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Is adequate and balanced nutrition during pregnancy more effective than iron and folic acid supplements?

Research Article

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Abstract: To provide instruction for pregnant women regarding adequate and balanced nutrition and determine whether iron and folic acid supplementation is essential. The research was an experimental clinical intervention. The study was conducted between March 2004 and May 2005 with 80 pregnant volunteers. The study participants were in their 16th to 24th weeks of pregnancy; all participants were healthy, carried only one fetus, and successfully completed their pregnancy. All participants were instructed about adequate and balanced nutrition. Until the participants gave birth, 40 (Group 1) consumed an iron-rich diet that was equivalent to the inclusion of a supplement containing 100 mg Ferro III plus 0,35 mg folic acid; the other group (Group 2) was also instructed in proper nutrition and was given by a gynecologist 1 tablet (100 mg) Ferro III hydroxide polymaltose complex and iron pharmaceutical with 0,35 mg folic acid (Maltofer Fol). In both groups, before and after the instruction, consumption frequency was noted, and the levels of serum ferritin, serum iron, total iron-binding capacity, folic acid, and vitamin B12 in the blood were determined at monthly intervals. Between the two groups, no statistical difference was found with regard to age, number of pregnancies, weight before pregnancy, body mass index (BMI) before pregnancy, and weight of the newborn ($p>0,05$). At the end of the study, the hemoglobin, hematocrit, and serum ferritin levels decreased considerably in both groups compared to the initial values ($p<0.01$). No statistically significant difference in serum ferritin levels could be found between the two groups ($p>0,05$). The comparison of Group I and Group II in terms of nutritional status (average energy and food consumption) in the pre-instruction and post-instruction periods revealed that intake of total protein, heme protein, dietary fiber, folic acid, carotene, vitamins A, B1, B2, B6, C, and B12, potassium, calcium, phosphorus, iron, and zinc was higher in Group I in the post-instruction period ($p=0.000$); no statistically significant change in nutritional status during pregnancy was observed in Group II. Conclusion: Medical diet programs with iron sources are examined in association with food consumption. Assessment of hematological results suggests that, during pregnancy, each patient should receive a specific dose, rather than a routine dose, of iron and folic acid.

