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Full Length Research Paper

Iron supplementation during pregnancy and birth weight

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In this controlled prospective and longitudinal study, we explored among 92 pregnant women, the probable correlation between the epidemiological and socio-economic factors and the installation of anaemia. We were also interested in the effect of the iron supplementation on the modifications of the hematological parameters among anaemic pregnant women, the gestational age and the weight of the newborn child. However, an iron supplementation (of 30 mg/day) prescribed for all anaemic women (n = 40) throughout 4 months, made it possible to restore certain hematologic parameters. Indeed, at the supplemented group, the rates of hemoglobin and serum iron increased. Thus, a strong positive correlation was found between these two parameters (r = 0.89). The rate of the red blood cells (RBC) and the mean corpuscular concentration in hemoglobin (MCCH) increased significantly ($p < 0.05$) at the group of supplemented anaemic women. Any honest correlation was noted between the installation of anaemia and certain factors like the age (r = -0.11) and number of pregnancy (r = -0.30). The average gestational age was of 38.8 ± 1 WA among supplemented anaemic women, against 38.1 ± 1 WA among non-anaemic women ($p > 0.05$). The mean weight of the newborn was of 3170 ± 374 g in the group supplemented against 3,192 ± 291 g at the reference group ($p > 0.05$). According to our results, it appears that the iron supplementation improves some parameters haematologically, the age gestation and the weight of the new-born baby.

Key words: Pregnancy, iron, anaemia, supplementation, birth weight, gestational age.

INTRODUCTION

Iron Deficiency Anaemia (IDA) is the most common nutrient deficiency in the world (Yip, 1994). Pregnant women are at particularly high risk of iron deficiency anaemia. This may be related to high iron requirement during gestation because iron is necessary to cover basal iron losses, the increase in maternal red cell mass, and development of the fetus and placenta (INACG, 1981).

Estimates from the World Health Organization Report that from 35 to 75% (56% on the average) of pregnant women in developing countries, and 18% of women from industrialized countries are anaemic (WHO, 1992). According to recent studies, the prevalence of IDA in the first trimester ranges from 3.5 to 7.4%, and this rate increases from 15.6 to 55% in the third trimester (Allen, 1994). This is influenced by several epidemiological factors such as age, parity, short intervals between children, race and socio-economic status (Scholl and Hediger, 1994). Also, iron requirements during pregnancy are not easily satisfied by dietary intakes, which generally provide poor iron bioavailability (Galan et al., 1990; Galan et al., 1991).

When diagnosed early in pregnancy, IDA is associated with an increase frequency of preterm labour and low-birth weight infants (Scholl and Hediger, 1994). Based on these considerations, prophylactic supplementation of oral iron is advocated but remains a disputed issue (Hemminki and Starfield, 1978; Sifaskis and Pharmakides, 2000; Cogswell et al., 2003). Numerous studies showed beneficial effects of iron supplementation on hemoglobin concentrations and body iron stores in pregnant women (Fenton et al., 1977; Buytaert et al., 1983; De Benaze et al., 1989).

The present prospective and longitudinal study was undertaken to investigate changes in hematological status

