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Prevalence of anaemia in pregnant women during the last trimester: consequense for birth weight

A. DEMMOUCHE, A. LAZRAG, S. MOULESSEHOUL

Department of Biology, Djillali Liabes University, Sidi Bel Abbes (Algeria)

Abstract. – ***Objectives:*** Iron deficiency continues to be one of the most prevalent single-nutrient deficiencies in the world. The current study aimed to estimate the prevalence of iron deficiency anemia (IDA) among pregnant women who attend Antenatal Care Centers in Sidi Bel Abbes, Algeria. The effect of anaemia on infant birth weight was also examined.

Materials and Methods: The study was conducted during the period March-Mai, 2010 and the sample consisted of 207 pregnant women (in the third trimesters) in the age group (17-41) years. The subjects were not taking iron, folate or vitamin B_{12} supplements at the time of the study. Blood samples were collected from each pregnant woman and a questionnaire was completed at the time of blood collection. A series of determinations was conducted to determine hemoglobin concentration (Hb); packed cell volume (PCV); corpuscular hemoglobin concentration (MCHC), corpuscular volume (MCV). The effect of anemia on the weight of new born babies was examined by calculating the correlation coefficient of birth weight and hematological indexes.

Results: The overall prevalence of anemia was found to be 46.86%. According to the severity anemia was 36.08% mild, 49.48% moderate and 14.43% severe anemia. The mean values (±SD) of haematological indexes were as follows: Hb 9.00±1.57 g/dl; PCV 27±5.37%; mean corpuscular haemoglobin concentration (MCHC) 33.75±2.69 g/dl and mean corpuscular volume (MCV) 75.7±10.4fl. The results have shown that 46.39% of the subjects had MCV values less than standard value of 75fl suggesting a microcytic anemia.

The mean haemoglobin concentration was 9±1.57g/dl while the mean birth weight was 3201.54±566.71 g. There was a not significant correlation between the Hb level and the birth weight of the infants (r = 0.28, $p>0.05$).

The prevalence of low birth weight was 9.2%. There was no statistically significant haemoglobin concentration /foetal birth weight difference among the various hemoglobin concentration (Chi square test = 0.34, $p>0.05$).

Conclusions: Anemia had no significant obstetric adverse effects in our pregnant population (Fischer test = 0.06, $p>0.05$). There was no statistically significant difference in mean birth weight among the various haemoglobin groups suggesting that other parameters may play important roles in influencing the birth weight than the maternal haemoglobin concentration.

Key Words:

Iron, Deficiency, Anemia, Supplementation, Pregnancy, Newborns.

Introduction

In many developing countries, iron deficiency anemia (IDA) in pregnancy is highly prevalent[1-6]. This may be related to high iron requirements during the gestation because iron is necessary to cover basal iron losses, the increase in maternal red cell mass, and the development of the fetus and placenta[7]. The risk of IDA is particularly high in women who begin gestation with depleted or low body iron stores, a situation common in Africa and most Third World countries, where high parity and short intervals between children are often found[8].

Also, iron requirements during pregnancy are not easily satisfied by dietary intakes, which generally provide poor iron bioavailability[9,10]. According to the World Health Organization (WHO) anemia should be considered when the hemoglobin level is below 11 g/dL[2].

In the past, the relation between maternal iron status and that in newborn infants was investigated by evaluating the biologic status of newborns according to the presence or absence of anemia in their mothers or by reporting on correlations

Corresponding Author: Abbassia Demmouche, Ph.D; e-mail: demmoucheabbassia@yahoo.fr

between biochemical iron indicators in mothers and anthropometric, clinical, or biologic data in their new borns. However, most of these studies were cross-sectional, involving a bivariate regression or, in some cases, a multiple regression analysis[11-16]. This approach has a limited use fulness because the anthropometric, clinical, and biologic factors in newborns are related to numerous factors other than the maternal iron status. Moreover, the correlation coefficients may be confounded by the effects of other correlated independent variables. In many studies linking maternal anemia to anemia in newborns, the cause of anemia was not necessarily related to the iron status[14-16]. The most efficient way to evaluate the specific relative effect of iron deficiency on newborns is to use methods based on iron-supplementation trials that include a placebo group.

