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Prevalence of Anemia among Jordanian Pregnant Women and the Effect of Early Pregnancy on Alkaline Phosphatase Activity

Mohammad A. Salahat and Abdallah I. Ibrahim*

Zarqa University, Faculty of Allied Medical Sciences, Department of Medical Technology. P.O. Box 132222, Zarqa, 13132, Jordan

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Abstract

A cross-sectional study was conducted on 1030 pregnant women in the age of 16-40 years for the assessment of their hemoglobin status. One hundred pregnant women in their first trimester were selected from the whole sample to study the effect of their pregnancy on alkaline phosphatase activity. The overall prevalence of anemia and the mean hemoglobin (Hb) concentrations in the investigated sample were found to be 56.7% and 9.8±1.4g/dL, respectively. The highest prevalence of severe anemia was found among pregnant women of the Eastern region as well as among pregnant women of third trimester. The prevalence of anemia was found lower among pregnant women in the developed region (Amman; 41.4%) than in other less developed regions in particular Eastern, Southern and Western being 54.0%, 63.4% and 67.9%, respectively. The obtained results of the study also showed that anemia was greater among pregnant women of age 16-19 years. Anemia was of higher prevalence among multipara than among primigravida. Prevalence of anemia was greater the more advanced the gestation. The activity of alkaline phosphatase was normal in 80.0% of the investigated sample, where as 20.0% of the sample showed extremely high concentrations of alkaline phosphatase. The significant increase in alkaline phosphatase activity ($p<0.01$) accompanied the early pregnancy complications such as diabetes mellitus, preeclampsia, proteinuria and diabetes with hypertension. This suggests that alkaline phosphatase activity could be used as a monitor for status of pregnancy in its first trimester.

k**eywords:** Anemia, pregnancy, alkaline phosphatase activity, Jordan.

1. Introduction

Iron deficiency anemia is a problem of serious public health affecting more than 700 million in the world (Dawood *et al*., 1990). It is considerably more prevalent in the developing than in the industrialized world, being 59% in the developing region and 14% in the developed region with global prevalence 51% (DeMaeyer, 1989). Anemia is the second highest cause of maternal mortality in Asia (Sanghvi *et al.*, 2010).

Pregnancy constitutes a major drain on the iron reserves of women. The loss of iron in normal pregnancy, delivery and lactation shifts the balance of reproductive women to the side of negative iron balance (Passmore and Eastwood, 1986; Halper, 1987). In pregnant women, iron deficiency increases the risk for a preterm delivery and delivering a low birth-weight baby (CDC, 1998; Banhidy *et al*., 2011). Studies on iron deficiency anemia among pregnant women in some countries revealed prevalence of 78% in Liberia (Jackson and Lantham, 1982), 73.9% in Guyana (Johnson *et al.*, 1982), 61% in Jamaica (Simmons *et al*., 1982), 50.0% in Bahrain (Aldallal, 1984), 39.7% in Kuwait (Dawood *et al.,* 1990), 44.9% versus 31.1% in the Gaza Strip and the West Bank, respectively (Khader *et al.*, 2009), 32.6% in China (Zhang *et al.*, 2009) and 89.8% in Monchegorsk, Russia (Chumac and Grjibovski, 2010).

Iron supplementation during pregnancy raises and maintains the serum ferritin above 10 µg/L, thus, resulting in a substantial reduction in proportion of women with hemoglobin level below 10 or 10.5 g/dL in late pregnancy (Mahomed, 1997; Sloan *et al*., 2002). The bone and placental alkaline phosphatase have been identified as the source of the increase in alkaline phosphatase activity in normal pregnancy in its second and third trimesters, respectively (Okesina *et al.*, 1995). Fenuku and Foli (1975), reported significant decrease in the concentration of alkaline phosphatase in the second trimester and an increase in the third trimester of pregnancy. Aleem (1972) suggested that the increase in alkaline phosphatase activity may accompany threatened abortion. Very low activities of alkaline phosphatase in first trimester indicated affected fetus (Muller *et al.*, 1991). Rosenau *et al*. (1994) reported greater elevation of alkaline phosphatase in cases of vomiting during first trimester.

