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PREGNANCY OUTCOME AND THE EFFECT OF MATERNAL NUTRITIONAL STATUS

By
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Abstract

To assess the prevalence of malnutrition among Egyptian pregnant women and its effect on the pregnancy outcome, a comparative cohort study in which a total of 206 normal pregnant and 197 babies born to the pregnant subjects were enrolled. The study was conducted in El Sahel Teaching Hospital, Cairo, Egypt. Maternal anthropometry, blood parameters including hemoglobin (Hb) concentration, serum iron, total iron binding capacity (TIBC) and serum albumin were assessed. Patients were classified into 3 groups based on hemoglobin concentration. Pregnancy outcome was assessed by means of birth weight, length and Apgar score at birth.

The mean Hb serum iron concentration, total iron binding capacity, and serum albumin were 10.332, 73.84, 382.74, & 3.846g/dl respectively; and 46% of the subjects were anemic. When subjects were classified into 3 groups based on the Hb levels, 16% fell into severe anemia category, while 30% of the subjects fell into mild anemia category. Statistically significant differences were found between each of maternal age & pre pregnancy BMI on one hand and the degree of anemia on the other hand. Comparisons between pregnancy outcomes in the three groups showed a statistically significant difference between gestational age, birth weight, birth length and Apgar score on one hand and the degree of anemia on the other hand. The incidence of preterm labor was much higher (65.6%) in the group of severe anemia than the other two groups.

Key words: Egypt, Nutrition status, Pregnancy outcome.

Introduction

The period of intrauterine growth and development is one of the most vulnerable periods in the human life cycle (Muthayya, 2009). Pregnancy associated with physiologic changes result in increased plasma volume, red blood cells, decreased concentrations of circulating nutrient-binding proteins and micronutrients (Brown *et al*, 2013). In many developing countries, these physiologic changes can be aggravated by under-nutrition, leading to micronutrient deficiency states, such as anemia, that can have disastrous consequences for both mothers and newborn infants (Ladipo, 2000).

Globally, fifty six million pregnant

women are affected with anemia, mostly due to iron deficiency (Sato and Fujimori, 2012). In developing countries, this proportion can be 80% that led to other perinatal complications like preeclampsia, low birth weight, prematurity and perinatal mortality (Kumar et al, 2007). Most vulnerable and least educated are disproportionately affected by iron deficiency, and stands to gain the most by its reduction (Jabeen *et al*, 2011). During pregnancy, the demand for iron clearly increases due to the necessity for an increase in the mass of red blood cells, increase in plasma volume and the demand of the developing fetus for this component (Scholl, 2005).

The weight of the infant at birth is a powerful predictor of infant growth and survival, and is dependent on maternal health and nutrition during pregnancy (Wilcox *et al,* 2011).

The low birth weight is complex and interdependent, but the anthropometry of the mother and her nutritional intake are thought to be among the most important. Pre-pregnancy weight, body mass index (BMI) and gestational weight gain all have strong, positive effects on fetal growth suggesting that energy balance is an important determinant of birth outcomes (Kruse *et al*, 2012).

This study aimed to assess the association between maternal nutritional state and pregnancy outcome.

Patients, Materials and Methods

The comparative cohort study included 206 normal pregnant women with 197 newborn infants born alive to them, admitted to Al Sahel Teaching Hospital in Obstetrics and Gynecology department for labor in the period from august 2010 up to January 2011.

Normal pregnancy criteria: 1- No pregnancy complications. 2- Did not receive medications (except vitamins and minerals' supplements). 3- No pregravid chronic disease. 4- Received antenatal care in or outside the hospital.

The research protocol was approved by the Ethical Committee of Al Sahel Hospital and informed consent forms were obtained from all subjects.