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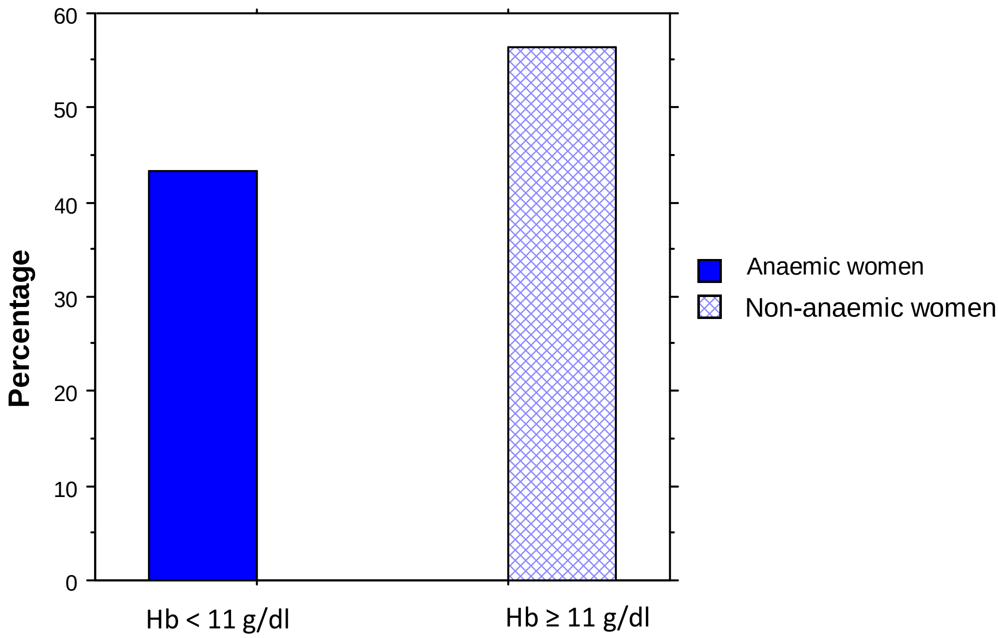

Figure 1. The distribution (%) of our sample (n = 92) in anaemic group (Hb < 11 g/100 ml) and non-anaemic group (Hb ≥ 11g/100 ml).

during the course of pregnancy in anaemic women with oral supplements (30 mg/day of iron), who were compared to non-anaemic and non-supplemented women, in order to assess the effect of martial treatment.

We were also interested in the effect of the iron supplementation on the weight of the new-born and the gestational age. The relation between anaemia and certain anthropometric factors, the socio-economic situation and the antecedent's gynecology-obstetrics was not neglected in this study.

MATERIALS AND METHODS

Our sample consists of 92 pregnant women aged 18 to 42 years. All women were selected between 10 ± 2 weeks and 26 ± 3 weeks of pregnancy during prenatal consultation in a mother and child-health center (MCH) of Sidi Bel Abbes (Algeria) between June (2009) and January (2010).

Their requirement was carried out on the basis of clinical data which allowed to exclude all those presenting complications like the diabets and rheumatism. For each pregnant woman, data of gynaecological and obstetric antecedents, age, parity, intervals between children, and socio-economic status were collected. The women were followed from 10 ± 2 weeks of pregnancy to 26 ± 3 weeks.

Two venous blood samples (10 ml) were obtained from each mother. The first was obtained at 10 ± 2 weeks of gestation, the second at 26 ± 3 weeks. For each sample, several assays were performed. Hemoglobin concentrations, haematocrit, mean corpuscular volume (MCV), were assayed by using a coulter counter (Standard meter analyzer ABX Micros 60-OT). Serum iron concentrations and total iron binding capacity were mesured with a colorometric method using the ferrozine reagent.

The gravity of anaemia in the mothers was classified in three stages, severe anaemia corresponding to hemoglobin lower than 7 g/dl, higher hemoglobin or equalizes to 7 g/dl but lower than 10 g/dl mark a moderate anaemia. Lastly, a higher hemoglobin or equalizes to 10 g/dl but lower than 11 g/dl defines a light anaemia.

According to our results, we prescribed to the women who showed an anaemia an iron supplementation (30 mg/day) in the form of ferro-iron.

We carried out the second taking away for two groups: anaemic women who received an iron supplementation, and non-anaemic women, in order to compare our results and evaluate the efficacity of the treatment, its effect on the gestational age and the weight of the newborn.

We also, examined the relation between the epidemiologic factors and installation of anaemia during pregnancy.

Statistical exploitation of the results was carried out by the Software Stat-View (1998). The statistical methods used are ANOVA test. The coefficients of correlation were evaluated by study of Pearson's correlation matrix. We used also the frequency distribution for variable nominal and continues and the complete descriptive statistics. The averages were compared with test of Students.

