

# The effect of maternal anemia on anthropometric measurements of newborns

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## ABSTRACT

**الأهداف:** لتقييم العلاقة بين مستوى الهيموجلوبين الموروث من الأم قبل الولادة والقياسات البشرية في الأطفال حديثي الولادة.

**الطريقة:** شملت الدراسة 3688 من قسم الولادة والأطفال حديثي الولادة في مستشفى الدكتور لطفي قيردار - كارتال - اسطنبول - تركيا، خلال الفترة ما بين يناير 2005 وحتى ديسمبر 2006م. تم تسجيل قياسات الوزن، الطول، محيط الرأس والصدر للمواليد الجدد. كما أُجرى تقييم تعداد الدم الكامل للنساء الحوامل المذكورات. تم تقييم الأمهات ذوات تركيز الهيموجلوبين أقل من 11g/dl علي أنهن مصابات بالأنيميا (فقر الدم). وتم تقسيم الأمهات المصابات بالأنيميا (فقر الدم) إلي ثلاث مجموعات: الخفيفة، المعتدلة والحادة، وتعتبر الأم مصابة بالأنيميا الحادة إذا كان مستوى تركيز الهيموجلوبين أقل من 7g/dl، وبالمعتدلة إذا كان 8.9-7.0g/dl، والخفيفة إذا كان مستوى تركيز الهيموجلوبين بين 10.9-9.0g/dl. تم مقارنة القياسات البشرية للمواليد الجدد من الأمهات في المجموعات المصابة والغير مصابة

**النتائج:** تبين أن 1588 (43%) من الأمهات المصابات بالأنيميا (فقر الدم) من النساء الحوامل البالغ عددهن 3688. 1245 (78.5%) من الأمهات مصابات بالأنيميا الخفيفة، و311 (19.5%) مصابات بالأنيميا المعتدلة، و32 (2%) كن مصابات بالأنيميا الحادة. كان هناك اختلاف إحصائي فيما يتعلق بالقياسات البشرية بين المواليد الجدد من مجموعات الأمهات المصابات والغير مصابات بالأنيميا (فقر الدم). ( $p=0.036$ ,  $p=0.044$ ,  $p=0.013$ ,  $p=0.0002$ ). كما كان هناك اختلاف إحصائي ملحوظ في القياسات البشرية للمواليد من الأمهات المصابات بالأنيميا الحادة والأنيميا المعتدلة ( $p=0.017$ ,  $p=0.02$ ,  $p=0.008$ ). كانت قياسات الوزن، الطول، محيط الرأس والصدر للمواليد الجدد من مجموعة الأمهات المصابات بالأنيميا الحادة 1cm، 1.1cm، 260g، 0.42cm أقل من مواليد الأمهات المصابات بالأنيميا المعتدلة على التوالي.

**خاتمة:** تؤثر إصابة الأمهات بالأنيميا خلال فترة الحمل على القياسات البشرية للمواليد الجدد، ويكون تأثيرها سلبى على هذه القياسات في مواليد الأمهات المصابات بالأنيميا الحادة.

**Objectives:** To evaluate the relation between maternal prenatal hemoglobin concentration and neonatal anthropometric measurements.

**Methods:** All pregnant women who gave birth at the Obstetrics Department of Dr. Lutfi Kirdar Kartal Training and Research Hospital, Istanbul, Turkey, from January 1, 2005 to December 31, 2006, and their newborns were included in this prospective, cross-sectional study. The newborns' weight, height, head, and chest circumference were recorded. Mothers with hemoglobin concentration less than 11 g/dl were evaluated as anemic. The anemic mothers were then grouped into 3 categories according to the corresponding hemoglobin concentration: mild (10.9-9.0 g/dl), moderate (8.9-7.0 g/dl), and severe anemic (less than 7 g/dl). The anthropometric measurements of newborns from non-anemic and anemic mother groups were compared.

**Results:** Of the 3688 pregnant women, 1588 (43%) were found to be anemic. Among the anemic mothers, 1245 had mild (78.5%), 311 had moderate (19.5%), and 32 (2%) had severe anemia. The anthropometric measurements (height, weight, head and chest circumference) of newborns of anemic and non-anemic mother groups showed a statistically significant difference ( $p=0.036$ ,  $p=0.044$ ,  $p=0.013$ , and  $p=0.0002$ ). There was a statistically significant difference in height, weight, and chest circumference of newborns of severe anemic and mild anemic mothers ( $p=0.017$ ,  $p=0.008$  and  $p=0.02$ ). The height (1.1 cm), weight (260 g), head (0.42 cm), and chest (1 cm) circumference of neonates in the severe anemic group is less than the mild anemic group.