Pregnant subjects were subjected to: 1- History taking with special attention to education level (number of education years), dietary habits, supplementation with vitamins and minerals during pregnancy. 2-Anthropometric data: Heights were measured by a stadiometer, self-reported pre-pregnancy weight recorded and pre-pregnancy body mass index (BMI) calculated. 3- Blood parameters: Hemoglobin (Hb) level, serum iron concentration, total iron binding capacity (TIBC) and serum albumin. 4- Pregnancy outcomes: Birth weight, height & Apgar score of newborn infants at 1 & 5 minutes immediately following delivery were reported from the initial assessment sheet at birth. 5- Birth weight <2500g was considered as low birth weight and gestational age less than 37 weeks was considered as preterm labor. 6- Fasting, peripheral venipuncture blood samples were also collected. Analysis of maternal serum was tested immediately. Hb conc. was measured by a Hemocue (AB Angelhom, Sweden). Serum total iron binding capacity (TIBC) was measured by Nitrose-Point Subtraction Aggression Paradigm using autobiochemical analyzer (Hitachi 7150, Japan), and serum concentration of albumin and iron were assessed by using Vitros DTSCII (Johnson & Johnson, USA). 7- They were categorized due to Hb concentration into 3 groups: No anemia: Hb>10.5 g/dl, mild anemia Hb =8-10.5 g/dl, Severe anemia Hb< 8 g/dl.

Statistical analysis: Data were described as mean ± standard deviation (±SD) and range, or frequencies (number of cases) and percentage when appropriate. Comparison of numerical variables among groups was done using one-way analysis of variance (ANOVA) test with posthoc multiple 2-group comparison. For categorical data, chi square ($\chi 2$) test was performed. Exact test was used when the expected frequency was less than 5. Correlation between various variables was done by Pearson moment correlation equation for linear relation. P value less than 0.05 was considered statistically significant. All data were done using computer programs SPSS (Statistical Package for Social Science; Inc., Chicago, USA) version 15 for Microsoft window.

Results

The mean age of mothers was 27.6 years (20-35), were from the upper-middle socioeconomic class judged by education levels, with a mean of 13.67 education years, and a mean pregnancy BMI of 24.85 kg/ m2. Mean serum albumin was 3.846 g/dL showing normal nutritional status. Mean Hb was 10.332 g/dl, below normal range. Mean serum iron was 73.84mcg/dl, & mean TIBC was 382.74 mcg/dl, within normal ranges. Sixteen percent suffered severe anemia, and 30% had mild anemia.

Mean neonatal weight was 3.1475 kg, length was 52.22 cm and the mean gestational age was 38.04 weeks; all of them within the average range. Mean for Apgar score at 1& 5 minutes was in the average indicating that general condition of the newborns was good.

Table 1: General characteristics of subjects

Demographics	Mean ± SD
Age (years)	27.62 ± 4.143
Gravidity (n)	1.42 ± 1.249
Pre-pregnancy BMI (kg/m2)	24.85 ± 5.171
Education (years)	13.67 ± 2.611
Biochemical status	
Albumin (g/dl)	3.846 ± 0.5006
Serum Iron (mcg/dl)	73.84 ± 31.056
Serum TIBC (mcg/dl)	382.74 ± 88.055
Hb (g/dl)	10.332 ± 0.9773
Distribution according to Hb level	
Severe anemia (Hb < 8 g/dl)	7.653 ± 0.3261
Mild anemia (Hb = 8-10.5 g/dl)	9.942 ± 0.2424
No anemia (Hb > 10.5 g/dl)	11.046 ± 0.4695
Pregnancy outcome	
BW (Kg)	3.1475 ± 0.39498
BL (cm)	52.22 ± 2.023
GA (weeks)	38.04±1.428
Apgar 1	7.05 ± 1.043
Apgar 5	9.42 ± 0.578

Values= mean ± SD, BMI=body mass index, TIBC=total iron binding capacity, Hb=hemoglobin, BW=birth weight, BL=birth length, GA=gestational age.