RESULTS

In the first quarter of pregnancy (10 ± 2 Weeks of amenorrhea), 40 women present an anaemia (Hemoglobin < 11 g/100 ml), among these 16 have a moderate anaemia (7 g/dl ≤ Hb <10 g/dl), 24 present a light anaemia (10 g/dl ≤ Hb <11 g/dl), while no case of severe anaemia was revealed (Figure 1).

As regards the characteristics of the sample (Table 1), we noticed that there is no significant difference between

Table 1. Anthropometric, socio-economic and gynéco- obstetrics data (average ± SD, number of subject) for the whole of the sample and comparison enters the anaemic women (supplemented Group) and the non-anaemic women (Reference group).

Parameter	Supplemented group (n = 40)	Reference group (n = 52)	P
Age (year)	29.1 ± 5.1	29.2 ± 5.2	NS
Parity	2.4 ± 1.2	2.6 ± 1.6	NS
Inter pregnancy spacing (year)	2.3 ± 2.5	2.2 ± 2.1	NS
Abortion number	0.4 ± 0.7	1.0 ± 0	NS
Duration of the feeding (month)	6.1 ± 7.7	6.3 ± 9.0	NS
Level of study	0	2	
Illiterates	24	30	NS (p > 0.05)
Primary			
Secondary	10	16	
University	6	4	

NS: non significatif.

the anaemic women (supplemented group n = 40) and the non-anaemic women (reference group n = 52).

Among 40 anaemic women, we did not reveal any honest correlation between the installation of anaemia and certain factors like the age (r = -0.11), the number of pregnancy (r = -0.30), or space intergenesic (r = 0.16).

Concerning the effect of the iron supplementation, among 40 anaemic women, three women presented a moderate anaemia; feel through in 16 Weeks of amenorrhea of their pregnancy.

The results of the various variables in maternal blood during the course of gestation in women with and without iron supplementation are summarized in Table 2.

Serum iron concentrations in non-supplemented women fall from 67.5 to 60.8 µg/100 ml between 10 ± 2 and 26 ± 3 weeks of pregnancy, for the same period in the group of supplemented anaemic women the concentrations increased from 45.6 to 46 µg/100 ml.

The total iron binding capacity (TIBC) levels rose in the treated as well in the non-supplemented group.

Hemoglobin values in treated women determined at 26 ± 3 weeks of pregnancy, were increased (1.1 g/dl) when compared to 10 ± 2 weeks of pregnancy, but this increase is weaker (0.3 g/dl) in the non-supplemented group.

Red corpuscule levels in treated women showed a significant ($p < 0.05$) increase between 10 ± 2 and 26 ± 3 weeks of gestation, whereas in non-supplemented group no significant increase could be demonstrated.

In the group of treated women, the mean corpuscular concentration in hemoglobin (MCCH) increases significantly ($p < 0.05$) between 10 ± 2 and 26 ± 3 weeks of pregnancy. Whereas at the group of non-supplemented women, this increase is light ($p > 0.05$).

Thus, the hematocrit (Ht), mean corpuscular volume (MCV) and mean corpuscular content of hemoglobin, remained almost at the same levels throughout pregnancy.

After supplementation, the number of the anaemic women was reduced from 40 to 5. The prevalence of anaemia in the first trimester (before beginning of the supplementation) was 43.4%, in the third trimester and after supplementation, it is reduced to 5.4% (Figure 2).

After the childbirth, we could noted that the average age gestational was of 38,8 ± 1 weeks of amenorrhoea among supplemented anaemic women dice the 10 ± 2 weeks of pregnancy (group supplemented n = 40), against 38.1 ± 1 weeks of amenorrhoea among non-anaemic women (reference group n = 52), ($p > 0.05$). The average weight of the newborn was 3170 ± 374 g in the group supplemented against 3192 ± 291g at the reference group ($p > 0.05$).

In the analysis of Test-T series not paired (ANOVA), we did not observe a connection significantly between the weight of birth and the degree of anaemia at the group supplemented (Moderate anaemia - light Anaemia ($p = 0.5424$)).