Materials and Methods

A total of 207 pregnant algerian women were selected by systematic random sampling from the Antenatal Clinic at Sidi Bel Abbes Hospital, Algeria. All the women were in the last trimester of gestation (37-42 weeks). They were healthy and had no chronic diseases. Data were collected during the period march to may 2010. A specially designed questionnaire was prepared.

Pregnancy outcome date, birth weight were obtained during physical examination of the newborn infants by the midwife within 24 hours of delivery. Infants who were less than 2500 g at birth were considered as infants with low birth weight.

Also at the time of the interview, a small venous sample was obtained. Coulter ABX micros 60-OT machine (ABX Horiba, TX, USA) was used for hematological analysis.

Based on the Center for disease control and prevention (CDC) criteria, anemia was defined as hemoglobin level less than 11 g/dl in the first and third trimester and less than 10.5 g/dl in second trimester[17]. Microcytosis was defined as mean corpuscular volume MCV lesser than 75 fL and macrocytosis was considered when MCV was greater than 85 fL.

Statistical Analysis

Data of the questionnaire and results of blood tests were analyzed using software program statistical State Vieux (1998). Frequencies and the percentages were calculated and Student's t test was performed to investigate the significance in the association of the different variables and the prevalence of IDA. Correlations were considered significant if the observed significance level p was <0.05. Chi-square test was used as test of significance at 5% level. Pearson's correlation coefficient was used to study the relation between prevalence of anemia and birth weight.

Results

From march 1, to may 31, 2010 there were 2892 pregnant women attended the Antenatal Clinic of Sidi Bel Abbes Hospital. 207 pregnant women were recruited in the last trimester.

The mean hemoglobin level was 12.23 ± 0.79 (range 11-14.4 g/dl). The mean age was 30.07 ± 6.74 (range 18-44 years). There were 85 (41.06%) nulliparous and 122 cases (58.91%) had one child or more. The signifi-

Table I. Anthropometric, socio-economic and gynecological-obstetric data (average ± SD, number of subjects) for the whole of the sample and comparison between the anemic and non anemic women.

	Anemic women (n = 97) mean SD range	No anemic women (n = 110) mean SD range	P
Age (years)	(28.93 ± 6.53) range (2-46)	(31.07 ± 6.79) range (18-44)	0.64 NS
Number of abortion	(0.2 ± 0.49) range (0-2)	(0.33 ± 0.57) range (0-2)	0.86 NS
Gestational age (weeks)	38.9 ± 2.	39.6 ± 1.6	P > 0.05 NS
Parity	0.85 ± 1025	1.36 ± 1.39	0.06 NS

S: significant correlation; NS: no significant correlation.