Keywords: *Pregnancy • Nutrition condition • Iron • Folic acid • Anemia*

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1. Introduction

Adequate and balanced nutrition to meet metabolic, physiologic, and hematologic requirements during pregnancy is very important for both the mother and fetus [1]. The demand for both energy and nutrients is increased during pregnancy [2]. Malnutrition negatively affects the health of the mother and causes health problems such as anemia, edema, eclampsia, preeclampsia, hypertension, and osteomalacia [3]. Adequate and balanced nutrition directly affects the physiology of the fetus. Premature birth and congenital anomalies generally result from malnutrition during pregnancy. Premature babies in terms of gestational age have a high risk of hypertension, obesity, glucose intolerance, and cardiovascular diseases [4]. Anemia develops in a high proportion of women during pregnancy in both industrialized and developing countries. The World Health Organization (WHO) estimates that anemia develops in 35% to 75% (56% on average) of pregnant women in developing countries and 18% of women from industrialized countries. However, many of these women were already anemic at the time of conception, with an estimated prevalence of this condition of 43% in non-pregnant women in developing countries and 12% amongst women from wealthier regions [5]. The reason is because plasma volume increases by 50% in malnutrition and pregnancy; however, the volume of red blood cells cannot match that increase. Previous research suggests that, on average, a decrease in hemoglobin concentration of 2 g per 100 ml blood may be expected [6]. The Centers for Disease Control and Prevention (CDC) defines anemia during pregnancy as a hemoglobin level below 11g per deciliter during the first and third trimesters and below 10.5 g per deciliter during the second trimester. The WHO defines a hemoglobin level below 7 g per deciliter as severe anemia [7]. The Turkey Population Health Survey conducted in 1998 found that the rate of anemia in pregnant women was 61% [8]. Iron-related anemia results from many factors in pregnancy; the main factors include blood loss, parasites, iron deficiency due to iron accumulation in the fetus, unbalanced diet, and digestion disorders [9]. Furthermore, increasing plasma volume, the iron requirement of the fetus, cereal-based diet (phytic acid in cereals hinders iron absorption), enterozoa, poor environmental and living conditions (infections), frequent births, and excessive tea and coffee consumption play an important role in the frequency of anemia. Daily intake of vitamin C is important for iron absorption. The Recommended Dietary Allowance (RDA) for iron is 15-20 mg in pregnant women [10]. There are many collective studies about iron consumption during pregnancy and its effects on mother and fetus. The results of these studies are similar; however, there are some studies that have produced conflicting findings [1]. A collective study by Sloan et al. stated that iron supplementation increases the hemoglobin level and reduces the risk of maternal anemia. A collective study by Haram et al. pointed out that the iron needs of pregnant women can be supplied with iron-rich nutrition; however, there is insufficient information about itseffect on infant birth weight and other complications [12]. Scholl et al. stated that iron supplementation reduces the risk of premature birth and low infant birth weight [13]. Another collective study concluded that iron deficiency reduces the total iron-binding capacity of the mother and causes premature birth, low infant birth weight, and abortus [14]. The prevalence of anemia in pregnant women and its relation to other factors such as nutrition have been studied by many researchers. Some studies revealed that an iron supplement can meet the increased requirement during pregnancy and increase absorption; however, it does not prevent preterm birth or low infant birth rate [16]. Furthermore, women who are at risk for hereditary hemochromatosis with sufficient iron levels can be negatively affected by an additional iron supplement [16]. Consequently, if a nutrition program is able to achieve equivalent outcomes to a pharmacological supplement, the nutrition program should certainly be preferred. Calcium, phosphorus, sodium, magnesium, copper, zinc, and iron are essential for good health [17]. The present study is designed to assess the necessity of iron and folic acid supplementation when a “Pregnancy Nutrition Program” with iron-rich foods is given to pregnant women who are instructed in adequate and balanced nutrition.

2. Material and Methods

This study was conducted by Ondokuz Mayıs University Faculty of Medicine, Department of Gynecology, between March 2004 and May 2005. The study group was comprised of 80 pregnant patients, all of whom met the following parameters:

1. At 16 – 24 weeks of their pregnancy, with the ultrasound findings matching the date of the last period;
2. Pregnant with one fetus;
3. Free of any systemic or infectious illness.

After the patients were accepted in the research program, they were randomly divided into two groups. Until they gave birth, Group I (n=40) consumed an iron-

Table 1. Comparison of Criteria for Group I and Group II.

	Group I Average±SD	Group II Average±SD
Age	27.55±4.33	28.30±4.17
Gravida	2.20±1.20	2.13±1.11
BMI(kg/m^2)	23.47±4.41	22.96±3.13
The week of pregnancy at the beginning of therapy	18.45±2.79	20.10±2.71
The week of pregnancy during the birth	38.73±1.26	38.60±1.10
Body weight before pregnancy	61.45±11.32	59.65±8.32

rich diet that was equivalent to 100 mg Ferro III plus 0.35 mg folic acid. In addition to nutritional instruction, Group II (n=40) was advised by a gynecologist to take 1 tablet daily of 100 mg Ferro III hydroxide polymaltose complex plus iron pharmaceutical with 0,35 mg folic acid (Maltofer Fol Chewing Tablet, Abdi İbrahim, Türkiye).

The 80 participants were randomly divided into two groups. Until they gave birth, Group I (n=40) consumed an iron-rich diet that was equivalent to 100 mg Ferro III plus 0,35 mg folic acid. Group II (n=40) received nutritional instruction from a gynecologist. Group II was also advised to take 1 tablet daily of 100 mg Ferro III hydroxide polymaltose complex plus iron pharmaceutical with 0,35 mg folic acid (Maltofer Fol Chewing Tablet, Abdi İbrahim, Türkiye).

