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Association Between Maternal Anemia and the Anthropometric Measurements of Full-Term Newborns

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ABSTRACT

Background: Anemia during pregnancy continues to be a serious public health concern, especially in poorer nations where it strongly increases mother and newborn morbidity and mortality. This study highlights the effect of maternal hemoglobin levels on fetal growth by examining the connection between maternal anemia and neonatal anthropometric measurements. **Methods:** From January 2024 to January 2025, a cross-sectional descriptive study was carried out at the Gynaecology and Obstetrics Department of a Quetta tertiary care hospital. A straightforward sample strategy was used to choose 300 full-term pregnant women between the ages of 18 and 40. Maternal anemia was classified as mild (10.9–9.0 g/dl), moderate (8.9–7.0 g/dl), and severe (<7.0 g/dl) according to WHO standards. Anemic and non-anemic groups were compared based on measurements of newborn anthropometric characteristics, including birth weight, length, head circumference, and chest circumference, taken within 24 hours of delivery. **Findings:** Of the 300 individuals, 48% had anemia, with moderate anemia accounting for the majority (78.5%). Height (48.2 ± 2.5 cm vs. 50.1 ± 2.4 cm), weight (2.85 ± 0.32 kg vs. 3.20 ± 0.35 kg), head circumference (33.4 ± 1.2 cm vs. 34.7 ± 1.3 cm), and chest circumference (32.1 ± 1.0 cm vs. 33.4 ± 1.1 cm) were all significantly lower in newborns of anemic mothers than in those of non-anemic mothers ($p < 0.001$ for all). **Conclusion:** There is a clear correlation between maternal anemia and poor neonatal anthropometric results. The growth and development of the fetus are greatly impacted by even slight anemia. To improve delivery outcomes and lower infant morbidity and death, these findings highlight the significance of early detection and management of maternal anemia by nutritional interventions, iron and folic acid supplements, and enhanced prenatal care.

INTRODUCTION

Abnormal fatigue develops when anemia occurs from the combination of reduced healthy red blood cells and/or low haemoglobin concentration because this impairs the body's oxygen transportation ability. The anemia rate among pregnant women stands at 51% before childbirth according to Galloway R (2003) and Flemming A (2014). Among the common problems associated with pregnancy anemia proves to be the most widespread medical condition. Scientific evidence supports that all pregnant women experience substantial plasma volume expansion when compared to their red cell mass. Active evaluation of rising plasma volume stands essential because it plays a critical role in fetal development (Goodlin RC et al., 1983). The WHO defines anemia in pregnancy when hemoglobin levels drop below 11 g/dl because symptoms become apparent at this point prompting patients to need essential medical intervention (Odekunle A, et al., 2010). The World Health Organization sets criteria for diagnosing pregnant woman anemia based on hemoglobin levels that include mild anemia at 9–11 g/dl and moderate anemia at 7–9 g/dl and severe anemia at 7 g/dl (Galloway R, 2003). Public health authorities acknowledge that anemia during pregnancy represents a major healthcare concern in underdeveloped regions since it elevates mortality and morbidity rates for female patients [Rosmawti N et al., 2012]. The occurrence of anemia becomes more prevalent because of viral diseases together with hereditary abnormalities and deficiencies in iron and folic acid (Balarajan Y et al., 2011).

In underdeveloped countries maternal anemia causes 40–60% of procedural deaths thus becoming a potential factor for detrimental pregnancy results which lead to fetal growth abnormalities and perinatal death. The life of both the fetus and mother becomes endangered because of anemia during pregnancy (Brabin L et al., 1998; Viteri FE, 1994).

Research confirms that anemia in pregnant women leads to increased mortality risk throughout pregnancy. The childbirth period or early postpartum period becomes a fatal outcome for 500,000 women each year mostly affecting underdeveloped nations. A recent study (Hughes A, 1991) shows anemia acting as the leading cause in 20–40% of such deaths with anemia serving as the sole causative factor in this group. The pregnancy and childbirth risk for maternal death rises fivefold when women are anemic and this condition directly contributes to most maternal deaths throughout different regions. Anemia in its severe form increases mortality statistics. The health-oriented world community acknowledges that anemia mainly due to iron deficiency affects numerous low-income tropical communities and generates essential health challenges and functional complications while its nutritional elements remain largely manageable with high cost-effectiveness. Women from the reproductive age exhibit the greatest risk together with pregnant individuals who deliver newborns and feed infants as well as their children up until the early years of life. International authorities selected the diminishing of anemia in pregnant women to one-third of its current levels as their minimum required reduction by 2100. According to the proactive groups previous targets for iron deficiency anemia elimination at less than 10% can be achieved through innovative iron deficiency management approaches (Viteri FE, 1992).