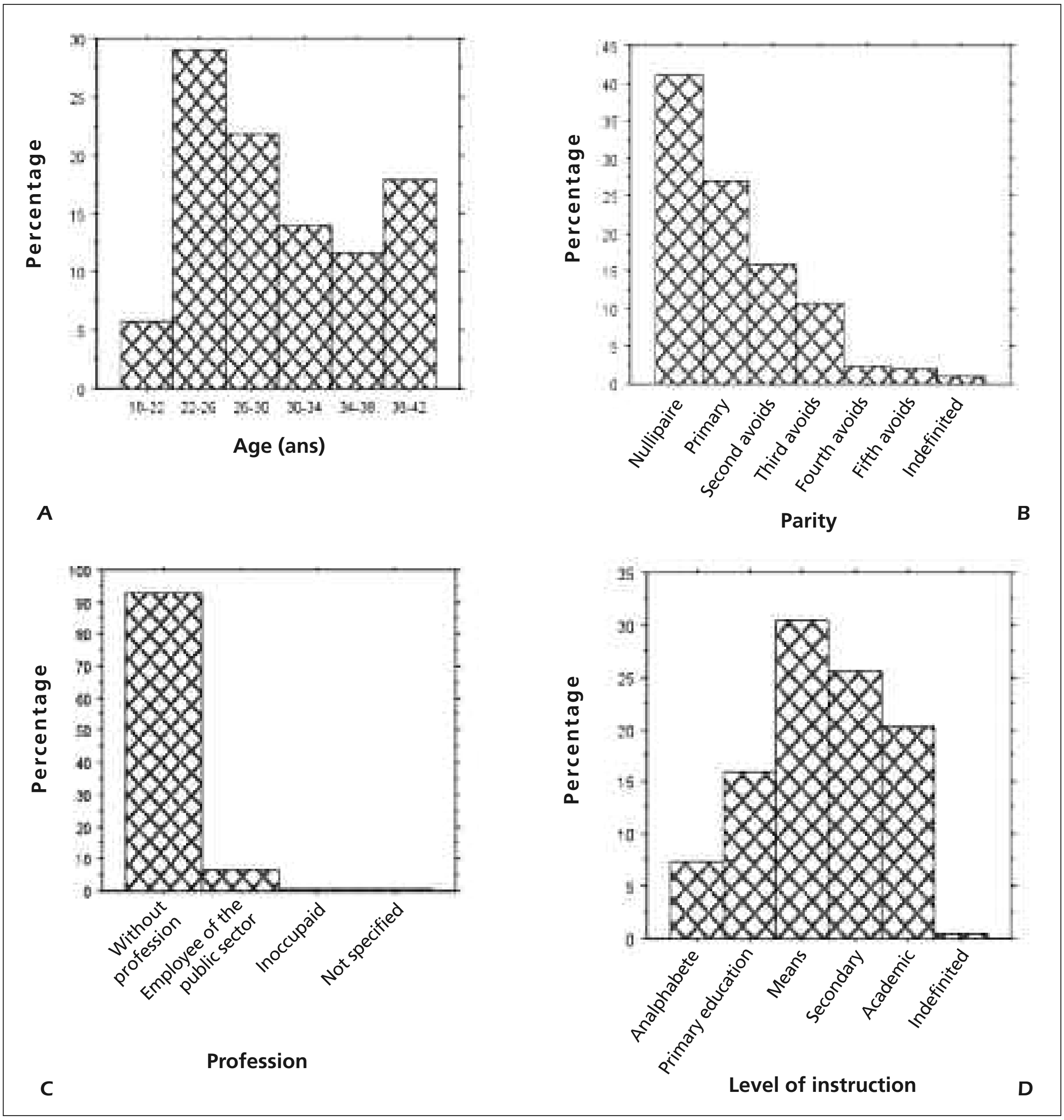

Figure 1. Distribution of the whole sample (n= 207) according to age *(A)*, parity *(B)*, level of instruction *(C)* and profession *(D)*.

cant outcome of the study was that the iron deficiency anemia existed in educated middle class (30.43%) and subjects without profession (93.81%) (Figure 1).

Out of the total 207 cases, 97 were found to be anemic. The overall prevalence of anemia was found to be 46.86% (Figure 2). According to the severity 36.08% were mild, 49.48% moderate and 14.43% severe anemia (Figure 3).

The maternal characteristics of both groups were not different. There was no significant difference in the mean gestational age at delivery 38.9±2.0 vs 39.6±1.6 weeks (Table I).

The results of the measurements of the various variables in maternal blood during the last trimester of gestation in women with and without anemia are summarized in Table II. In the anemic group the mean of Hb (±SD) (n=97) was

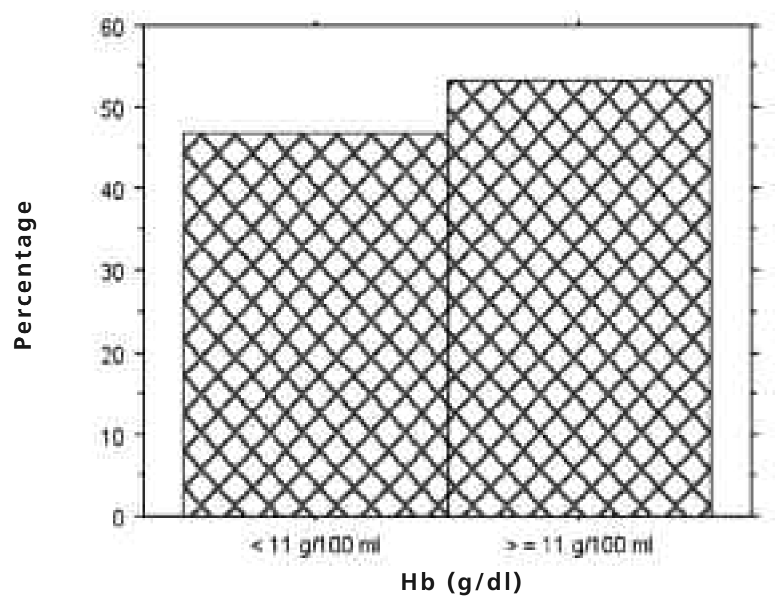

Figure 2. Distribution (%) of the sample (n = 207) for anemic group (Hb < 11 g/100 ml) and non-anemic group (Hb ≥ 11 g/100 ml).