The sociodemographic and prolificacy chara–cteristics of the participants was recorded by a questionnaire with a face-to-face interview technique. Instruction on adequate and balanced nutrition was given to the participants monthly. These instructions were provided 5 times prior to the participants' giving birth. At each control visit, values for serum ferritin, hemoglobin, hematocrit, folic acid, and vitamin B12 were obtained. Blood samples after the participants had fasted for 10 – 12 hours were taken by a doctor. These were centrifuged the same day, and then the serum iron and total iron-binding capacity were studied. Serum ferritin was analyzed by Emulate 2000 equipment; folic acid and vitamin B12 were analyzed by E 170 equipment; blood collected in EDTA vacuum collection tubes was submitted to a hematology laboratory, where a routine hemogram was conducted with use of ADVIA 120 equipment. It was administered as an energy supplement and enriched 1.0-1.5 kg per month to prevent weight loss (35-40 kcal/kg for pregnant women who had 80% of ideal body weight; 30 kcal/kg for women who had 80-120% of ideal body weight; 24 kcal/kg for pregnant women who had 120-150% of ideal body weight). Carbohydrates provided 50-60% of the energy content; 12-15% was provided by proteins (at least 50% animal protein); 25-30% was provided by fats (7% saturated, 10-15% monounsaturated and 8-10% polyunsaturated) in the proposed diets, and diet and the diets were evaluated every 20-35 days [18]. Group I received 45 minutes of personal nutrition instruction monthly [19].

The following schedule was used for recording startup measurements and subsequent control visits: Startup values were determined between 16 – 23 weeks pregnancy; 1st controls between 24 – 28 weeks; 2nd controls between 29 – 33 weeks; 3rd controls between 34 – 38 weeks; and 4th controls between 39 – 42 weeks.

Nutritional status was recorded in the pre-instruction and post-instruction periods. A record was made once a week (on weekdays or at the weekend) detailing the type and quantity of foods consumed. The adaptation of pregnant women to the proposed diet was assessed with Nutrition Information Systems 2004 Packaged Software [20]. The values of nutritional elements and energy content of consumed food were calculated before and after the instruction. Data analysis was conducted with the SPSS statistical analysis program (Version 12.0). Paired t testing was conducted for the data that showed a normal distribution; the Wilcoxon test was conducted for data that did not show normal distribution. To compare the two study groups, the Student T test was used for data that showed a normal distribution, and the Mann Whitney U test was used for features that did not show normal distribution [21].

According to the demographic characteristics, the majority of the participants in Group I were university graduates (42.5%), whereas the majority of the participants in Group II were graduates of high school.

Table 2. Blood Analysis Values of Group I.

	GROUP I Average±SD				
	The startup values	1.Control	2.Control	3.Control	4.Control
Vitamin B12 (pg/ml)	173 ±70	177,8±62	160±49	140±35	128±28
Ferritin (ng/ml)	18,27±12,4	15,74±10	12,74±9,1	11,6±11,2	10,68±9,8
Folic Acid (ng/ ml)	9,34±5,32	10,03±5,7	9,23±5,25	8,49±4,50	7,84±3,47
Hemoglobin (g/dl)	12,40±1,0	11,92±0,96	11,04±0,9	11,17±0,95	10,9±1,06
Hematocrit (%)	35,17±2,89	34,05±2,62	33,7±2,83	33,07±3,0	32,18±2,8

Table 3. Blood Analysis Values of Group II.

	GROUP II Average±SD				
	The startup values	1.Control	2.Control	3.Control	4.Control
Vitamin B12 (pg/ml)	187±63	173±68	174±70	164±71	157±62
Ferritin (ng/ml)	23,49 ±18,4	20,05±16,5	15,26±12,1	14,39±9,96	14,54±9,98
Folic Acid (ng/ ml)	11,59 ±5,35	11,07±5,41	10,89±5,13	10,81±5,20	10,84±4,93
Hemoglobin (g/dl)	12,22 ±1,15	11,82±0,68	11,63±0,93	11,51±0,81	11,54±0,89
Hematocrit (%)	35,16 ±3,83	33,75±2,25	33,39±2,51	33,30±2,12	33,62±2,49

Table 4. Statistical Comparison of Blood Analysis Results for Group I and Group II.