Maternal anemia stands as a known pregnancy risk factor that triggers anemia in newborns (NB). Wojtyla C et al. (2011) indicates that anemia during pregnancy heightens the chance of miscarriage and results in intrauterine growth restriction, prematurity and fetal death together with first-year infant anemia because of depleted iron storage. The possible causes of nutritional anemia include acute infections, chronic inflammation, hemoglobinopathies and deficits in iron, vitamin B12, folic acid or any possible combination of these nutrient shortages according to Scholl T O (2011).

Our body needs iron to perform cell-based activities which form an essential basis for nervous system growth in early development stages. Both intrauterine and postnatal development need essential support because the fetus accomplishes its biggest weight increase and iron storage during the final pregnancy trimester (Whitney E et al., 2008).

A difference exists between premature or low birth weight children and full term newborns regarding their stored iron amounts. The swift postnatal growth consumes maternal pregnancy stores from a four to six month period starting immediately after delivery (Schmitz BAS, 2007). Low birth weight strongly determines child survival rates until the first anniversary so these babies face higher sickness risks and mortality statistics.

The regular measurement of anthropometric factors leads research into child growth and development to maintain its importance. The parameters are influenced by maternal lifestyle together with clinical circumstances as well as anthropometric measurements (Utpala GD et al., 2004).

The measurement-focused aspect of anthropometry has developed widely acceptable easy-to-use non-harmful procedures which measure human dimensions along with body proportions and composition. The measurement technique helps predict upcoming health as well as survival outcomes and performance while approximating both nutritional status and general health condition (Abeysena C et al., 2010).

LITERATURE REVIEW

Maternal anemia represents a widespread public health problem in developing countries where the main cause remains iron-deficiency anemia which affects both pregnant women and their newborns negatively. Pregnant women who show levels of hemoglobin below 11 g/dL meet the criteria outlined by the World Health Organization (WHO 2015) for pregnancy anemia while iron deficiency accounts for approximately half of such cases worldwide (WHO 2015). The health condition produces pronounced impact on fetal growth together with maternal well-being because it affects birth weight as well as length and head circumference which serve as significant health indicators for newborns and their nutritional state. Newborn anthropometry in relation to maternal anemia has received extensive attention from scientific investigations. Data show that maternal anemia leads to low birth weight (LBW) as one of its most commonly observed implications. The research conducted by Kumar et al. (2018) in India involved following pregnant mothers and identified anemic women to experience larger rates of LBW compared to non-anemic mothers. According to Rahman et al. (2016), maternal third-trimester hemoglobin concentrations under 10 g/dL significantly enhanced the occurrence of intrauterine growth restriction (IUGR), preterm birth and low birth weight in Bangladesh. The dietary status of pregnant women particularly their iron content influences birth weight as an important measure for neonatal survival as well as future health development. Lower birth weight and restricted fetal growth occur because insufficient iron prevents oxygen delivery to the developing baby (Allen, 2000). The research by Scholl and Hediger (1994) demonstrated that early pregnancy anemia in women leads to a double increase in the frequency of LBW births thereby revealing that anemic placental deficiencies lead to the condition's worsening. Anthropometric measures such as length and head size together with birth weight receive modification based on maternal blood cell count. Anemic mothers in Benin gave birth to babies who displayed reduced head

circumference measurements and decreased crown-heel dimensions than newborns born to mothers without anemia (Koura et al. 2012). Maternal anemia produces changes which affect both fetal weight measurements and growth of brain and linear body components. Poor fetal development of both body tissues and brain occurs because inadequate oxygen delivery limits the growth of the developing fetus. How severely fetal damage occurs depends on the timing of anemia onset and its pregnancy severity levels. Anemia levels that were moderate to severe during the first two trimesters generated a stronger impact on adverse pregnancy results than third-trimester anemia based on results presented in Haider et al. (2013). The high importance of early pregnant woman identification requires appropriate interventions for minimizing fetal growth restriction risk. Research interventions confirm the substantial benefits of treating anemic mothers during pregnancy. Pregnant women who supplemented their diet with iron and folic acid decreased their risk of delivering LBW children according to Titaley et al. (2010). Prenatal care programs should regularly supplement iron medicine because research shows its benefits for locations with high rates of anemia.