9±1.57 while in the control group non-anemic (n=110) it was 12.23±0.79 g/dl, (p = 0.0001).

The mean of Ht (g/dl) (±SD) in the anemic group (n=97) was 27±5.39% while in the control group non-anemic (n=110) it was 36.78±3.28%, (p=0.0001). Moreover, the mean of MCV (fl) (±SD) in the anemic group (n=97) was 75.7±10.48 (fl) while in the control group non-anemic (n=110) it was 84.76±4.17 (fl), (p= 0.0001).

The mean of MCHC (g/100 ml) (±SD) in the anemic group (n=97) was 33.75±2.79 while in the control group non-anemic (n=100) it was 33.38±2.48 g/100 ml, (p=0.39). The mean of white blood cells (±SD) in the anemic group (n=97) was 6.78 ±2.12 while in the control group non-anemic (n=100) it was 6.82±1.82; (p = 0.88). Finally, The mean of platelets (±SD) in the anemic group (n=97) was 276.29±100.06 while in the control group non-anemic (n=100) it was 282.36±65.93, (p = 0.60).

The Hb value of about 46.86% of the subjects was found to be below <11 g/100 ml; for the remaining 53.14% their Hb were above ≥11 g/100

Table II. Parameters of hematologic status (average ± SD) of the whole sample and comparison between the anemic group and non anemic group.

	HB (g/dl) mean ± SD range	PCV (%) mean ± SD range	MCV (fl) mean ± SD range	MCHC (g/100 ml) mean ± SD range	White blood cells (10^3/Mm^3) mean ± SD range	Platelets (10^3/Mm^3) mean ± SD range
Anemic women (n = 97)	9.00 ± 1.57 (5-10.9)	27 ± 5.39 (14.9-35.5)	75.7 ± 10.4 (50.2-90)	33.75 ± 2.79 (26.69-40)	6.78 ± 2.1 (3.76-16.3)	276.29 ± 100.06 (125-618)
Non-anemic women (n = 110)	12.23 ± 0.79 (11-14)	36.78 ± 3.28 (26-48)	84.76 ± 4.17 (67-96.8)	33.38 ± 2.48 (34.94-44.7)	6.821 ± 1.82 (3.8-11.3)	282.36 ± 65.93 (145-430)
P	0.001 S	0.001 S	0.001 S	0.39 NS	0.88 NS	0.60 NS
WHO value	> 11	> 33	75-85	30-35	4-10	130-400

S: significant correlation; NS: no significant correlation.

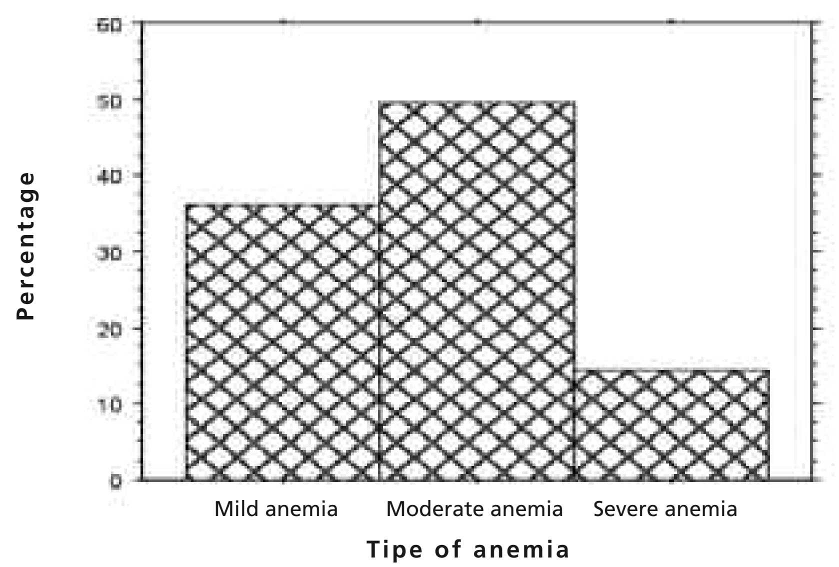

Figure 3. Distribution of anemia among pregnant women by severity of anemia.

ml (considered to be normal). There are a positive correlation between Hb and Ht (r=0.91), and between the Hb level and the MCHC level (r= 0.90), (Figure 4).

