemia and hypertension boosts the probability of preterm birth and low birth weight (Ali AA, Rayis DA, *et al.*, 2011).

Although this study doesn't show significant factor as moderate to severe anemia patient was 15.3% only in this study. Prenatal anemia may elevate the risk of postpartum hemorrhage (PPH) but specifically when anemia is severe. A single study explored the link between anemia and PPH-related mortality, revealing that severe prenatal anemia heightens the chances of PPH-related mortality (Omotayo MO, *et al.*, 2021). Other studies demonstrated an established connection between raising blood loss and moderate-to-severe anemia. Preterm delivery, grand inequality, oxytocin receipt, uterine weight, and length of labor were other factors that contributed to blood loss. To find out whether women with moderate-to-severe anemia are more vulnerable to endure hemorrhaging after delivery more research needs to be conducted to verify these findings on a larger sample of women (Kavle JA, *et al.*, 2008).

Blood transfusion had a significant association with anemic status of mother where p-value is 0.02. Anemia throughout the mid-trimester increased the risk of anemia at delivery by a substantial margin. Despite having lower EBL than those who were not anemic, these patients experienced greater rates of postpartum blood transfusions (Scholz, Rob MD *et al.*, 2018). The two primary reasons why red blood cells (RBCs) are transfused still are anemia

and postpartum hemorrhage. The high incidence of anemia and the elevated risk of red blood cell transfusion indicate that PBM has enormous potential for use in obstetrics (Kloka JA, *et al.*, 2023). Preeclampsia and eclampsia also has significant association with anemic status of mother. Compared to the other study, women that suffered from severe anemia were 3.6 times more inclined compared to individuals who weren't diagnosed to develop preeclampsia. Research discovered that women with moderate to severe anemia went through eclampsia and gestational hypertension or preeclampsia. (Ali AA, *et al.*, 2011).

More than 90% of the mother had either elective C-section or emergency C-section where most of the mothers are anemic which has significant association with maternal anemia where p-value was 0.004. Anemia elevated the likelihood of C-section delivery (CD) in pregnant women, corresponding to a meta-analysis of 14 research studies encompassing 336,128 pregnant women. Anemia was noticed in 93,046 (27.6%) of the 336,128 women whose data were evaluated. In contrast with pregnant women without anemia, the frequency of CD was substantially greater among individuals with anemia. (Adam I, Salih Y, Hamdan HZ. 2023).

In neonatal outcome preterm delivery has significant association with anemic status of the mother. Recent study delves on the hyperlink between preterm birth and maternal anemia throughout pregnancy. In spite of considering for potential confounding factors which means maternal age, preceding abortion history, premature delivery, overweight or obesity, parity, preeclampsia/eclampsia, and GDM, mothers with anemia continued to correlate with preterm birth. (Khezri R, Salarilak S, Jahanian S., 2023). This study explores the incidences of preterm birth, low birth weight, and perinatal mortality that could have been connected with maternal anemia. Anemia within the first or second trimester has been reported to have significant, favorable associations with preterm birth, low birth weight, and perinatal and neonatal death (Rahman MM, *et al.*, 2016).

Though it is not a significant factor in this study but many research has been shown maternal anemia has effect on low birthweight. A study executed in Northwest Ethiopia demonstrated an important association amongst low birth weight babies and maternal anemia during pregnancy, especially among the first trimester. The findings imply an important association between LBW in the first trimester of pregnancy and maternal anemia. On the other hand, between the second and third trimesters of the pregnancy, the following hyperlink was not notable. Low birth weight babies are frequently attributed to anemia and the level of education of the mother. (Rahmati S, *et al.*, 2017). The analysis's findings clarify that, in comparison to moms who do not have anemia, expectant mothers who suffer from anemia throughout pregnancy are more likely to give birth to LBW children. The traditional risk factors for low birth weight (LBW) are typically linked to unsuitable biological, social, and environmental circumstances that may arise in the mother before to or during pregnancy (Azizah F. K., *et al.*, 2022).

5.2 Strength and Limitation

Strength

The first cross-sectional study of this type study was conducted in a private hospital in the Mirpur area. The majority of expectant mothers were aware of prenatal care and frequent hospital visits, which was a study strength. The majority of patients were cooperative and voluntarily provided the information required for this investigation.

Limitation

The number of participants was restricted since data could only be gathered from patients who had recently given birth due to limitations that the study is unable to meet. Furthermore, there were financial and scheduling limitations because the hospital administration could only provide a one-month term.

CHAPTER-6

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Maternal anemia during pregnancy is a worldwide phenomenon which is associated with adverse outcome of the mother and neonatal. The study highlights maternal anemia are linked with monthly income, financial status, less antenatal care, occupation and education level. The study also highlights risk factor associated with anemia which are transfusion, preeclampsia, eclampsia, caesarian delivery in mother and for newborn preterm delivery, low birth weight can be risk factor. Policies and programs ought to allocate priority to initiatives that alleviate anemia in women of reproductive age and throughout pregnancy, which include iron supplementation. Maternal anemia must be recognized and managed early, commencing in the first trimester, as the condition has an immediate bearing on the perinatal outcome. Validating the hemoglobin concentration which supports the most favorable attainable health for expecting mothers and fetuses involves further investigation. It is strongly encouraged to emphasize fundamental healthcare be emphasized and that considerations which involves early identification, prevention, and therapeutic management of anemia in pregnancy must receive prominence in order to further improve positive results for mother and newborns.