The main aim of this study was to assess the hemoglobin status in Jordanian pregnant women and the impact of pregnancy duration and repeated pregnancies on the prevalence of anemia among pregnant women. This study was also concerned with the effect of pregnancy in its first trimester on the activity of alkaline phosphatase.

* Corresponding author: abdallahibrahim@windowslive.com

2. Materials and Methods

2.1. The Sample

A representative sample of 1030 pregnant women in the age of 16-40 years was randomly selected from four health regions of the country.

2.2. Technique

2.2.1. Collected data and blood samples

A questionnaire was completed for each pregnant investigated woman and the following data was collected:

- Age at pregnancy
- Duration of present pregnancy
- Total number of pregnancies Every woman investigated was requested to offer a finger prick capillary blood sample.

2.2.2. Determination of hemoglobin (Hb) concentration

Assessment of hemoglobin concentration was carried out by cyanmethemoglobin technique (Makarem, 1974).

2.2.3. Cut-off level of anemia

The World Health Organization (1972) cut-off level for diagnosis of anemia among pregnant women was used in the present study.

Anemia was categorized into three classes of severity:

- Severe: Hb. concentration < 8.0 g/dL
- Moderate: Hb. Concentration 8.0-9.0 g/dL
- Mild: Hb. concentration 9.0-10.9 g/dL

2.2.4. Determination of alkaline phosphatase activity

Blood samples were collected from 100 pregnant women in their first trimester. The serum was separated from each blood sample upon centrifugation at 2500 rpm for 10 minutes. Alkaline phosphatase activity was determined according to the procedure of American Association for clinical chemistry (Tietz, 1983). The reference range of alkaline phosphatase activity was 26.0-99.0 UIL at 30°C.

2.2.5. Statistical Analysis

All the statistical analyses were performed using the *student t test*.

3. Results

Table 1 shows the prevalence of anemia and the mean hemoglobin concentrations among Jordanian pregnant women in different regions of the country. The lowest prevalence was observed in the capital Amman (41.4%; mean Hb concentrations 11.4 ± 1.2 g/dL) and become higher in the Eastern (54.0%; mean Hb concentrations 9.5 ± 1.4 g/dL), Southern (63.4%; mean Hb concentrations 9.1 ± 1.5 g/dL), and Western (67.9%; mean Hb concentrations 9.3 ± 1.3 g/dL). The differences were found to be statistically significant (P <0.01). Eastern region showed highest prevalence of severe anemia (4.4%).

Table 1. Prevalence of Anemia among Pregnant women in different regions of Jordan

Region	Anemic (%)				Non-Anemic (%)	Hb (Mean ± SD) (g/dL)	No. of Sample
	Severe	Moderate	Mild	Total			
Amman (Capital)	0.0	6.3	35.0	41.4	58.6	11.4 ± 1.2	400
Eastern	4.4	15.2	48.0	54.0	46.0	9.4 ± 1.4	120
Southern	3.0	12.6	43.0	63.4	36.6	9.1 ± 1.5	150
Western	0.0	5.2	52.0	67.9	32.1	9.3 ± 1.3	360
Mean	1.85	9.8	45.0	56.7	43.3	9.8 ± 1.4	
Total							1030

Table 2 represents the prevalence of anemia and the mean hemoglobin concentration by duration of pregnancy. The overall prevalence of anemia was found to be 47.0% during the first trimester (mean Hb concentration 11.0 ± 1.6 g/dL), 56.1 % during the second trimester (mean Hb concentration 10.1 ± 1.3 g/dL) and 66.9% during the last trimester (mean Hb concentration 8.7 ± 1.4 g/dL), which also showed a higher prevalence of severe anemia.

A statistically significant increase (P<0.01) was found between the prevalence of anemia during the second and third trimesters versus the first trimester.