46.39% of the subjects had MCV values less than standard value of 75fl suggesting a microcytic anemia. For the remaining 25.77% their MCV were above >85 (fl); suggesting a megaloblastic anemia. There was a not significant correlation between the Hb level and the MCV level (r = 0.06). The MCHC values of about 7.21% of the subjects were found to be below <30 (g/dl); for the remaining 92.78% their MCHC were above >30 (g/dl) (considered to be normal) (Figure 5).

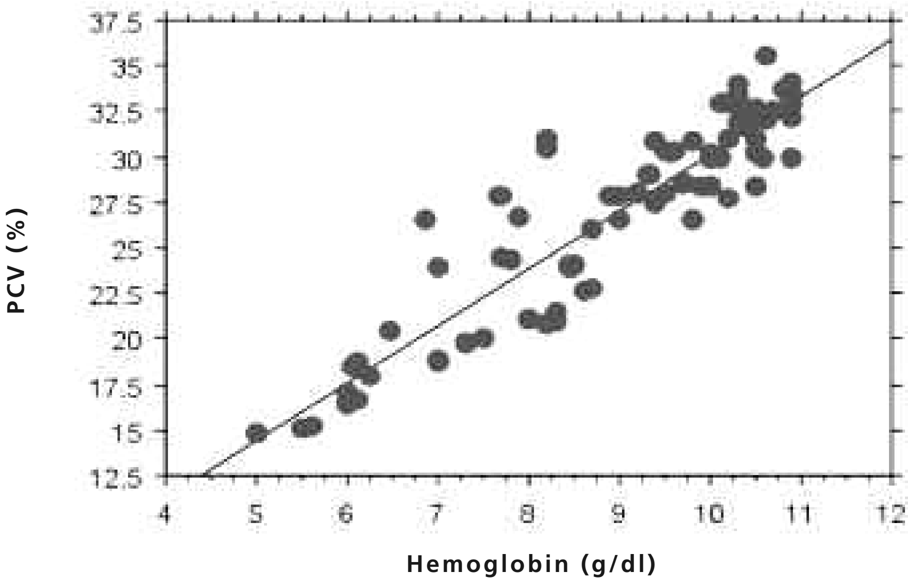

Figure 4. Correlation between PCV and Hb.

