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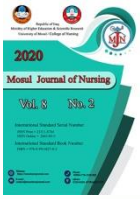

The Association of BMI, smoking, caffeine consumption and folic acid supplementation with hemoglobin levels in third trimester pregnant women in Erbil city

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Abstract

Background and Aim: Pregnancy induces some physiological changes in hemoglobin (Hb) level. In addition, multiple factors are influencing the Hb level such as dietary intake of iron and folic acid before and during pregnancy, smoking, the amount of caffeine consumption, body mass index (BMI) and visiting prenatal health centers. The study aimed to determine the percentage of anemia among third trimester pregnant women and the relation of these factors with anemia.

Materials and Methods: This cross sectional study was conducted from October 2019 to February 2020 on 288 pregnant women aged (17- 48 years) with various gestational ages in third trimester (28 - 42weeks), who attended different primary health centers in Erbil city, Iraq. The data were collected by face to face interview and the questioner was designed. Their hemoglobin concentration was measured by testing the peripheral venous blood and their BMI before and during pregnancy was calculated using the pregnant self-reported pre-pregnant weight and their weight and height during pregnancy. Data was entered to Microsoft Excel 2016 then analyzed by the statistical package for the social sciences (SPSS) version 22.

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Results: The results showed a significant relationship between Hb level and folic acid supplementation, caffeine consumption, routine prenatal visits, and smoking. No significant relationship was found between BMI and Hb level.

Conclusion: This study concluded that anemia was found more in those who were not consuming folic acid supplementation, smokers, consuming coffee or tea after meals and they did not visit health center routinely. No significant relationship was found between BMI and Hb level.

Recommendations: Encourage pregnant women to do routine checkup, consuming folic acid supplementation before conceiving and during pregnancy, and avoid smoking and caffeine consumption.

Key words: Pregnancy, Hemoglobin, BMI, folic acid supplementation and caffeine.

Introduction

Pregnancy induces some physiological changes that often confuse the diagnosis of several disorders and the assessment of the suitable treatments. This is especially true in case of anemia. Anemia during pregnancy is defined as a reduction in hemoglobin (the molecule which carries oxygen in the blood) level of less than 11 g/dl, during which plasma volume increases disproportionately compared with red cell mass resulting in a physiological disorder. To produce red cells, the women body needs (among other things) iron, vitamin B12 and folic acid. If there is a lack of one or more of these ingredients, anemia will develop (Kumar et al, 2013). Signs and symptoms of anemia include; fatigue, weakness, pale or yellowish skin, increased heartbeats, shortness of breath, dizziness or lightheadedness, chest pain, cold hands and feet, and headache (Mayo et al., 2017).

The risk factors of anemia in pregnant women are iron deficient diet and several other nutritional deficiencies that can cause anemia such as folic acid and vitamin B12 deficiency (VanderJagt et al., 2007)**.** Folic acid or folate is a vitamin B (B9) found mostly in leafy green vegetables like kale and spinach, orange juice, and enriched grains. Mothers' body needs folate to make normal red blood cells and prevent anemia. One of the most important things mothers can do to fulfill their body needs and to help prevent serious problems is to get enough folic acid every day- especially during early pregnancy. Folic acid is also essential for the formation and maturation of red blood cells and necessary for cell growth and repair. Deficiency of folate reduces the rate of DNA synthesis with consequent impaired cell proliferation, intramedullary death of resulting abnormal cells; this shortens the lifespan of circulating red blood cells and results in anemia. There is, however, little evidence that folic acid deficiency may be a

public health problem in many developing countries (Tolentino and Friedman, 2007)

Daily oral iron and folic acid supplementation is recommended as part of the antenatal care to reduce the risk of low birth weight, maternal anemia and iron deficiency. The WHO recommends that all pregnant women in areas where anemia is prevalent should receive supplements of iron and folic acid (WHO, 2012). In spite of the WHO recommendation, the use of iron and folic acid supplementation is still low in many countries, especially in countries with low resources (Maina-Gathigi et al, 2013).