**Conclusion:** Anemia during pregnancy affect the anthropometric measurements of a newborn. Severe anemia had significant negative effect on neonatal anthropometric measurements.

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Anemia in pregnancy is a common problem in many developing countries.<sup>1,2</sup> Maternal anemia during pregnancy may lead to poor fetal outcome through growth retardation or perinatal death, while the risks of infant morbidity and mortality are also increased. Several surveys found that a mother's anemia and/or low serum iron was related to the small size and mortality of the infant.<sup>3,4</sup> A high proportion of women in both industrialized and developing countries become anemic during pregnancy. World Health Organization reports that anemia affects nearly half of all pregnant women in the world: 52% in developing countries compared with 23% in the developed world.<sup>5</sup> Our study was designed to evaluate the relation between maternal prenatal hemoglobin concentration and neonatal anthropometric measurements.

**Methods.** Three thousand and six hundred eighty-eight pregnant women who gave birth at the Obstetric Department of Dr. Lutfi Kirdar Kartal Training and Research Hospital, Istanbul, Turkey, from January 1, 2005 to December 31, 2006, and their newborns were included in this study. The premature babies, multiple pregnancies, and the newborns admitted to the Neonatology Unit for medical problems were not included. After delivery, the birth weight of neonates was recorded by 2 nurses in the delivery room. The newborns' height, head and chest circumference were recorded by the same doctor in the first 24 hours. Before birth, maternal venous blood samples were collected for hemoglobin evaluation. According to the criteria of World Health Organization advice, the mothers with hemoglobin concentration less than 11 g/dl were evaluated as anemic. The anemic mothers were then categorized into 3 groups according to the corresponding hemoglobin concentration: mild (10.9-9.0 g/dl), moderate (8.9-7.0 g/dl), and severe anemia (less than 7 g/dl). The anthropometric measurements of newborns from non-anemic and anemic mother groups were compared. The Chair of the Local Research Ethics Committee granted the ethical approval for this study. The statistical analysis was carried out with NCSS 2007 program. The results were evaluated as significant with *p*-value less than 0.05. Besides standard descriptive statistical calculations (mean and standard deviation), one way ANOVA was used in the comparison of groups, post Hoc Tukey multiple comparison test was utilized in the comparison of subgroups, unpaired t-test was used to compare the two groups.

**Results.** Of the 3688 pregnant women, 1588 (43%) were found to be anemic. Among the anemic mothers, 1245 had mild (78.5%), 311 had moderate (19.5%) and 32 (2%) had severe anemia. The anthropometric

measurements (height, weight, head and chest circumference) of newborns of anemic and non-anemic mother groups showed a statistically significant difference ( $p=0.036$ ,  $p=0.044$ ,  $p=0.013$ , and  $p=0.0002$ ) (Table 1). We observed that the average birth weights of children born to mothers with mild anemia were higher than the other groups (Table 2). The mild anemic group was regrouped according to their hemoglobin level as group I (9-9.5 g/dl), group II (9.6-10 g/dl), group III (10.1-10.5 g/dl) and group IV (10.6-10.9 g/dl). The birth weight of children born to mothers in group I was highest in all groups (Table 3). There was a statistically significant difference in the anthropometric measurements of newborns of severely anemic and mildly anemic mothers. It was found that the height (1.1 cm), weight (260 g), head (0.42 cm.) and chest (1 cm) circumference of neonates in severe anemic group were less than the mild anemic group (Table 4).

**Discussion.** Anemia is one of the most prevalent nutritional deficiency problems affecting pregnant women.<sup>6</sup> The high prevalence of iron deficiency among women during pregnancy in developing countries is of concern, and maternal anemia is still a cause of considerable perinatal morbidity and mortality.<sup>7</sup> The most common causes of anemia are poor nutrition, deficiencies of iron and other micronutrients, and malaria.<sup>5</sup> Sufficient maternal prenatal care during pregnancy by increasing mother's knowledge in nutrition, breast feeding, and by supplementation of iron during pregnancy would be beneficial for both the mother and the neonate.<sup>8</sup> In developing countries, prevalence of anemia in pregnancy is reported to be 52%.<sup>5</sup> In the

**Table 1** - Anthropometric measurements of neonates born to anemic and non-anemic mothers.

Anthropometric measurements	Anemic n=1588	Non-anemic n=2100	P-value
Height, cm	48.44 ± 2.16	48.29 ± 2.12	0.036
Weight, g	3356 ± 486	3323 ± 488	0.044
Head circumference, cm	34.45 ± 1.32	34.34 ± 1.34	0.013
Chest circumference, cm	32.95 ± 1.98	32.75 ± 1.95	0.0002