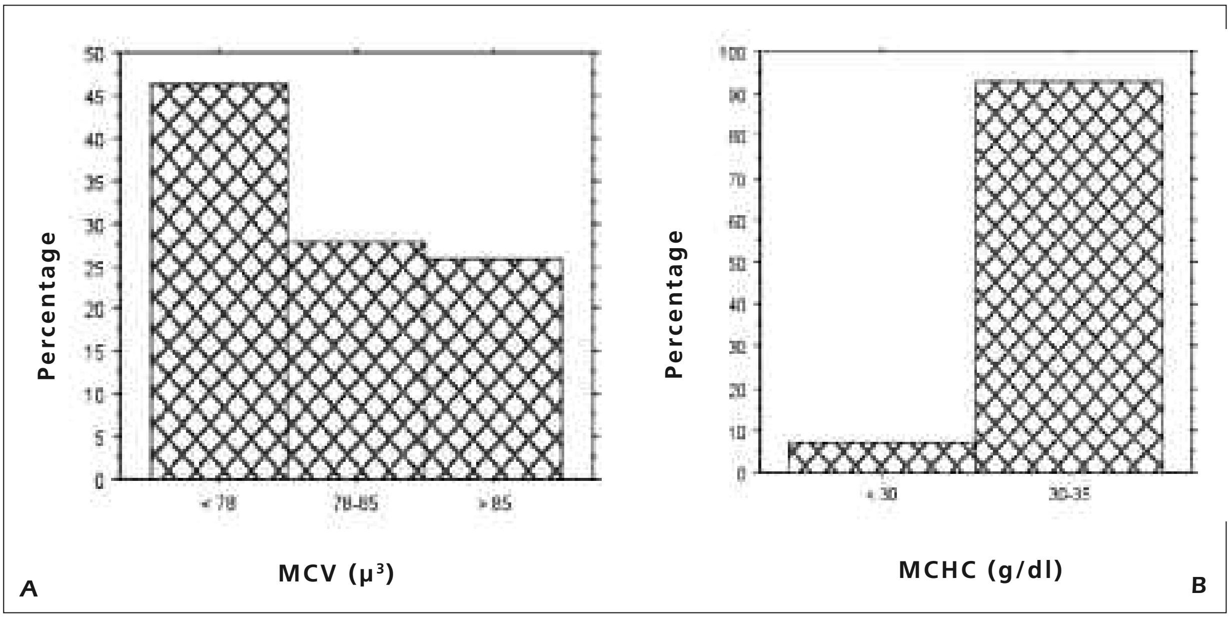

Figure 5. Distribution of the whole sample (n=97) according to MCV (fl) level *(A)* and MCHC (g/dl) level *(B)*.

The distribution of birth weight of the children and hemoglobin level at the last antenatal visit is shown in Table III and (Figure 6).

The mean of weight of the babies (± SD) in the anemic group (n = 97) was 3201.54 ± 566.71 g while in the control group (n=110) it was 3712.72 ± 534.34, ($p < 0.001$).

The prevalence of low birth weight (<2500 g) was 9.2%. However, the prevalence was higher among mothers who were anemic (9.2%) compared to mothers who were non-anemic (0%). There is no significant association of low birth weight (<2500 g) and the status of anemia in the anemic mothers (Chi square test = 0.34, $p > 0.05$).

There was a not significant correlation between the Hb level and the birth weight of the infant (r = 0.28).

Anemia, therefore, had no significant obstetric adverse effects in this pregnant population (Fischer test = 0.06, $p > 0.05$).

The frequency of anemia was 46.86%. Table IV shown the maternal age and mean birth weight distribution. 59.79% of the patients were aged between 26 and 34. Anyone correlation between birth weight and maternal age (r = –0.02) was observed.

Table V shows the parity and mean birth weight distribution. Most were nullipara (49.48%) while 26.08% were para 1, 10.30% para 2 and remaining (13.14%) para 3 and above. The mean birth weights among the different parity groups showed no statistically significant difference.

The type of anemia matched against the birth weight distribution is shown in Table VI. The mean hemoglobin concentration was 10.72 + 2.02 g/dl. 36.08% of the subjects had a mild anemia, 49.48% had a moderate anemia and 14.43% had a severe anemia. The mean birth weight was 3233.12 g. There was no statistically significant difference in the mean birth weight amongst the type of anemia. Moreover, we found no correlation between birth weight and hemoglobin (r = 0.28, $p > 0.05$) (Figure 7).

Table III. Mean birth weight among anemic and no anemic women.

	Anemic women (n = 97) *Mean ± SD range*	*No anemic women (n = 110)* *Mean ± SD range*	*P*
Birth weight (g)	(3201.54 ± 566.71) (2000-4300)	(3712.72 ± 534.34) (2700-4900)	$P < 0.001$

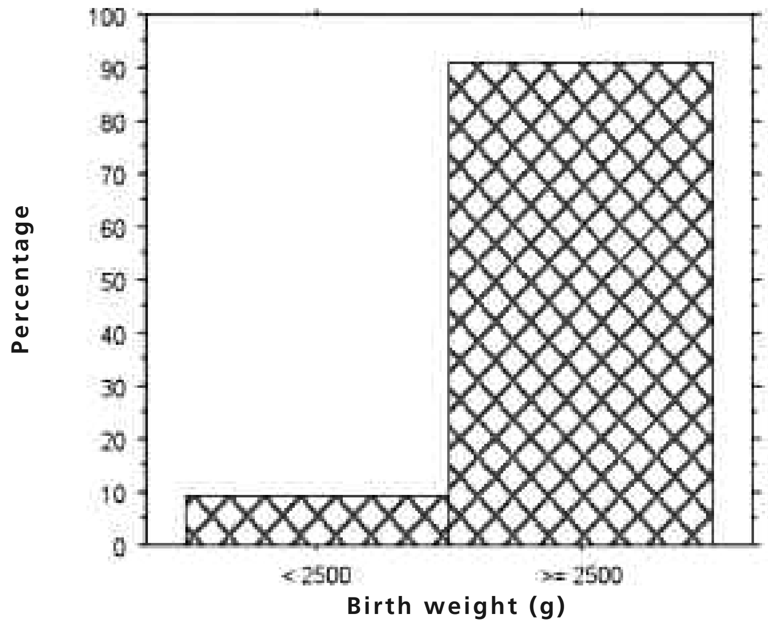

Figure 6. Distribution (%) of the sample (n = 97) according to birth weight (< 2500) and birth weight (≥ 2500).