The body mass index (BMI, kg/m^2) is currently the gold standard for measuring body fatness**,** BMI less than 18.5 kg/ m^2 considered as underweight, between 18.5 - 24.9 kg/ m^2 considered as normal, between 25.0 - 29.9 kg/ m^2 regard as overweight and more than 30.0 kg/ m^2 falls within the obese range (Defining Adult Overweight and Obesity, 2020). Healthy diet is important during pregnancy, because it allows the pregnant woman to gain an optimal weight, and it is also important for the baby's health. In addition, a woman who is overweight or obese before getting pregnant will have an increased risk of different complications during pregnancy (National Research Council, 2010).

Smoking has multiple effects on reproductive health, smoking in pregnancy is connected to an adverse perinatal outcome such as the increase in the incidence of miscarriage, premature births, a lower birth weight of the newborn, an increase in intrauterine growth retardation, a lower vitality score, a more difficult and longer period of adaptation of the newborn (Gajewska et al, 2008), as well as a shorter breastfeeding period in comparison to pregnant women who do not smoke (Napierala et al, 2016). Some researchers have noted the tendency of a decrease in concentrations of hemoglobin, hematocrits and iron during long periods of exposure to smoke and a higher number of smoked cigarettes daily (Wojtyla et al, 2012). Various factors, such as socio-demographics and health factors, determine the compliance and adherence of pregnant women to the iron and folic acid supplementation (Leung and Kaplan, 2009).

Anemia in pregnancy is a major public health concern worldwide and one of the leading causes of disability, especially in developing countries (Chatterjee and Fernandes, 2014). Thus, there is a need of having current information and local data about anemia and associated factors during pregnancy to help inform preventive programs. The aims of this study are measuring the hemoglobin level in pregnant women during third trimester, examining the weight gain level during pregnancy, detecting the relation between smoking, intake of coffee or tea after meals, consuming folic acid before and during pregnancy and pregnant BMI with Hb level and the impact of visiting primary health centers on women health during pregnancy.

Material and methods

After receiving the approval from the ethics committee at the Collage of Health sciences/ Hawler Medical University, a cross sectional study started collecting data randomly from pregnant women aged (17- 48 years) with various gestational ages in third trimester (28-42weeks) who attended different health centers in Erbil city. Women with any of the following conditions were excluded from the study: Twin pregnancy, known cases of hemolytic anemia, bleeding disorders, active bleeding from any site, chronic renal disease and other chronic illnesses.

The study conducted from October 2019 to February 2020, the data collected by direct interview with the participants and an open-ended questionnaire was distributed for them including questions about their age, residence, history of smoking, their life style, caffeine consumption, folic acid supplementation and routine visit to the antenatal centers. Pre-pregnant BMI was calculated using the patient's self-reported pre-pregnant height and weight and their BMI during pregnancy also calculated at the day of data collection. Gestational age was determined with a combination of information using the last menstrual period and ultrasound measurement.

The Hb values were measured from the blood sample of each subject was performed by withdrawing three milliliters of venous blood collected from the median cubical vein with minimum stasis, while subject was seated, and put it into sterile labeled tubes containing Ethylene di-amine tetra acetic acid (EDTA) acting as anti-coagulant, at primary health centers laboratory. The results of the analyzed blood samples were generated by the analyzer, and displayed by a paper speed on thermal printing copy were performed using an automated hematology analyzer (Beckman coulter –ACT diff 1 &2, Germany). Data were entered to Microsoft Excel 2016 then analyzed by the statistical package for the social sciences (SPSS) version 22

Results

Out of the 288 pregnant women in the third trimester (28-42) gestational weeks included in this study, the mean age was (27.53±6.29) years with minimum and maximum age (17 and 48) years, respectively. The mean level of hemoglobin was (11.19±1.44) mg/dl with minimum and maximum levels (6.00 and 16.00) mg/dl. The mean of BMI before pregnancy was (26.80±4.97) while the mean of BMI during pregnancy was (31.04±4.98), and the difference between them was highly significant statistically (P value=0.0001) as shown in figure (1).