	The startup point		1.Control		2.Control		3.Control		4.Control	
	P	Difference	P	Difference	P	Difference	P	Difference	P	Difference
Vitamin B12 (pg/ml)	0.349	NS	0.791	NS	0.293	NS	0.066	NS	0.009	*
Ferritin (ng/ml)	0.142	NS	0.166	NS	0.300	NS	0.251	NS	0.085	NS
Folic Acid (ng/ml)	0.064	NS	0.409	NS	0.156	NS	0.036	*	0.002	*
Hemoglobin (g/dl)	0.452	NS	0.628	NS	0.953	NS	0.094	NS	0.005	*
Hematocrit (%)	0.992	NS	0.588	NS	0.522	NS	0.689	NS	0.018	*

p<0.05

According to distribution of occupations, 62.25% of the participants in Group I were housewives, whereas 52.5% in Group II were housewives. Prior to the study, 17.5% of the participants in Group I and only 5% in Group II took some form of iron supplement.

Tables 1 and 2 show the mean and standard deviation of the blood analysis values obtained during the study ($p<0.05$).

Table 3 shows a comparison of the blood analysis results of Group I with Group II. When all values obtained during control visits were compared with those of the startup blood parameters, it was found that the vitamin B12, hemoglobin, hematocrit (%) values showed a statistically significant difference only after the 4th control. When the other parameters were examined, folic acid values showed a statistically significant difference in the 3rd and the 4th controls ($p<0.05$).

Table 4 shows a comparison of the two groups according to baseline nutrition and post-instructional nutrition. Vitamin A, carotene, total cholesterol, and vitamin B12 consumption were significantly higher in Group II than in Group I ($p<0.05$). No statistically significant difference was found between the 2 groups with regard to the other nutritional elements.

3. Discussion

Daily iron intake is an important factor in whether or not anemia develops. Vitamin C increases the bioavailability of iron, and so it plays a key role in prevention of anemia [22]. It has been established that pregnant women with anemia should receive an iron supplement. However, the issue of whether pregnant women who are not anemic should also receive an iron supplement is controversial.

Anemia, which occurs due to iron deficiency, is an important public-health problem and one of the most widespread health problems. Anemia occurs because of malnutrition [23]. Previous studies have shown that pregnancy and gravida is not an important factor in the etiology of anemia [24]. Whereas the maternal erythrocyte mass of the patients who did not take an iron supplement increased between 10 and 20%, the maternal erythrocyte mass of those patients who took an iron supplement increased by 30% [25].

Providing an iron supplement reduces the incidence of delusional anemia. It was determined that serum ferritin, iron level, and hemoglobin concentration decreases as pregnancy progresses in women who are not anemic and who do not take an iron supplement, even if adequate and balanced nutrition is provided [26,27]. Some studies have reported cases where, even if the pregnant patient was well nourished, the iron requirement could not be met without additional iron supplementation [28,29]. It has been established that patients who are not anemic at the start of their pregnancy and who are not given supplementary iron show normal iron levels 2 years after giving birth. The recovery process of some patients who were unable to access sufficient iron might have taken longer because of poor nutrition. In such cases, supplementary iron was essential [29]. Although it is recommended that pregnant women take iron supplements because iron sources are inadequate and maternal iron depots are unreliable,

Table 5. Comparison of energy and food consumption in pre-instruction and post-instruction periods for Group I and Group II (p<0.05).