Table 2. Prevalence of Anemia among Pregnant women by duration of pregnancy

Pregnancy Duration	Anemic (%)				Non-Anemic (%)	Hb (Mean ± SD) (g/dL)	No. of Sample
	Severe	Moderate	Mild	Total			
First Trimester	0.3	7.2	39.5	47.0	53.0	11.0 ± 1.6	305
Second Trimester	2.1	9.6	44.4	56.1	43.9	10.1 ± 1.3	515
Third Trimester	3.2	12.6	51.1	66.9	33.1	8.7 ± 1.4	210
Mean	1.86	9.8	45.0	56.7	43.3	9.9 ± 1.4	
Total							1030

The prevalence of anemia among pregnant women and mean hemoglobin concentrations by the number of pregnancies are shown in table 3. A statistically different increase (P<0.01) was found between the overall prevalence of anemia in Multipara women (64.0%) compared to primigravida women (49.3%). The mean hemoglobin concentration was found to be 11.0 ± 1.4 g/dL for primigravida, but, it decreased to 8.7 ± 1.3 g/dL for multipara women. The prevalence of anemia among pregnant women by pregnancy age was demonstrated in table (4). The prevalence was greater among pregnant women of ages 16-19 (70%).

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Table 3. Prevalence of Anemia among pregnant Women by Number of Pregnancies

Parity	Anemic (%)				Non-Anemic (%)	Hb (Mean ± SD) (g/dL)	No. of Sample
	Severe	Moderate	Mild	Total			
Primigravida	1.6	7.2	40.5	49.3	50.7	11.0 ± 1.4	385
Multipara	2.1	12.4	49.5	64.0	36.0	8.7 ± 1.3	645
Mean	1.85	9.8	45.0	56.7	43.3	9.9 ± 1.4	
Total							1030

Table 4. Prevalence of Anemia among Pregnant women by Pregnancy Age

Pregnancy age (year)	Anemic (%)				Non-Anemic (%)	Hb (Mean ± SD) (g/dL)	No. of Sample
	Severe	Moderate	Mild	Total			
16-19	2.3	12.4	55.3	70.0	30.0	9.5 ± 1.6	130
20-23	1.8	10.2	47.5	59.5	40.5	10.5 ± 1.3	230
21-27	2.6	9.3	38.5	50.4	49.6	9.1 ± 1.4	210
28-31	3.1	10.9	48.5	62.4	37.6	8.9 ± 1.2	220
32-35	1.3	11.5	35.5	48.3	51.7	10.7 ± 1.3	151
36-40	0.0	4.5	44.8	49.3	50.7	11.5 ± 1.3	89
Mean	1.85	9.8	45.0	56.7	43.3	10.0 ± 1.4	
Total							1030

Table 5 shows the effect of pregnancy in its first trimester on alkaline phosphatase activity. Eighty percent of the investigated sample (n=100) showed normal levels of alkaline phosphatase activity (78.3 ± 12.5 U/L), whereas 20.0% showed extremely high levels of alkaline phosphatase activity (146.1 ± 8.8 U/L).

Table 5. Mean Alkaline Phosphatase Activity in Different Types of Early Pregnancy Complications

No. of Sample	Complications	(%)	Alkaline Phosphatase Activity (Mean ± SD) (U/L)
7	Diabetes Mellitus	7	125.0 ± 8.5
3	Pre-eclampsia	3	172.3 ± 8.1
4	Proteinuria	4	155.5 ± 11.2
6	Diabetes Mellitus and Hypertension	6	131.7 ± 7.4
80	No complication	80	78.3 ± 12.5

4. Discussion

The lowest prevalence of anemia among Jordanian pregnant women was observed in the capital Amman (41.4%; mean Hb concentrations 11.4 ± 1.2 g/dL), while it was higher in the Eastern (54.0%; mean Hb concentrations 9.5 ± 1.4 g/dL), Southern (63.4%; mean Hb concentrations 9.1 ± 1.5 g/dL), and Western (67.9%; mean Hb concentrations 9.3 ± 1.3 g/dL). These differences were statistically significant (P <0.01). Eastern region showed the highest prevalence of severe anemia (4.4%). Despite the fact that iron supplementation is given to pregnant women as part of the health management program in Jordan, prevalence of anemia was observed. That is most often due to willfully reduced total intake of food, increased consumption of highly refined food or food fads (Halper, 1987; Dawood *et al.*, 1990; Gharaibeh *et al.*, 2005).