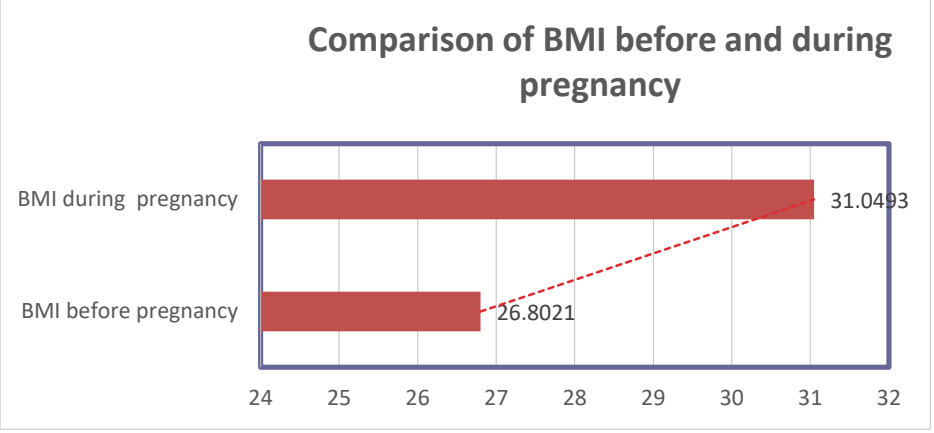

Figure (1): Comparison of BMI before and during pregnancy

Table (1): some sociodemographic factors in pregnant women in third trimester

		Frequency	Percentage
Age rang(years)	15-19	19	6.6
	20-24	86	29.9
	25-29	84	29.2
	30-34	51	17.7
	35-39	38	13.2
	40-44	7	2.4
	45-49	3	1.0
Hb level	≥11mg/dl	180	62.5
	≥10mg/dl	67	23.3
	<10mg/dl	41	14.2
Residency	rural	60	20.8
	city	228	79.2
History of smoking	non-smoking	239	83.0
	smoking	49	17.0
Visiting primary health center	no	86	29.9

	yes	202	70.1
History of using folic acid before pregnancy	no	119	41.3
	yes	169	58.7
Taking tea or coffee after meal	No	154	53.5
	yes	134	46.5

Table (1) reveals some sociodemographic factors related to the pregnant women in the third trimester which shows that the highest percentage of the women were in the age group (20-24) years which was (29.9%) and the highest percentage of women (62.5%) had Hb level ≥11mg/dl. The highest percentage of pregnant women were from urban areas (city) which was (79.2%) and the highest percentage of women were non-smokers (83.0 %). The study reveals that (70.1%) visited primary health centers and demonstrates that (58.7%) took folic acid before pregnancy, (53.5%) of pregnant women consumed tea and coffee after meals.

Table (2): Effect of taking folic acid before pregnancy on the Hb level index

			HB level index			Total
			≥11mg/dl	≥10mg/dl	<10mg/dl	
Taken of folic acid before pregnancy	**no**	**Count**	**72**	**27**	**20**	**119**
		%	**40.0%**	**40.3%**	**48.8%**	**41.3%**
	yes	**Count**	**108**	**40**	**21**	**169**
		%	**60.0%**	**59.7%**	**51.2%**	**58.7%**
Total		**Count**	**180**	**67**	**41**	**288**
		%	**100.0%**	**100.0%**	**100.0%**	**100.0%**

P value= 0 .010(S)

Table (2) reveals that the highest percentage of normal Hb level ≥11mg/dl was among those who took folic acid in comparison to those who did not take folic acid before pregnancy which was (40.0%); this result is statistically significant.

Table(3): Correlation between visiting of health Hb level index (P value= 0.224 NS)

			HB level index			Total
			≥11mg/dl	≥10mg/dl	<10mg/dl	
Visiting health center	No	Count	54	23	18	95
		%	56.8%	24.2%	18.9%	100.0%
	yes	Count	126	44	23	193
		%	65.3%	22.8%	11.9%	100.0%
Total		Count	180	67	41	288
		%	100.0%	100.0%	100.0%	100.0%

Table (3) clarifies the relationship between visiting the primary health center and the Hb level: the highest percentage of the pregnant women visiting primary health center (65.3%) had Hb level ≥11mg/dl which was higher than those who did not visit primary health centers (56.8%); however, this relationship was statistically non-significant.