Indeed, We noted a small percentage of child weighing less 2500 g (5%) in the supplemented group.

DISCUSSION

Our study carried on a sample of pregnant women (n = 92) all followed in the center of mother and child-health center (MCH) of Sidi Bel Abbes.

In the present study we found 40 women among 92 during first trimester presented anaemia, the remainder, 52 women or 56.5% did not present anaemia. Indeed three months of pregnancy, nothing has allowed to maintain yet if this anaemia will persist or than all returns in order after a supplementation. This stage indeed the growth fetal and adaptation physiological due to the pregnancy hardly start and their repercussion on the iron statute of the mothers is not final. Can we speak about iron deficiency in three months of pregnancy?

Table 2. Variation of serum iron, TIBC, RBC, Hb, Ht, MCV and MCCH (mean ± DS) anaemic and non-anaemic women at the 1st and at the 3rd trimester (after iron supplementation).

Parameter	Group of non-anaemic women n = 52		Group of anaemic women (after supplementation) n = 40	
	1st trimester (10 ± 2 WA)	3rd trimester (26 ± 3 WA)	1st trimester (10 ± 2 WA)	3rd trimester (26 ± 3 WA)
Serum iron (µg/100 ml)	67.5 ± 23.6	60. 8 ± 15.0	45. 6 ± 23.4	46.0 ± 19.3
TIBC (µg/100 ml)	361 ± 122	376 ± 79	409 ± 117	422 ± 57.0
RBC (million/mm³)	4.07 ± 0.2	4.11 ± 0.4	3.7 ± 0.2	3.9 ± 0.5
Hb (g/100 ml)	12.6 ± 0.9	12.9 ± 1.18	10.2 ± 0.6	11.3 ± 1.5
Ht (%)	35.5 ± 2.9	35.2 ± 3.5	30.3 ± 1. 9	31.9 ± 4. 4
MCV (µ³)	87.1 ± 4.8	85.9 ± 3.4	80.3 ± 6.2	81 ± 8.4
MCCH (g/100 ml)	35.3 ± 1.5	36.6 ± 1.1	33.6 ± 1.5	35.2 ± 1.3

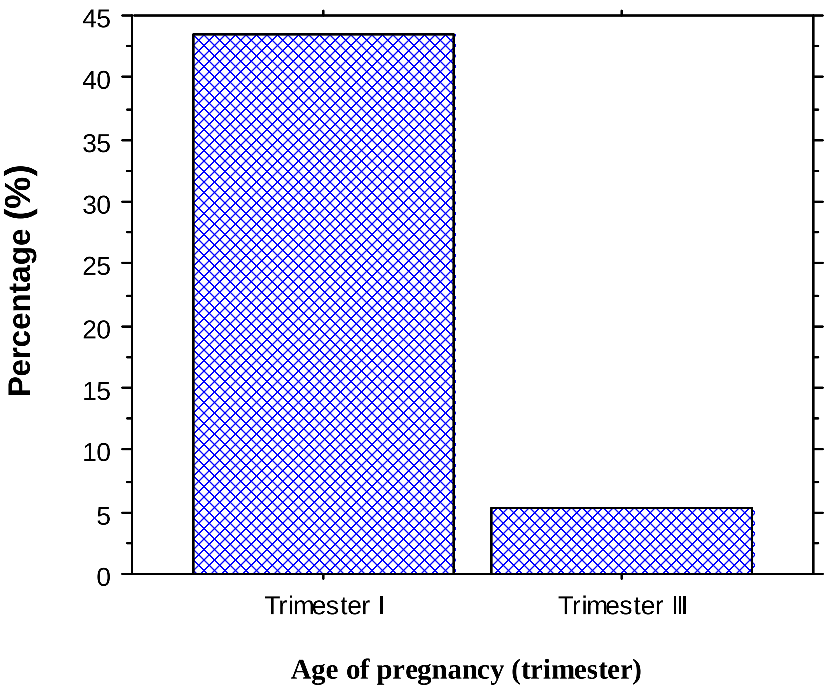

Figure 2. Prevalence of anaemia in the whole of the sample (N = 92) in function stage of pregnancy (after supplementation).