When subjects were classified into three Hb groups; maternal serum albumin of the severe anemia group (3.622g/dl) was significantly lower than no anemia group (3.974 g/dl), even though the values were in the normal range for both groups (Tab. 2). Mean Hb, TIBC and serum iron in severe anemia group was 7.653g/dl, 507mcg/dl and 37.66mcg/dl respectively. The severe anemia group showed significantly lower values of Hb, serum iron and also showed significantly higher TIBC than the mild anemia and no anemia groups. All these indices strongly suggested that the subjects in this group were in iron deficient state.

Table 2: Biochemical characteristics of subjects:

Maternal serum	All	Severe Anemia Gp (Hb<8 g/dl)	Mild Anemia Gp (Hb=8-10.5 g/dl)	No Anemia (Hb>10.5g/dl)	P value
Hb (g/dl)	10.332±0.9773	7.653±0.326	9.942±0.2424	11.046±0.4695	0.000*
TIBC (mcg/dl)	382.74±88.055	507.88±32.543	412.98±75.774	328.85±53.111	0.000*
Iron (mcg/dl)	73.84±31.056	37.66±15.745	59.47±20.883	92.54±24.925	0.000*
Albumin (g/dl)	3.846±0.5006	3.622±0.4937	3.735±0.4672	3.974±0.4866	0.000*

Gp= group, *Statistical significant difference

Statistically significant differences were found between each of maternal age & pre pregnancy BMI on one hand and the degree of anemia on the other hand (Tab. 3). Comparisons between pregnancy outcomes in the three groups showed a statistically significant difference between GA, BW, BL and Apgar score on one hand and the degree of anemia on the other hand (Tab. 3). The incidence of preterm labor was much higher (65.6%) in the group of severe anemia than the other two groups.

Table 3: Maternal characteristics and pregnancy outcomes in relation to anemia degree:

Maternal characteristics	All	Severe Anemia Gp (Hb <8 g/dl)	Mild Anemia Gp (Hb=8-10.5 g/dl)	No Anemia (Hb >10.5g/dl)	P value
Gravidity	1.42±1.249	2.34±1.310	1.68±1.157	0.99±1.089	0.000*
Maternal age(yr)	27.62±4.143	28.66±3.730	28.65±3.569	26.73±4.376	0.004*
Pre-preg BMI	24.85±5.171	27.25±6.730	26.78±4.823	23.06±4.092	0.000*
Pregnancy outcome					
GA(weeks)	38.04±1.428	36.25±1.503	37.68±0.813	38.77±1.099	0.000*
BW(kg)	3.1475±0.3949	3.273±0.3124	3.219±0.3342	3.0702±0.43195	0.009*
BL(cm)	52.22±2.023	50.22±2.106	51.73±1.561	53.08±1.703	0.000*
Frequency of LBW	7%	10.2%	3.3%	3.1%	0.160
Frequency of preterm	13%	65.6%	5%	1.9%	0.000*
Apgar score					
1min	7.05±1.043	6.56±1.243	7.05±1.048	7.19±0.939	0.012*
5min	9.42±0.578	9.22±0.659	9.23±0.533	9.57±0.533	0.000*

yr=year, preg=pregnancy, GA=gestational age, BW=birth weight, BL=birth length, LBW=low birth weight, min=minute, Gp= group.*Statistically significant difference

Discussion

In the present study, the mean albumin, serum iron, TIBC and hemoglobin of the pregnant mothers were all within an average, and also the clinical parameters for the neonates were within normal range. When the study subjects were classified into 3 groups according to Hb level, women in the group with severe anemia had an older age and increased gravidity compared to the other two groups. This strongly suggests that repeated pregnancies together with negligence of healthy dietary habits, vitamin supplementation, and proper spacing of pregnancy leads to exhaustion of the body stores of maternal micronutrients, which causes anemia.

It was obvious that mothers with severe anemia had higher body mass index than the other two groups. So, the prevalence of malnutrition in the present subjects was probably due to low iron intake and poor dietary habits rather than food insecurity or disease. Anemia is an indicator of both inadequate nutrition and poor health status (Sifakis and Pharmakides, 2000). The prevalence of anemia was 46%. This result agreed with 32%-55% reported in Egypt by Gadallah *et al.* (2002) and in other developing countries; it was 34.7% in Jordan (Al-Mehaisen *et al,* 2011), 50% in Bangladesh (Hyder *et al,* 2004), and 57% in rural areas of South Africa (Hoque *et al,* 2007).