Table (4): Correlation between smoking and Hb level index (P value= 0.05, S)

			HB level index with smoking			**Total**
			≥11mg/dl	**≥10mg/dl**	**<10mg/dl**	
History of smoking	**Non-smoker**	**Count**	**148**	**52**	**39**	**239**
		%	**82.2%**	**77.6%**	**95.1%**	**83.0%**
	Smoker	**Count**	**32**	**15**	**2**	**49**
		%	**17.8%**	**22.4%**	**4.9%**	**17.0%**
Total		**Count**	**180**	**67**	**41**	**288**
		%	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table (4) demonstrates that the highest percentage (82.2%) of normal Hb level ≥11mg/dl was among non-smoker, pregnant which was higher than smoker (17.8%); this relationship was statistically significant.

Table (5): Correlation between Drinking tea or coffee after meal with Hb level index

			HB level index			
			≥11mg/dl	≥10mg/dl	<10mg/dl	Total
Drinking tea or coffee after meal	**no**	**Count**	**102**	**37**	**14**	**153**
		%	**66.7%**	**24.2%**	**9.2%**	**100.0%**
	Yes	**Count**	**78**	**30**	**27**	**135**
		%	**57.8%**	**22.2%**	**20.0%**	**100.0%**
Total		**Count**	**180**	**67**	**41**	**288**
		%	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table (5) shows that the highest percentage of Hb level (<10mg/dl) was in those taking tea or coffee after meals (20%) in comparison to those not taking tea or coffee after meals (9.2%); this relationship was statistically significan

Table (6) classification of the pregnant women according to their BMI

BMI Index		Frequency	Percentage
	underweight	14	4.9
	normal	57	19.8
	overweight	145	50.3
	obese	69	24.0
	superobese	3	1.0
	Total	288	100.0

Table (6) reveals the number and percentage of pregnant women according to their BMI index: the highest percentage were overweight (50.3%) while the lowest percentage of pregnant women were superobese (1%).

Table (7): relation between BMI index and Hb level index P value=0.

			HB level index			Total
			≥11mg/dl	≥10mg/dl	<10mg/dl	
BMIindex	Underweight	Count	11	2	1	14
		%	6.1%	3.0%	2.4%	4.9%
	Normal	Count	33	16	8	57
		%	18.2%	24.2%	19.5%	19.8%
	Overweight	Count	87	35	23	145
		%	48.1%	53.0%	56.1%	50.3%
	Obese	Count	48	12	9	69
		%	26.5%	18.2%	22.0%	24.0%
	Superobese	Count	2	1	0	3
		%	1.1%	1.5%	0.0%	1.0%
Total		Count	181	66	41	288
		%	100.0%	100.0%	100.0%	100.0%

Table (7) shows that the highest percentages (56.1%, 22%) of anemia with Hb level of <10 mg /dl was among overweight and obese pregnant, more than normal and underweight pregnant; this relationship was not significant (P value>0.05).

Discussion

Pregnancy induces several physiological alterations in most organ systems, which results in considerable changes in laboratory test values. For example, obstetricians are familiar with the lower Hb concentrations in normal pregnancy (Kalaivani, 2009). Of the total respondents who participated in this study, 37.5% were anemic; the overall prevalence of anemia obtained in this study was nearly equal with a study conducted in Arsi, Ethiopia (36.6%) (Niguse et al, 2013), But it is lower than a study conducted in Nigeria (54.5%) (Olatunbosun et al, 2014) and 87% in India (Cunningham et al, 2005).

The approximately low percentage of anemia in the present study may be related to adequate diets and more frequent prenatal folic acid and iron supplementation consumption; the provision of iron and folic acid

supplements to pregnant women will undoubtedly reduce the overall prevalence of anemia in pregnant women (Abbas et al, 2017). In this study, it is obvious to notice that (58.7%) of pregnant were practicing folic acid intake; meanwhile, the rest did not take folic acid at all, and the highest percentage (60.0%) of normal Hb (level ≥11mg/dl) was among pregnant who were taking folate in comparison to those who did not take folic acid before pregnancy. This result was statistically significant. Although some of the pregnant who were on folic were anemic, this might be due to the malabsortion of folic or insufficient dietary intake. One of the studies found no significant difference among women in their response to folic acid during all stages of pregnancy (Garcia-Valdes et al., 2015).