Table IV. Relation between maternal age and mean birth weight.

Age rage	Number	Percentage	Mean birth weight (g)
18-22	4	4.12	3325.0 ± 424.2
22-26	33	34.02	3306.0 ± 472.9
26-30	25	25.77	3030.0 ± 735.1
30-34	17	17.52	3205.8 ± 461.6
34-38	8	8.24	3387.5 ± 635.6
38-42	10	10.30	3080.0 ± 509.4

Table V. Relation between parity and mean birth weight.

Parity	Number	Percentage	Mean birth weight (g)
0	48	49.48	3183.33 ± 614.4
1	26	26.08	3278.84 ± 581.0
2	10	10.30	3130.00 ± 356.0
3-5	12	12.37	10060 ± 550.1
6 & Above	1	1.03	3600.00 ± 550.1

Table VI. Relation between severity of anemia and mean birth weight.

Type of anemia	Number	Percentage	Mean birth weight (g)
Mild anemia 10 g/dl <= hb < 11 g/dl	35	36.08	3125.71 ± 612.7
Moderate anemia 7 g/dl <=hb < 10 g/dl	48	49.48	3209.37 ± 78.37
Severe anemia < 7 g/dl	14	14.43	3364.28 ± 141.2

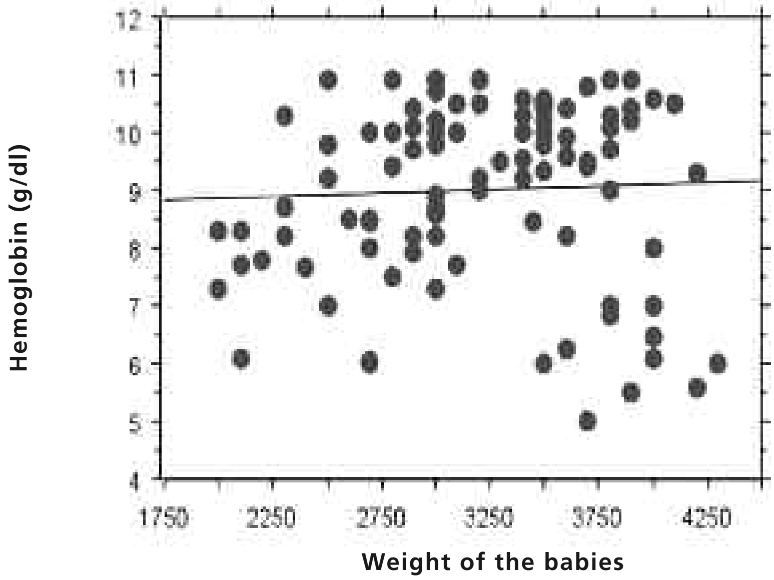

Figure 7. Correlation between birth weight and hemoglobin.

Discussion

Anemia in pregnant women in developing countries is generally presumed to be the result of a nutritional deficiency. Iron deficiency anemia is the most prevalent nutritional deficiency problem affecting the pregnant women[18]. Iron deficiencies may develop during the pregnancy because of the increased iron requirements on the mother's body to supply the expanding blood volume and the rapidly growing fetus and placenta.

Literature suggests that the iron deficiency is responsible for about 50% of the cases of anemia in pregnant women in developing countries[19,20].

The objective of the present study was to determine the prevalence of anemia in the pregnant women by examining several hematological indexes in a sample population. The indexes variables studied included Hb, Ht, MCHC and MCV.