5.2 Recommendation

Maternal anemia is a treatable illness, if not appropriately managed, can result in severe maternal and neonatal issues and our country is making progress to prevent maternal anemia and adverse effect. Many initiatives have been made such as intervention program, prenatal care, parental education, providing supplements.

Intervention program – Several intervention program in physical or online have been made which give effective routine counseling in improving hemoglobin level, knowledge, dietary iron intake, and behavior towards adherence to iron supplementation among pregnant women with anemia or without anemia. Iron supplementation, during pregnancy and among reproductive-aged women need to be prioritized in the policies and programs.

Parental Education - Adherence to anemia preventative measures had a strong connection with a good comprehension of anemia. There was additionally an abundance of maternal comprehension of anemia. For greater consciousness regarding the effects of anemia in pregnant women and boost adherence to efforts to prevent it, it must be done to reinforce nutritional guidance on the consumption of foods that are high in iron and boosting awareness of the effects of anemia.

Therapies and supplementation - The International Nutritional Anemia Consultative Group, the World Health Organization, and the United Nations Children's Fund have all recommended that all pregnant women acquire supplemental iron because achieving their

daily iron requirements during pregnancy can be harder when relying exclusively on their diet.

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Appendix-1
Daffodil International University
Department of Nutrition and Food Engineering (NFE)
Faculty of Health and Life Sciences (FHLS)
Daffodil International University
Daffodil Smart City, Birulia, Savar, Dhaka – 1216, Bangladesh

1. **Student's Name:** Afia Antara
2. **Id:** 201-34-1067
3. **Section:** 201 B
4. **Project Title:** Effect of anemia during pregnancy on maternal and neonatal health outcome at hospital settings: A cross sectional study.

1. Introduction:

A lower-than-normal quantity of hemoglobin (Hb) or red blood cell concentration is an indicator of anemia. Anemia throughout gestation has served as the target of plenty of published research, and it has been demonstrated to be predictive of a higher risk of adverse pregnancy consequences, notably low birth weight, premature delivery, and small-for-gestational-age (SGA) neonates (Xiong X., *et al.*, 2000). Anemia affects approximately forty percent of pregnant women around the world. Aided rates of demise across mothers and newborns have been discovered attributed to precocious delivery, hypertension, insufficient birth weight, small-for-gestational-age (SGA) births the fact that remain viable, anemia throughout pregnancy, and cesarean delivery. (Bailit JL, Stoltzfus R, *et al.*, 2007). Due to the realization that low- and middle-income countries have a considerably greater incidence of hemoglobinopathies, dietary iron deficiency, macronutrient deficiencies, and conditions like HIV, malaria, and hookworm advancement, women that reside in nations like these are far more likely to be suspected of anemia. (McLean E, Cogswell M, *et al.*, 1993-2005). Anemia, which afflict 14% of women in developed nations, 51% of women in nations with limited resources, and between 65% and 75% of pregnant women in India, is one of the least severe problems with nutrition affecting expectant moms. (Kalaivani K. 2009).

2. Rationale

The significance factor of anemia during pregnancy is detrimental to both mothers and fetuses, increasing both maternal and perinatal mortality, and putting infants at risk for permanent cognitive damage.

3. Hypothesis

There will be a significant association of anemia during pregnancy with neonatal and maternal outcome.

4. Objective

1. To discover the prevalence of anemia among mothers during pregnancy.
2. To ascertain along with assessing the correlation amongst inpatient mother and newborn health effects along with the amount of anemia throughout pregnancy.

3. To gauge the interaction between infant effects after birth and maternal anemia.

5. Methodology

Study subject and design of the study: In the Obstetrics and Gynecologic Unit of the Department of Pediatrics and Neonatology at one notable hospital in the Dhaka part of Bangladesh, 150 anemia patients will be enrolled in a cross-sectional study.

Self-administered Questionnaire: Each patient gets to provide data concerning their diet, clinical state of affairs, and demographic information using a comprehensive questionnaire that is self-administered. Additional queries will be incorporated based on maternal anemia to determine the problems patients are facing afterwards the birth of newborn and also the mother health after pregnancy.

Statistical analysis: Estimate the severity of maternal anemia and outcome of mother and newborn and mortality rate of newborn if the mother has anemia. Statistical analysis will be done by software.

6. Expected Outcome of the study

The present study will help us to evaluate the adverse effects of maternal anemia on maternal health and neonatal outcomes. It will implement the strategies to diagnose maternal anemia patients and avoid perinatal death and recommend additional care for them to improve their health status. The conclusions might help persons formulating policies and programs that mitigate the probability of these detrimental effects through supplying evidence-based initiatives and measures. **Socio-economic Impact**

The primary socioeconomic variables that trigger maternal anemia may involve aging, low socioeconomic position, inadequate health education, and insufficient dietary iron consumption. This study intends to increase awareness of the desire for further education addressing the negative consequences of anemia, especially among young women who lack comprehension of in this area alongside adolescent girls and women all around who are of reproductive age.