The other cause which might decrease anemia is prenatal care visits. The study showed that women had more visits for primary care (70.1%). In each visit, the women were encouraged to take their supplements (Abbas et al, 2017). The highest percentage of the pregnant women visiting primary health center (65.3%) had an Hb level ≥11mg/dl which was higher than those who did not visit the primary health center (56.8%), but this difference was not significant.

The study demonstrated that out of the total number of pregnant women, 17% smoked and that the high percentage (82.2%) of normal Hb level ≥11mg/dl was among non-smokers, which was higher than smokers (17.8%); this relationship was statistically significant.

A study conducted in Poland indicates that smoking causes lower hemoglobin concentrations in pregnant women (Garn and Petzoid, 1982). Some researchers have noted the tendency of a decrease in concentrations of hemoglobin during long periods of exposure to smoke and a higher number of smoked cigarettes daily (Wojtyła et al, 2012).

The study finding indicated an association between tea or coffee intake and maternal anemia, the percentage of anemia (Hb < 10mg/dl) was (20%) among those taking coffee or tea more than those who did not take tea or coffee (9.2%). Coffee drinking affects iron bioavailability. By inhibiting absorption, it is likely to aggravate anemia at times of increased physiological need or when dietary iron intake is precarious (Savolainen,1992). Coffee is known to contain tannin which can potentially interfere with iron absorption (Munoz et al, 1988). This study estimated that 50.3% and 24.0% of pregnant women were overweight or obese respectively, possibly due to urbanization (79.2% of pregnant women were from city or urban areas) as city life can be more sedentary than rural life (Wu et al, 2017), food environment, especially fast or processed foods with low energy expenditure, and low physical activity (Michimi and Wimberly, 2015). The study demonstrated a low Hb level (less than 10 g/dl) in overweight and obese pregnant women compared to their normal- weight and underweight counterparts. However, this study did not have sufficient resources to demonstrate a statistically significant difference in Hb levels between

them. The percentage of normal Hb levels was greater among overweight pregnant. A study done by University of Florida found 6.1% (0.7 g/dl) lower Hb level in obese women compared with their normal-weight counterparts. It is believed that these obese women have a greater plasma volume than normal-weight women, so this lower Hb level may be the result of an even larger plasma volume expansion in obese women during pregnancy compared to that seen in non-obese women. Or it may be related to the inadequate dietary intake common among overweight/obese persons as a means of weight control as well as an intake of foods with low nutrient density (MacDonald et al, 2007). Abbas et al. in a study that assessed the association between high BMI and anemia in 432 pregnant Sudanese women reported no significant difference in Hb level between normal and obese pregnant women (Abbas et al, 2017). A significantly higher number of obese women had iron deficiency, The conjunction of increased hepcidin (Chełchowska et al., 2016), which decreases iron absorption from GIT) and enhanced iron transfer across the placenta during pregnancy even if maternal iron stores are depleted (Garcia-Valdes et al., 2015) was a likely explanation for iron deficiency anemia in the obese pregnant women. Another study by Garn and Petzoid demonstrated a 0.2 g/dL – 0.5 g/dL higher Hb level in obese pregnant patients compared to their lean counterparts during each trimester of pregnancy. This discrepancy may be due to using tricep skinfold measurement in their study to define obesity, in addition to including some underweight patients in the lean group (Garn and Petzoid, 1982).

Conclusion

As previously mentioned, hemoglobin level can be influenced by many factors. This study concluded that normal hemoglobin level during the third trimester was found with those women who are non-smokers, consume folic acid supplements, visit their doctor routinely, and consume less caffeine. On the other hand, our results showed no significant relationship between BMI and hemoglobin level. Pregnant women who smoke, do not consume folic acid supplements and do not receive routine health checks develop anemia during pregnancy.

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