Items	Group I Average±Standard deviation Pre-instruction	Post-instruction	P	Group II Average±Standard deviation Pre-instruction	Post-instruction	P
Energy kcal	1780,4±157,4	1821,4±48,7	0,783	1994,2±117,0	1522,0±52,0	0,000*
Water (g)	1346,8±159,3	1543,4±53,6	0,185	1340,9±78,2	1284,1±50,1	0,430
Protein (g)	76,5±5,5	93,2±4,1	0,004*	85,3±5,7	83,6±4,5	0,763
Heme Protein	43,3±4,5	61,1±4,2	0,001*	49, 7±4,9	56,6±4,4	0,129
Protein percentage (%)	18,9±1,1	20,9±0,7	0,077	17,9±0,9	22,5±0,9	0,000*
Fat (g)	62,9±9,3	59,7±2,7	0,719	70,5±6,5	50,4±2,6	0,003*
Fat Percentage (%)	28,6±1,5	29,2±0,9	0,711	30,2±1,4	29,4±0,9	0,636
Polyunsaturated fat (g)	16,4±3,8	13,4±0,9	0,385	16,0±2,1	11,0±0,7	0,019*
Fiber (g)	22,4±1,9	29,9±1,1	0,000*	25,7±1,7	26,7±1,2	0,545
Cholesterol (mg)	195,2±22,5	293,8±19,7	0,000*	277,5±30,5	252,2±18,8	0,421
Folic Acid (gr)	283,9±17,4	392,6±14,3	0,000*	335,5±20,1	328,1±13,3	0,735
Vit A (µg)	831,5±85,7	1586,8±274,9	0,012*	1241,5±113,2	1631,3±472,8	0,430
Carotene (mg)	2,9±0,3	4,8±0,3	0,000*	4,1±0,5	4,5±0,3	0,597
Vitamin E (mg)	9,3±1,5	12,3±0,7	0,069	13,2±1,5	10,0±0,8	0,036*
Carbohydrate	220,5±16,9	219,1±6,5	0,935	247,4±14,0	178,0±7,3	0,000*
Carbohydrate Percentage (%)	52,4±1,7	49,9±1,1	0,128	51,8±1,5	48,2±1,5	0,046*
Vitamin B1 (mg)	0,8±0,1	1,2±0,0	0,000*	1,1±0,1	0,9±0,0	0,086
Vitamin B2 (mg)	1,5±0,1	2,0±0,1	0,000*	1,7±0,1	1,7±0,1	0,853
Vitamin B6 (mg)	1,3±0,1	1,6±0,1	0,004*	1,4±0,1	1,3±0,1	0,789
Vitamin C (mg)	106,4±16,1	210,5±11,7	0,000*	148,9±15,1	144,5±13,5	0,727
Vitamin B12 (mg)	2,6±0,3	5,6±1,2	0,0003*	4,24±0,5	5,3±1,7	0,438
Sodium (mg)	3965,3±1302,3	3558,9±128,5	0,752	3566,6±335,9	3098,9±152,6	0,156
Potassium (mg)	2502,1±217,6	3352,5±114,0	0,000*	2695,2±155,0	2645,3±109,1	0,749
Calcium (mg)	826,9±58,4	1174,4±51,4	0,000*	994,1±64,1	953,5±46,6	0,501
Magnesium (mg)	297,9±47,0	325,2±15,0	0,506	280,7±16,8	272,3±11,5	0,648
Phosphor (mg)	1274,6±116,6	1520,9±55,3	0,032*	1338,1±75,9	1295,2±55,4	0,596
Iron (mg)	11,7±1,5	14,5±0,5	0,032*	12,6±0,7	12,4±0,5	0,798
Zinc (mg)	10,1±0,9	12,7±0,6	0,002*	11,5±0,8	10,6±0,5	0,230

there is a view in the literature that iron absorbency increases parallel to the increasing iron requirement, so the requirement is then met naturally. Some studies have shown that additional support for women whose iron level is sufficient does not increase the hemoglobin concentration [23,25,26,30].

It has been established that accumulation of excessive iron increases the future risk of coronary heart disease by slowing free radical effects [31,32].

The results of the present study show a statistically significant decrease between the initial hemoglobin values and the last control values for the group that was given instructions on adequate and balanced nutrition ($p<0,05$). There was also a statistically significant decrease between the initial hemoglobin values and the last control values of the group given supplementary iron ($p<0,05$). The WHO has established a hemoglobin concentration limit of 11 gr per deciliter. The incidence of anemia within the group that was given nutrition instruction was initially 5%, but this increased to 65% at the end of the study. By comparison, in the group that was given supplementary iron, an initial anemia rate of 22.5% increased to 30% at the end of the study. Research conducted by Milman et al. on a group of pregnant participants (n=63) involved the administration of an iron supplement (66 mg) in form of Ferrum fumarate from the beginning of pregnancy to giving birth. The results were compared with the results for well-nourished pregnant women who received placebo (n=57). The pregnant women who received an iron supplement had higher hemoglobin values when compared with the control group [33]. In another study by Milman et al. 206 pregnant women participated who were in their 9th to 18th week of pregnancy; 107 were given a placebo, and the remaining 99 were given 66 mg/day ferrous iron. All participants were examined up until 8 weeks before giving birth; none of the participants were given nutritional instruction. It was found that the hemoglobin values of the participants who were given iron were higher than those who were given the placebo; while the hemoglobin values rose at 39 – 42 weeks, no increase was seen in the group that was given the placebo. The present study found that hemoglobin values within both groups showed a statistically significant reduction ($p<0,01$) [34].