According to recent studies, the prevalence of Iron deficiency Anaemia in the first trimester ranges from 3.5 to 7.4% and this rate increases to 15.6 to 55% in the third trimester (Allen, 1994). This is influenced by several epidemiological factors such as age, race and socio-economic status (Scholl and Hediger, 1994).

Age of our patients does not seems to have an effect on the hematological parameters, indeed no correlation was found between age of our patients and the rate of hemoglobin (r = -0.11). However, we noted that the rate of serum iron, the rate of Hb and Ht is lower among old women between 18 and 22 years. Our results are in agreement with those of Meda et al. (1999), which showed after a study carried out on 248 women of Burkina Faso that the prevalence is not correlated with age (Meda et al., 1999). On the other hand an analysis of eight clinical studies carried out in United States showed that the old pregnant women of less than 20 years risked twice more be anaemic that the older women (Scholl et al., 1994). Thangleela and Vijayalakshmi (1994) confirmed this relation at the time of work on 194 having an age lower than 20 years, among which 81% are anaemic. However, the study of Galan et al. (1998), made on 6648 women, showed that the rate of hemoglobin increases significantly starting from 35 years old (Galan et al., 1998).

Our study showed a weak negative correlation between the rate of hemoglobin and number of pregnancy (r = - 0.30). According to an explatory study carrying on 826 pregnant with higher parity and old women between 12 and 29 years, it showed that 29.7% of women are anaemic (Allen, 1993). Thus, according to work of Thangleela and Vijayalakshmi (1994), it was shown that among 1040 pregnant women, 9.14% are multiparous, of which 9.7% are anaemic. In addition, it was shown that a weakens Iron Deficiency Anaemia at a primaparous women is rare outwards a deprives preexistence with origin food or in connection with significant menstruation (Afolabi and Akinola, 2004).

A weak correlation is noted between the rate of serum iron and the number of pregnancy (r = - 0.10). This negative correlation was observed by Monkaila et al. (1995), which related to 91 pregnant women on the level of MCH of Niamey, which showed a fall of the sideremy among women multiparous (Monkaila et al., 1995).

Concerning the effect of iron supplementation, we noticed an improvement of same hematologic parameters such as the rate of red blood cell (RBC) and the mean corpuscular concentration in hemoglobin (MCCH).

Thus, we noted that hemoglobin concentrations increase 1.1 g/dl between the first and third trimester. Iron supplementation appeared to prevent the physiologic fall in hemoglobin concentration, presumably by elevating erythrocyte volume (Taylor and Lind, 1976).

However, a strong positive correlation was found between serum iron concentration and hemoglobin levels among supplemented women (r = 0.89). This is in agreement with study of Chanarin and Rothman (1971), which showed an increase in hemoglobine levels from 1 to 1.7 g/dl among women supplemented (30 mg/day of iron), (Chanarin and Rothman, 1971).

According to a study made on 403 pregnant women, it was shown a significant ($p < 0.001$) increases in the mean hemoglobin of 0.85, 0.59 and 0.36 g/dl among supplemented women in the first, second and third trimesters (Abel et al., 2000).

Moreover, the study of Paul and al. (1994), realized on 55 anaemic pregnant women and the study of Wallenberg and Van Eijk (1984) realized out of 44 pregnant women, that of Haram et al. (2001) and Sloan et al. (2002), shows an impact of iron supplementation on improvement of maternal hemoglobin levels (Haram et al., 2001; Sloan et al., 2002). However, the study of Zavaleta et al. (2000) made on 645 pregnant women, showed that hemoglobin concentrations in supplemented anaemic were increased, whereas among non-anaemic and non-supplemented women, it decreases during pregnancy (Zavaleta et al., 2000).