RESEARCH OBJECTIVE

The research analyzes the measurement connection between newborns born at full term and maternal anemia status before birth. Investigators aimed to assess the relationship between three parameters of newborn development: weight, length and head circumference as it relates to maternal hemoglobin levels. The research explores possible developmental impacts of maternal nutrition through an evaluation of the relationship between maternal anemia and newborn measurement outcomes. The project intends to offer evidence-based knowledge for nutrition programs with early intervention and mother health improvement initiatives to reduce neonatal risks and low birth weight along with stunted growth.

MATERIALS AND METHODS

A qualitative cross-sectional descriptive study took place at the Gynecology and Obstetrics Department of a tertiary care hospital in Quetta between January 2024 to January 2025. Three hundred pregnant women from ages 18 to 40 who were delivering a baby formed the study subject matter using convenient selection. The study did not include women under eighteen years of age and over forty years of age with chronic diseases, premature delivery cases and multiple pregnancies and medical patients from the Neonatology Unit. All participants accepted the study conditions by signing consent while filling out structured questionnaires and undergoing blood pressure checks and pulse monitoring along with blood venous extraction before receiving their general physical examination. The testing of maternal hemoglobin levels occurred through venous blood sample collection during pre-delivery. Women who had hemoglobin levels under 11 g/dl met WHO anemia criteria yet researchers split them into three groups: mild anemia at 10.9–9.0 g/dl, moderate anemia at 8.9–7.0 g/dl and severe anemia at less than 7 g/dl. The first 24 hours of delivery brought neonates to the clinic for measurements of length, head circumference and chest circumference and birth weight. One doctor completed all neonatal measurements after which two trained nurses recorded birth weight at delivery. Caregivers evaluated the connection of maternal anemia with newborn results by examining growth measurements between babies born to anemic and non-anemic mothers.

Researchers examined maternal anemia status against neonatal growth outcomes using the gathered data which contained measurements of maternal hemoglobin levels and infant anthropometric data. The researchers used qualitative methods to analyze how severe maternal anemia affected infant physical attributes in their observations.

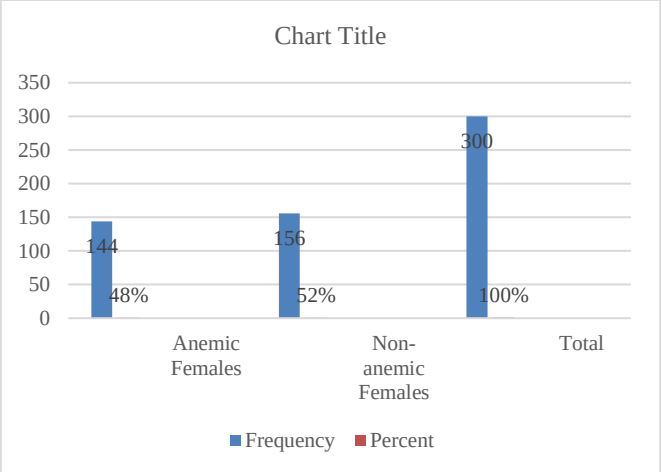
RESULTS

Table 1

Distribution of pregnant females into Anemic and non-anemic group

Group	Frequency	Percent
Anemic Females	144	48%
Non-anemic Females	156	52%
Total	300	100%