In the current study, the pregnant women with severe anemia had the lowest gestational age for their borne babies with a very high incidence of preterm labor (65.6%). This agreed with the study done on Korean pregnant women (Lee *et al,* 2006). Anemia in pregnancy was associated with unfavorable outcomes of delivery specially increased maternal and fetal mortality, an increased risk of premature delivery, and low birth weight of a newborn (Tsai *et al*, 2012).

The level of iron in the fetus depends on its level in the mother blood; its deficiency in a pregnant woman caused its lower content in the organism of a newborn after birth (Singla *et al,* 1996). There was strong evidence that maternal anemia in early pregnancy increases the risk of preterm low birth weight (Zhou *et al,* 1998). The same findings were also shown (Rush, 2000; Scanlon *et al,* 2000; Brabin *et al,* 2001; Sehgal *et al,* 2003; Marchant *et al,* 2004). On the other hand, there was no association between anemia and preterm birth during the 3rd trimester, in other studies (Klebanoff *et al,* 1989, 1991).

In the present study, significant difference was found between severity of anemia and Apgar score. Lone *et al*. (2004) reported association between low maternal Hb level and Apgar score <5 at 1 minute, the index of health status of newborn babies (Lone *et al,* 2004). These results agreed with that of Yip (2000).

In the present study, there was statistical difference between the three groups regarding the neonatal body weight. This means that low Hb level significantly contributes to low birth weight. The present study showed also that birth weight was affected by many factors besides maternal Hb status as maternal age and maternal body weight. The result agreed with Denguezli *et al,* (2007).

Generally speaking, parasites affect tens of millions of pregnant women worldwide, which lead directly and indirectly to a spectrum of adverse maternal and fetal/placental effects. With the increase in global travel, health-care providers will care for women who have recently moved from or traveled to areas where these infections are endemic. Malaria contributes to poor pregnancy outcomes of prematurity & fetal intrauterine growth retardation (El-Bahnasawy *et al,* 2010). Many liver parasites and gastrointestinal parasites lead to severe anemia particularly in pregnancy (Ali *et al*, 1990; Morsy and Al-Mathal, 2011).

Sabry and Fouad (2012) stated that a woman's nutritional status should be assessed preconception with the goal of optimizing maternal, fetal, and infant health. The pregnancy-related dietary changes should begin prior to conception, with appropriate modifications across pregnancy and during lactation. The Recommended Dietary Allowanc ommended by an expert IOM panel based on extensive evaluation of available scientific evidence and mathematically adjusted to meet the needs of up to 97% of the population. Aimonhe *et al*. (2013) stated that malaria and anemia are important health problems among children and pregnant women globally, with anemia prevalence tended to vary inversely with greater or poorer access to community services.

Besides, Egyptian pregnant women are advised to avoid raw fresh green vegetables, raw milk and light cooked meat and fish, all are sources of zoonotic parasites (El-Shafie *et al*, 2011) and microbial diseases (Abo-Madyan *et al*, 2004) and to avoid pet dogs and cats (Haridy *et al*, 2009; Sabry *et al*, 2012).

Conclusion

Substantial proportion of the Egyptian pregnant women was vulnerable to anemia, mainly due to iron deficiency. Infants born to women with low Hb levels had lower gestational age, birth weights, heights, and Apgar scores. Anemia was mainly due to unhealthy dietary habits rather than food insecurity or disease. The maternal Hb level was a good predictor of prognosis of pregnancy outcome.

The infants born to anemic women showed a lower birth weight, length and Apgar scores. The BMI was high in the women with severe anemia. Consequently, the prevalence of malnutrition was probably due to low iron intake and poor dietary habits rather than food insecurity or disease.

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