The overall prevalence of anemia by duration of pregnancy was found to be 47.0% during the first trimester (mean Hb concentration 11.0 ± 1.6 g/dL), 56.1 % during the second trimester (mean Hb concentration 10.1 ± 1.3 g/dL) and 66.9% during the last trimester (mean Hb concentration 8.7 ± 1.4 g/dL), which also, showed the highest prevalence of severe anemia.

This trend is consistent with the reports of previous studies (Jackson and Lantham, 1982; Johnson *et al.*, 1982; Simmons *et al*., 1982; Aldallal, 1984; Dawood *et al*., 1990; Charles *et al.*, 2010). A statistically significant increase (P<0.01) was detected between the prevalence of anemia during the second and third trimesters compared to the first trimester.

The overall prevalence of anemia by the number of pregnancies was found to be higher in Multipara women (64.0%) than among primigravida women (49.3%). The difference was statistically significant (P<0.01). This is consistent with previous results (Mirzaie *et al*., 2010; Al-Farsi *et al*., 2011; Taseer *et al.*, 2011). The overall mean hemoglobin concentration was found to be 11.0 ± 1.4 g/dL for primigravida, but it was decreased to 8.7 ± 1.3 g/dL for multipara women.

The prevalence of anemia among pregnant women by pregnancy age was greater among pregnant women of age 16-19 (70%), which is consistent with the data reported by Banerjee *et al.* (2009).

The above-stated findings of the present study showed 56.7% prevalence of anemia among Jordanian pregnant women. Iron deficiency anemia is more frequent in women of high parity. Although iron supplementation is given to pregnant women, it seemed that Jordanian pregnant women were not in a state of excellent nutrition. Therefore, their pregnancy ended with an iron deficit. If the pre-pregnancy nutrition is suboptional, anemia develops that might cause a reduction in iron stores in infant (Halper, 1987; Kilbride *et al*., 2000).

The effect of pregnancy in its first trimester on alkaline phosphatase activity showed that eighty percent of the investigated sample (n=100) had normal levels of alkaline phosphatase activity (78.3 ± 12.5 U/L), whereas 20.0% showed extremely high levels of alkaline phosphatase activity (146.1 ± 8.8 U/L) (1.5 fold increase). High increase in alkaline phosphatase activity may be taken as a complication of pregnancy such as hypertension, pre-eclampsia and eclampsia (Jamjute *et al*., 2009) and linked to preterm delivery (Bashiri *et al*., 2007; Grgic and Bogdanovic, 2009). The 20% of the pregnant women who showed high alkaline phosphatase activity complained of diabetes mellitus (7 cases), pre-eclampsia (3 cases), proteinuria (4 cases), and diabetes mellitus with hypertension (6 cases). The highest increase in alkaline phosphatase activity was among pregnant women with pre-eclampsia (172.3 ± 8.1 U/L) as shown in table 5.

Those findings clearly demonstrate a distinct relation between the existence of pregnancy complications and alkaline phosphatase activity!!! Therefore, it is recommended that alkaline phosphatase activity should be determined not only in the second and third trimesters, but also, in the first trimester of pregnancy.

5. Conclusion

The prevalence of anemia among Jordanian pregnant women was found to be relatively high. The high prevalence of anemia is a warrant for an in-depth study for the determination of the risk factors and for the development of a nutrition intervention action program directed towards pregnant women to combat iron deficiency anemia. Iron supplementation has to be joined with a nutritional education program directed towards pregnant women with special emphasis on:

1. The importance of a balanced diet and of iron-rich food.
2. The use of foods which enhance the absorption of iron.
3. The benefits of the proper use of iron tablets.

Alkaline phosphatase activity is found to be a good indicator for early pregnancy status. Therefore, it is recommended to use alkaline phosphatase as one of the routine clinical tests for pregnant women.

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