Figure 1



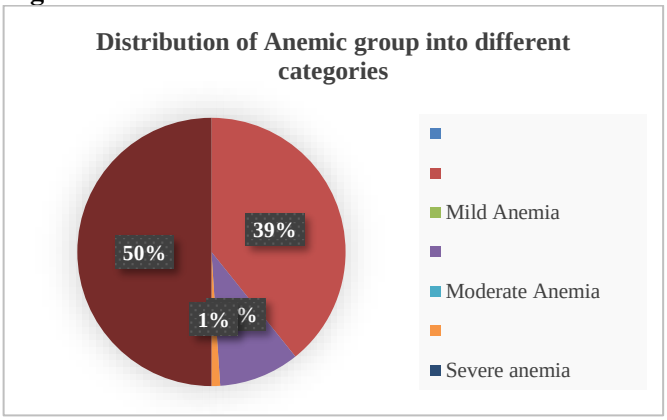
Among the sample of 300, 144(48%) females were found anemic, while remaining 156(52%) females were non-Anemic

Table 2

Distribution of Anemic group into different categories

Anemia sub-group	Frequency	Percent
Mild Anemia	113	78.5%
Moderate Anemia	28	19.5%
Severe anemia	3	2%
Total	144	100%

Figure 2



Among the Females who has Anemic, 113(78.5%) have mild, 28(19.5%) have moderate and 3(2%) have severe Anemia.

Table 3

comparison of Anthropometric measurement of Newborn to Anemic and Non-Anemic mother

Anthropometric measurement	Non-Anemic	Anemic	p-value
Height, cm	50.1 ± 2.4	48.2 ± 2.5	< 0.001
Weight, g	3.20 ± 0.35	2.85 ± 0.32	< 0.001
circumference, cm	34.7 ± 1.3	33.4 ± 1.2	< 0.001
Chest circumference, cm	33.4 ± 1.1	32.1 ± 1.0	< 0.001

Anthropometric measurement (height, weight, circumference and chest circumference) of neonates of Anemic mothers and non-anemic mothers show statistically significant difference.

DISCUSSION

Anemia in mothers generates a significant relationship with negative birth measurement results in their newborns. Research findings showed anemia among 48% of pregnant women in which mild forms (78.5%) were most frequent compared to moderate (19.5%) and severe (2%). Previous worldwide research has confirmed that pregnancy-related anemia continues to represent a major public health issue particularly within developing countries. Neonates born to anemic moms demonstrated statistically lower measurements of height and head size along with chest size and birth weight than babies delivered by women without anemia. There exists similar evidence in the research done by Koura et al. (2012) and Kumar et al. (2018) showing that maternal low hemoglobin levels create equivalent growth reductions in newborns. The diminished oxygen transport capabilities of women with anemia could explain why fetal cell proliferation and development would become restricted.

The study established that all anthropometric values demonstrated significant statistical differences ($p < 0.001$) which reflects how even minimal anemia levels affect infant wellness. Clinical evidence supports research from Scholl and Hediger (1994) which demonstrates that fetal development undergoes lasting damage because pregnancy anemia occurs alongside placental insufficiency and reduced iron transport during early gestation.

The study indicates pregnant women need prompt diagnosis and treatment of anemia. Neonates benefit considerably from consuming recommended amounts of iron and folic acid supplements combined with nutritional guidance and routine prenatal medical checkups. Public health programs should prioritize maternal nutrition because it enhances pregnancy results while reducing newborn health issues.

CONCLUSION

Maternal anemia exhibits direct negative effects on newborn anthropometrical measurements. The majority of expecting mothers had mild anemia since 48% of them displayed these symptoms during pregnancy. Statistical evidence demonstrates that anemic maternal conditions result in smaller Babies at birth in every body measurement when compared to babies born to mothers without anemia. Maternal hemoglobin deficiencies restrict oxygen and nutrient flow from mother to child and directly affect both fetal development and intrauterine growth period. Pregnant women need early anemia detection followed by appropriate treatment since research shows minimal anemia creates adverse effects on unborn child health. The public health concern demands implementation of iron and folic acid supplements together with diet improvement of mothers alongside consistent prenatal medical care. Infant morbidity and death rates decrease when anemia decreases along with the risk factors for low birth weight and stunted growth. The public health program must focus on maternal health because it directly affects neonatal outcomes and long-term child growth. Limited-resource settings need focused pregnancy interventions according to this research to reduce maternal and fetal anemia while enhancing healthcare for both populations.

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