**Table 2** - Birth weight of neonates according to the mother's hemoglobin level.

Hemoglobin concentration	Birth weight, g
Hemoglobin ≥11 g/dl	3323 ± 488
Hemoglobin 10.9 - 9 g/dl	3373 ± 486
Hemoglobin 8.9 - 7 g/dl	3313 ± 489
Hemoglobin <7 g/dl	3113 ± 382

**Table 3** - Anthropometric measurements of neonates born to mildly anemic mothers.

Anthropometric measurements	Hemoglobin				P-value
	Group I (9-9.5 g/dl)	Group II (9.6-10 g/dl)	Group III (10.1-10.5 g/dl)	Group IV (10.6-10.9 g/dl)	
Height, cm	48.83 ± 2.24	48.25 ± 2.11	48.54 ± 2.09	48.5 ± 2.26	0.032
Weight, g	3418.9 ± 507.83	3339.62 ± 489.99	3376.52 ± 480.86	3372.58 ± 477.06	0.345
Head circumference, cm	34.67 ± 1.37	34.38 ± 1.31	34.48 ± 1.36	34.43 ± 1.26	0.085
Chest circumference, cm	33.26 ± 2.13	32.78 ± 1.97	33.09 ± 1.91	33.02 ± 1.99	0.053

**Table 4** - Anthropometric measurements of neonates born to mild and severely anemic mothers.

Anthropometric measurements	Mild anemic group n=1245	Severe anemic group n=32	P-value
Height, cm	48.5 ± 2.18	47.45 ± 1.93	0.017
Weight, g	3373 ± 486	3113 ± 383	0.008
Head circumference, cm	34.47 ± 1.33	34.05 ± 1.31	0.179
Chest circumference, cm	33.02 ± 2	31.97 ± 1.7	0.02

study of Malhotra et al,<sup>9</sup> the overall prevalence of anemia among pregnant women was estimated to be 72.5%, and 34.4% in the study of Marti-Carvajal et al.<sup>10</sup> In our study, we found anemia prevalence in pregnant mothers to be 43%. Among the anemic mothers, 78.5% had mild, 19.5% had moderate, and 2% had severe anemia in our study. Among 630 pregnant women Marti-Carvajal et al<sup>10</sup> found that 83% had mild, 15.2% had moderate, and 1.8% had severe anemia. In the study of Malhotra et al<sup>9</sup> including 447 pregnant women, 31 of 447 (6.9%) were found to be severely anemic. Geelhoed et al<sup>11</sup> found that the average age of severe anemic mothers was 22 years, and 57% were nulliparous. In our study, in the severe anemic group the minimum hemoglobin level was found to be 4.3 g/dl, and the average maternal age was 23.78 years. Only 22% were nulliparous, and of the 32 severe anemic mothers, 90.6% did not receive any iron supplementation during pregnancy. While the minimum hemoglobin level in severe anemics was similar in the study of Malhotra et al,<sup>9</sup> in contrast to our study, they found that severe anemic mothers were older than the average, and the majority had 3 or more children. These results may reflect the wide range of variations of prevalence and the degree of anemia in pregnant women from developing countries. It is clear that maternal anemia during pregnancy may have adverse effects on the fetus, and the anthropometric measurements of the neonate, however, the effect depends on the degree and severity of maternal anemia. In the study of Steer et al<sup>12</sup> evaluating 153,062 pregnant women, the highest average birth weight was found in

the mother group with a hemoglobin concentration of 85-95 g/l. We similarly found that the highest birth weight belongs to the mother group with hemoglobin of 9-9.5 g/dl, suggesting the optimum hemoglobin concentration for birth weight to be 9-9.5 g/dl. The data from our study pointed out that optimal maternal hemoglobin concentration during pregnancy that are lower than the accepted levels should be evaluated with further studies. In our study regarding anthropometric measurements between anemic and non-anemic groups, a statistical significance was found. When we compared the neonatal anthropometric measurements of the mild anemic group with the severe anemic group, we found that all measurements for height, birth weight, head circumference and chest circumference were less in the severe anemic group.

In summary, our study showed that maternal anemia during pregnancy negatively affects the anthropometric measurements of the neonates. However, the severe form of maternal anemia has the most significant effect. A randomized, nation wide, multi-center study incorporating other maternal factors, like body height and body mass index may yield more representative results of the whole population. Our study has some limitations. Firstly, since it was performed in a single center, although the number of the sample is quite high, it may not be representative of the whole population. Secondly, mothers were not categorized for some other maternal factors like low height and body mass index, which could contribute to low birth weight.

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### Related topics

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