In the present study, we found that prevalence of anaemia decrease respectively from 43.4 to 5.4%, among supplemented pregnant women in the first and third trimester of pregnancy. This was shown at the time of the study of Preziosis et al. (1997), made on 197 pregnant women selected at 28 weeks ± 21 day of gestation, the prevalence of IDA decreased markedly during the last trimester among supplemented women (Preziosi et al., 1997). Also, in the study of Scholl and Hediger (1994), we found that prevalence anaemia was 34% for the supplemented women, then it was 53% among not supplemented women (Scholl and Hediger, 1994).

However, a light increase in some hematological parameters (Hb, RBC, MCCH) seems to be shown in our study for women not receiving iron supplements, on the other hand, we have not noted an improvement for serum iron, the MCV and Ht. Indeed, the early decrease in the reserves can be explained by weak reserves dice the departure of pregnancy, and by their mobilization for an improvement of the maternal erythrocyte volume, while an improvement at the end of the pregnancy, in spite of the considerable needs for the fetus at this period, is probably due to increase in absorption of iron at the end of pregnancy which installs as the reserves decrease (Beard, 2001). But, it appears that this light increase was not sufficient to compensate the considerable needs.

For the total iron binding capacity levels, it increases at two groups (supplemented and non-supplemented women) and this can be due to an increase of the requirements out of iron concentrated over the last two trimesters.

According to results of our study, we can say and undoubtedly that the iron supplementation remains a good strategy for the prevention and treatments of iron deficiency anaemia during pregnancy. And sight reduction of the rate of hemoglobin and iron stores during the pregnancy, World Health Organization and several Advisory groups recommended an iron supplementation for all the pregnant women. Thus several recent studies show that the iron supplementation among the anaemic women improves the iron stores of the mother in postpartum and new-born infants (Allen, 2001; Kullander and Kallen, 1976).

The relation between maternal anaemia and birth weight has been reviewed more extensively elsewhere in this issue. In several studies, a U-shaped association was observed between maternal hemoglobin concentrations and birth weight (Cogswell et al., 2003).

Our results reveal that an iron supplementation of the encircled inanimate women dices the first quarter improves the born weight and the duration of the gestation. What confirms the study of Cogswell et al. (2003) made on 513 pregnant women, who showed that the iron supplementation (30 mg/J) dices the first quarter improve the weight of the newborn children and the duration of the gestation (Cogswell et al., 2003).

Supplementation with iron is generally recommended during pregnancy to meet the iron needs of both mother and fetus. When detected early in pregnancy, iron deficiency anaemia (IDA) is associated with a_2-fold increase in the risk of preterm delivery. Maternal anaemia when diagnosed before midpregnancy is also associated with an increased risk of preterm birth. Results of recent randomized clinical trials in the United States and in Nepal that involved early supplementation with iron showed some reduction in risk of low birth weight or preterm low birth weight, but not preterm delivery.

In a prospective, controlled cohort study in Sweden, Kullander and Kallen collected data on 6,376 women in Malmo in 1963 to 1965 (Knottnerus et al., 1990). They found that women who took iron and vitamin supplements were significantly less likely to give birth before 38 weeks (6 to 9% of births) than women who did not use such supplements (11 to 13% of births).

The birth weight of boys (but not girls) was significantly higher in women who took iron and vitamins than in those who took no supplements. However, without proper control for confounding variables, it is difficult to know whether women who took iron supplements had other characteristics (for example,. healthier lifestyle) that reduced their risk of adverse outcomes. Conversely, a Dutch prospective study indicated no association between low maternal hemoglobin and adverse perinatal outcomes (Knottnerus et al., 1990).

Conclusion

IDA is a nutritional issue that can have serious consequences if not diagnosed and treated early enough. Educating women about the proper use of iron supplements, why iron is important to baby, and providing counselling on good food sources of iron is essential. In reality, however, it is difficult to always eat properly and remember to take supplements. Social and economic barriers need to be discussed in order to improve outcomes for women and their infants.

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