Studies by Stern et al., conducted over a 3-month period, demonstrated that their experimental group receiving nutritional supplements had a higher hemoglobin level compared with a control group [35]. In the present study, when the 1st, 2nd, 3rd, 4th control blood values were compared with the startup blood values of the participants receiving the supplement, hematocrit values were found to be statistically low. This finding could be explained by the low serum iron-binding capacity of the participants. Romslo et al. conducted a study of nutritional supplements using a sample of 45 pregnant women. An experimental group (n=22) were given 200 mg ferrous sulfate during the first 10 weeks of their pregnancy; A control group (n=23) were given a placebo. Nutritional instruction was not given. With respect to the startup values, the only factor that showed a statistically significant increase was serum iron-binding capacity. No statistically significant difference could be determined in other parameters [29]. In the present study, serum iron and ferritin levels showed a statistically significant reduction in Group I ($p<0.01$). In Group II, the serum iron level did not change. Iron is very important for the health of mother and fetus during pregnancy. After nutritional instruction, 48.3% of Group I and 41.3% of Group II showed sufficient iron intake. Previous studies in Turkey have shown daily iron intake to be below recommended levels [36]. In Turkish society, it is believed that pregnant women should eat in order to meet nutritional needs of two people (mother and fetus). This illustrates the importance placed on nutrition. However, over-nutrition can be as harmful as poor nutrition. According to studies of energy and food intake in pregnant women, protein, folic acid, vitamin B6, iron, calcium, and zinc intake is usually lower than the standard Recommended Dietary Allowance (RDA) [37]. The present study determined that Group I had a statistically high consumption of heme protein, fiber, total cholesterol, folic acid, vitamin A, carotene, vitamin B1, vitamin B2, vitamin B6, vitamin C, vitamin B12, potassium, calcium, phosphorus, total iron, and zinc in the post-instruction period. The results illustrate that instruction is essential for the nutritional status of pregnant women. Clinical reflection of nutritional developments occurs over time. Therefore, nutritional instruction should be provided throughout life and should form an ongoing part of a sustainable health-promotion policy. Food consumption rates and blood samples were analyzed in relation to each other to increase the effectiveness of the study. The present study determined that, after nutritional instruction, iron intake increased in Group I. A statistically significant increase was shown in Vitamin C intake, sourced from fruit and vegetables. These findings demonstrate the efficacy of information programs in improving the nutritional status of pregnant women. The health benefits of improved nutrition are only fully evident over the long term. Participating in nutritional-awareness programs during pregnancy is therefore very important. However, these benefits are not limited to pregnancy, and women should also be encouraged to practice good nutrition throughout their lives.

The WHO has recommended that 30 mg ferrous iron supplement should be given in divided doses to pregnant women who consume a balanced diet. For optimal absorption, the iron supplement should be taken between meals. For individuals with iron deficiency anemia, 60 – 120 mg ferrous iron should be taken daily in divided doses.

Conclusion and Recommendations

Nutritional status during pregnancy has implications for helping mothers ensure their own health, as well as for a healthy birth, and, in the longer term, for raising children to be healthy. The clinical outcomes of improved nutrition take time to develop. Therefore, nutritional instruction programs aimed at promoting a diet rich in iron, zinc, folic acid, vitamin B12, and vitamin C should be widely implemented during the 1st Step health services, as a means of promoting lifelong nutritional awareness.

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