The prevalence of anemia in pregnancy in this study, 46.86% is higher than the 37-56% given by the World Health Organization[21] using the criterion of hemoglobin concentration <11 g/dl to define anemia. However, given the fact that it is now generally accepted that the maternal iron status cannot be assessed simply from hemoglobin concentration[22], care needs to be taken in interpreting this finding. Hemoglobin concentration and the mean corpuscular volume are a better indicators for anemia or lack of it; since the plasma volume expansion in normal pregnancy is a common denominator in all the patients investigated, the comparative value of these findings is probably not lost.

The maternal age distribution among the subjects was expected as the majority (59.79%) fell within the most active reproductive age bracket of 22-30 years.

The mean hemoglobin concentration in this research of 10.72 g/dl was similar to findings in other studies[23]. Although the exact figures are not usually available for developing countries, the published rates are applicable to selected urban group of women[24]. There was a not significant correlation (r = 0.28) between the Hb level and the birth weight of the infants.

Reports about the relationships between anemia and adverse birth outcomes have been inconsistent. Some investigations have found anemia to significantly increase the risk of adverse birth outcomes[25-28], whereas others have not[29,30]. In this study, anyone direct relationship was established between the maternal hemoglobin concentration and the subsequent birth weight. It is interesting that despite the fact that the majority of our women (46.86%) were anemic, according to the World Health Organization standards, the mean birth weight was still within the normal range.

The fact that the birth weights of babies whose mothers have hemoglobin less than 11 g/dl were normal may underscore the relative importance of plasma expansion relative to increased red cell mass in the subsequent determination of specific foetal outcomes. The importance of an adequate plasma volume expansion in allowing adequate foetal growth is attested by several investigations that showed an increased frequency of low birth weight in association with either a high hematocrit[26,32-34]. The mechanism by which this effect is mediated is unknown but may be related to the blood viscosity. In developed countries, it is likely that the disorders of plasma volume expansion and associated high hemoglobin concentration are more important than is the anemia in the genesis of low birth weight. Nonetheless, substantial iron deficiency anemia <7 g/dl is also associated with an increased prevalence of low birth weight[35]. In this study, however, there was an even spread of the prevalence of low birth weight among the different hemoglobin concentration ranges.

We did not find any correlation (r = 0.27) between the Ht level and the birth weight of the infants. The relation between pregnancy outcome and hemoglobin or hematocrit was studied carefully. Kaltreider and Johnson[36] reported that the frequency of delivery of low-birth-weight infants was significantly higher in women wiyh hemoglobin values <9 g/dl than in women with higher hemoglobin values. Beischer et al[37] and Singla et al[38] observed a reduced birth weight in offspring of severely anemic mothers. Harrisson and Ibeziako[39] found that maternal anemia was associated with a retarded fetal growth. Kuizon et al[40], using a multiple-regression analysis, did not find any correlation between birth weight and maternal hemoglobin concentrations. However, anemic mothers had placental hypertrophy.

The prevalence of anemia in pregnancy in Sidi Bel Abbes remains high. This correlates with findings in other studies. The relative importance of anemia may, however, need to be reconsidered with regards to its bearing on adverse foetal outcomes, especially low birth weight. Other factors different from maternal hemoglobin concentration may play important roles in the determination of birth weights and must be further investigated.

Conclusion

Anemia is one of the most frequent complications related to pregnancy. Normal physiologic changes in pregnancy affect the hemoglobin (Hb), and there is a relative or absolute reduction in Hb concentration. The most common true anemia during pregnancy are iron deficiency anemia (approximately 75%) and folate deficiency megaloblastic anemia, which are more common in women who have inadequate diets and who are not receiving prenatal iron and folate supplements. Severe anemia may have adverse effects on the mother and the fetus. Anemia with hemoglobin levels less than 6 g/dl is associated with poor pregnancy outcome. Prematurity, spontaneous abortions, low birth weight, and fetal deaths are complications of severe maternal anemia.

Nevertheless, in the present study a mild to moderate iron deficiency does not appear to cause a significant effect on birth weight. There was no statistically significant difference in mean birth weight among the various hemoglobin groups suggesting that other parameters may play important roles in influencing birth weight than the maternal hemoglobin concentration.

Anemia, therefore, had no significant obstetric adverse effects in our pregnant population. Iron deficiency is quite frequent during third trimester of pregnancy in our population. A comprehensive research in our country is needed on how to improve existing iron supplementation programs and the overall health care and nutritional status of women before they enter their reproductive years.

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