7. Time Schedule:

	Activities by Months					
	1	2	3	4	5	6
Literature research	→					
Study protocol and questionnaire development	→	→				
Ethical approval		→				
Pretesting of study protocols, questionnaire			→			
Data and sample collection phase				→	→	
Data analysis and report writing					→	
Report Submission and article publication						→

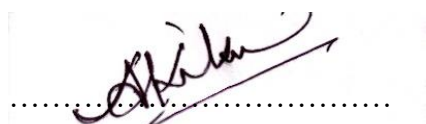
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Signature of supervisor

Name: Akibul Islam Chowdhury
Lecturer
Department of Nutrition and Food
Engineering
Daffodil International University
Cell: 01521331515
E-mail: akibul.nfe@diu.edu.bd



Signature of researcher

Name: Afia Antara
Roll no: 201-34-1067
Department of Nutrition and Food
Engineering
Daffodil International University
Cell: 01641060741
E-mail: afia34-1067@diu.edu.bd

Appendix-2

Effect of anemia during pregnancy on maternal and neonatal health outcome at hospital settings

Questionnaire

Consent form:

Details of Head Researcher: Akibul Islam Chowdhury, Lecturer, Department of Nutrition and Food Engineering, Daffodil International University, Bangladesh.

Details of Co-researcher: Afia Antara, Undergraduate Student, Department of Nutrition and Food Engineering, Daffodil International University, Bangladesh.

Duration: 6 months.

Confidentiality: The data provided by the participant will be considered strictly confidential and will not be given to others without written permission from the participant.

Right to Refuse or Discontinue: The participant has the right to discontinue or decline the participation in the research anytime he/she feels to do so.

- ☐ I confirm that my participants in this research project is voluntary
- ☐ I acknowledge that I will not be receiving any payments in regard to my participants
- ☐ I confirm that I have the right to decline or discontinue my participants in this research when I have a valid reason to do so.
- ☐ I have read and understand what the research is all about.
- ☐ I understand that the researcher will not identify me by my name in any reports and will publish it in books, newspaper, journals and other research-related projects.

✕

A. Participants characteristics:

1. Age (years)		2. Hb level (g/dl)	
3. Mother education	1. Illiterate 2. Primary 3. Secondary 4. Higher 5. Graduate/ above	4. Mother occupation	1. Unemployed/ home-maker 2. Employed
5. Husband education	1. Illiterate 2. Primary 3. Secondary 4. Higher 5. Graduate/ above	6. Husband occupation	1. Unemployed/ home-maker 2. Employed
7. Place of residence	1. Rural 2. Urban	8. Religion	1. Islam 2. Others
9, Number of Antenatal care	1. <4 2. 4 or more		
10, Parity	1. 0 children 2. 1-3 children 3. >3 children	11, BMI (kg/m ²)	1. Underweight 2. Normal 3. Overweight 4. Obese

B. Maternal Characteristics:

1, Taking folic acid	1. Yes 2. No 3. Don't know	2, Taking folic acid	1. Yes 2. No 3. Don't know
3, Have hypertension	1. Yes 2. No	4, Diabetic status	1. No diabetic 2. Type 1 3. Type 2 4. Gestational
5, Other chronic disease (renal, liver, CVD etc)	1. Yes 2. No		

C. Maternal outcome

Antepartum hemorrhage	1. Yes 2. No 3. Don't know	Postpartum hemorrhage	1. Yes 2. No 3. Don't know
Obstetric hemorrhage	1. Yes 2. No 3. Don't know	Transfusion	1. Yes 2. No 3. Don't know
Gestational Hypertension	1. Yes 2. No 3. Don't know	Pre-eclampsia	1. Yes 2. No 3. Don't know
Eclampsia	1. Yes 2. No 3. Don't know	Post-partum infection	1. Yes 2. No 3. Don't know
Death	1. Yes 2. No 3. Don't know	Amniotic fluid index	1. <2cm 2. 2-8cm 3. >8cm
Mode of delivery	1. Vaginal 2. Elective C-section 3. Emergency C-section		4.

D. Neonatal outcome

Living status	1. Alive 2. Death	Still birth	1. Yes 2. No 3. Don't know
Pre-term delivery	1. Yes 2. No 3. Don't know	Birth weight	1. >2500g 2. 1500-2500g 3. <1500g
SCBU/NICU admission	1. Yes 2. No 3. Don't know	Early new natal death	1. Yes 2. No 3. Don't know

Appendix-3

EFFECT OF ANEMIA DURING PREGNANCY ON MATERNAL AND NEONATAL HEALTH OUTCOME AT HOSPITAL SETTINGS: A CROSS- SECTIONAL STUDY

ORIGINALITY REPORT

11 %	9 %	8 %	4 %
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