

Maternal Anemia during Pregnancy

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Introduction: Maternal Anemia

Anemia is defined as a condition in which there is a reduction in the number of circulating red blood cells or hemoglobin per unit of blood¹. During pregnancy, anemia may occur most commonly due to iron deficiency or acute blood loss². In a typical gestation with a single fetus, a need for an additional 1000 mg of iron is induced by the pregnancy, an amount that often exceeds the iron stores of most women². In addition to this additional draw on iron stores, a reduction in the amount of hemoglobin available per g/L of blood results from natural processes that occur during pregnancy.

During pregnancy, blood volume increases above non-pregnant levels, causing a modest fall in hemoglobin levels in healthy women who are not deficient in iron or folate². This occurs because “a relatively greater expansion of plasma volume compared with the increase in hemoglobin mass and red blood cell volume results in plasma-dilution, an effect that accompanies all normal pregnancies” (p. 559, ²). These changes in blood volume occur for three reasons; first, to meet the demands of the enlarged uterus, second, to protect the mother, and in turn the fetus, against the damaging effects of impaired venous return in the supine and erect positions, and third, to safeguard the mother against adverse effects of blood loss associated with delivery².

Blood Measures of James Bay Cree Women During Pregnancy

A total of 2,080 women in the James Bay area had hemoglobin measurements available at some point during their pregnancy. Women usually have their blood tested in the first trimester for hemoglobin concentration, measured in g/L and mean cell volume, measured in fL. During this study the earliest available measurement was collected and for this reason, most of the measurements reported are from the first trimester. Those with blood testing reported in the later trimesters only, indicates that these women did not have their hemoglobin or mean cell volume levels measured earlier in pregnancy. Of the women with blood testing results, 68% had their earliest hemoglobin measurement during

the first trimester of pregnancy (weeks 1 to 14). 26% had their earliest hemoglobin measurement during their second trimester (weeks 15 to 28), and 4% had no measurement available before their third trimester (weeks 29 to 42).

Plasma begins to increase during the first trimester, and expands even more during the second trimester². “Because the expansion of red blood cells is proportionally less than the expansion of plasma, trimester-specific values for hemoglobin are proposed for screening for anemia in pregnant women” (p.385, ³). For this reason, maternal anemia has been summarised and compared in tables 1 and 2 according to hemoglobin and mean cell volume measurements in each trimester. Mean cell volume (mcv) is the average size of the red blood cell, and is a measure that should remain fairly constant throughout pregnancy despite increases in plasma volume. A measure of less than 80 fL in the mean cell volume of the red blood cell can indicate iron deficiency.

Table 1: Maternal Hemoglobin Concentration and Mean Cell Volume by Trimester

	1st Trimester		2 nd Trimester		3rd Trimester	
	Hemoglobin	Mcv	Hemoglobin	Mcv	Hemoglobin	Mcv
Number of Women	1409	1295	549	482	91	78
Mean	126.9 g/L	86.5 fL	120.2 g/L	87.9 fL	113.6 g/L	85.4 fL
Minimum	71 g/L	59 fL	74 g/L	59 fL	77 g/L	65 fL
Maximum	178 g/L	106 fL	146 g/L	105 fL	136 g/L	106 fL

The Center for Disease Control and Prevention (CDC) has defined anemia as less than 110 g/L in the first and third trimesters, and less than 105 g/L in the second

trimester². MCV is considered low if < 80 fL at any time in pregnancy. Independent of the trimester, 11.3% of all Cree women had low red blood cell mean cell volume during pregnancy, which is an indication of iron deficiency. Percentages of anemia in each trimester are reported in table 2.

Table 2: Percentages of Maternal Anemia during Pregnancy within each Trimester

	1 st Trimester	2 nd Trimester	3 rd Trimester
Anemia (low hgb) (trimester-specific guidelines used)	6.6%	6.0%	33.0%
Severe Anemia (hgb <100 g/L)	2.1%	3.6%	9.9%
Low Mean Cell Volume (< 80 fl)	11.6%	9.7%	17.9%

Note: The prevalence of anemia and small red blood cells is very high in women who had their blood first tested in the third trimester. It is likely that these women did not seek prenatal care early in pregnancy, and these women may differ from women seeking prenatal care earlier in pregnancy (poorer diet, poorer home environment, etc.)

Outcomes of anemia during pregnancy on births

Severe anemia occurs when women have a level of hemoglobin below 100 g/L at any time during pregnancy. Comparing all women with severe anemia at any time during pregnancy to those without, the most salient differences were that these women were much more likely to give birth to pre-term infants (< 37 weeks gestation) and that these infants, on average, weighed 248 g less than infants born to women without anemia. Nearly one quarter of women with severe anemia (20.7%) gave birth to pre-term infants, whereas only 6.7% of women without severe anemia gave birth to pre-term infants (see table 3). It is important to note that most women with severe anemia did not seek prenatal care until late in pregnancy. These women may have characteristics (poorer diet, poorer home environment, etc.) other than severe anemia that might have caused them to have a preterm infant.

Table 3: Birth Outcomes of Women With and Without Severe Anemia

	Severe Anemia (hemoglobin level < 100 g/L)	No Severe Anemia (hemoglobin level ≥ 100 g/L)
Percent of Preterm Births	20.7%	6.7%
Average Measurements at Birth		
Weight	3,556 g	3,804 g
Length	51.4 cm	51.9 cm
Head Circumference	35.3 cm	35.7 cm
Ponderal Index*	26.3 kg/m ³	27.2 kg/m ³
Maternal Characteristics		
Age	23.5	24.2
Pregravid weight	74.9	81.5
Parity	1.6	1.5

*An indication of relative thinness of the newborn.

Further significant differences at birth between babies born to women with severe anemia and those without were reduced ponderal index. The ponderal index, which is the ratio of an infant's length to the cube root of their weight (kg/m³)¹, describes the weight of the infant in relation to its length at birth. This measure was lower for infants born to mothers with severe anemia during pregnancy compared to those who were not, indicating that infants born to mothers with severe anemia were leaner (likely had less body fat). This might be an indication of intrauterine growth retardation in some infants.

An analysis of women who had haemoglobin measured during the first trimester (hemoglobin < 110 g/L), indicates that women with anemia in the first trimester also had an increased risk of giving birth to pre-term infants. See table 4 for a description of maternal characteristics and average birth outcomes for women with and without anemia measured in the first trimester.

Table 4: Description of women with and without anemia among those whose hemoglobin was measured in the first trimester

	Anemia (hemoglobin level < 110 g/L)	No Anemia (hemoglobin level ≥ 110 g/L)
Percent of Preterm Births	12.9%	6.6%
Average Measurements of Infant at Birth		
Weight	3741 g	3821 g
Length	51.7 cm	52 cm
Head Circumference	35.6 cm	35.7 cm
Ponderal Index	27.0 kg/m ³	27.2 kg/m ³
Maternal Characteristics		
Age	24.9	24.6
Pregravid weight	76.6 kg	82.4 kg
Parity	1.8	1.5

Reference List

1. Thomas CL. Taber's Cyclopedic Medical Dictionary. Philadelphia: F.A. Davis Company, 1985.
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3. Ziegler EE, Filer LJ. Present Knowledge in Nutrition. Washington, DC: International Life Sciences Institute Press, 1996.