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Nutrition Habits and Blood Test Results of Preeclamptic and Healthy Pregnant Women

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Abstract: Preeclampsia is a syndrome and complicates pregnancy. The purpose of this study was to determine the effect of nutrition on the etiology of preeclampsia. In this research, economic and social status, nutrition habits and medical biochemistry test results of the preeclamptic and healthy pregnant women were compared. A total 155 healthy pregnant women in the second trimester and 92 preeclamptic pregnant women were given a questionnaire containing questions related to social and economic situation and nutrition habits. Body mass index, blood pressure and laboratory analysis of blood and urine samples were also investigated. Majority of the preeclamptic women had low education and income. They consumed less meat and dairy products and more bread and legumes than healthy counterparts. Moreover, systolic and diastolic blood pressure values were greater thrombocyte count, calcium, protein and albumin levels were lower and urea, creatinine and liver enzyme (SGOT, SGPT and LDH) levels were higher for preeclamptic women than for healthy pregnant women. In conclusion, possibly in association with economical and educational statuses, women who consume less animal origin proteins and excess carbohydrates are at risk for preeclampsia.

Key words: Preeclampsia, pregnancy, nutrition, blood parameters, thrombocyte, economic

INTRODUCTION

Preeclampsia is a syndrome observed in pregnancy that affects a lot of systems and organs. The exact etiology of preeclampsia is not fully known (Lyell *et al*., 2003). For long years, various hypotheses have been put forward that preeclampsia is associated with either excessive or inadequate nutrition. However, there are not sufficient data to ascertain these hypotheses (Robert *et al*., 2003).

Women who have adequate level storable nutrients in the beginning of pregnancy are more ready for pregnancy and lactation and respective metabolic and hormonal changes (Dudek, 1997). Swensen *et al*. (2001) showed that pregnant women could obtain 85% of recommended energy need and the energy that should be supplied from fat was 30%. Urgell *et al*. (1998) stated that 46% of daily energy was supplied from fat. Recommend daily protein amount is 1 g kg^{-1} body weight for pregnant women (Urgell *et al*., 1998). However, Saracoglu claims that protein need should be 1 g kg^{-1} body weight plus 20 g in the second period of pregnancy. Deniz observed that the ratio of inadequate and excessive protein consumption was 61 and 3.5% among pregnant women. A report by Morris *et al*. (2001) shows that there is no difference in consumption of energy and 28 different nutrients between preeclamptic women and healthy pregnant women. However, excessive carbohydrate and polyunsaturated fatty acid consumption increases the risk of preeclampsia (Clausen *et al*., 2001). Dislipemia can also damage trophoblast invasion and increase risk for preeclampsia (Enquobahrie *et al*., 2004). Unlike healthy pregnant women, preeclamptic women have hypocalciuri, high parathyroid hormone concentration, low ionized calcium and 1.25 dihydroxyvitamin D levels (Prentice, 2000). This study was performed to determine if nutrition contributed to the etiology of preeclampsia by assessing nutrition habits, socio-economic and obstetric statuses and blood parameters.

MATERIALS AND METHODS

Study zone and subjects: The study was conducted between October 2004 and May 2005. The preeclampsia group was composed of 92 pregnant women from Konya and neighboring cities who had been hospitalized with preeclampsia diagnosis at Women's Health and Pregnancy Clinic, Selcuk University Meram Medical

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School. The control group was composed of 155 healthy pregnant women who had been visiting the same institute for routine control. Healthy pregnant candidates were chosen among the ones who were free of illness and in the second trimester. All volunteer participants were informed about the objective of the study and written permission was taken after institutional approval.

Questionnaire: Survey form was composed of three parts and contained questions related to the socio-economic status, health conditions and nutrition habits. Consumption amount and variety of foods and consumption frequency, especially animal origin food products were major items to evaluate nutrition habits. The food consumptions were calculated based on cup and serving size of each foodstuff.

Anthropometry and blood pressure: Anthropometric measurements were carried out to define their body mass indexes. Blood systolic and diastolic pressures were monitored.

Laboratory tests and clinical chemistry: Serum total protein, albumin, urea, creatinine, uric acid, sodium, potassium, phosphorus, magnesium, cholesterol, triglyceride, HDL, LDL, VLDL and LDH were determined by spectrophotometric measurements (Aerosette autoanalyser, Chicago, IL, USA). Urine analysis was carried out with 2 cc urine using H-10 urine strip and Photometric Reflectance Method (Dirui H-500, Dirui Company, Changchun, China). Hemogram measurements were performed using flow cytometry (Laser flowcell system, Beckman Coulter STKS, CA, USA and Beckman Coulter Gen-S, CA, USA).

Statistical analysis: Cross-tables were established to compare the information regarding health (before and after pregnancy), nutrition and socio-economic statuses between healthy and preeclamptic women using χ^2-test. Other data such as body mass index, systolic and diastolic blood pressure, daily nutrition consumption and laboratory findings were subjected to Students' t-test. All analyses were done using a commercial software [(The Statistical Package for Social Sciences (SPSS) for Windows (Version 10.0)] and significance of effects and differences was declared at $p<0.05$ (Steel and Torrie, 1981).

RESULTS

Socio-economic status: Table 1 shows socioeconomic distribution of the subjects. In both group, percentage of young women (<20 years old) was low. However, women >35 years constituted the greatest proportion in the preeclamptic group whereas women aged 25-29 constituted the greatest proportion in health pregnant women ($p<0.0001$). Majority of preeclamptic women had less education than health counterparts ($p<0.0001$). Almost half of the preeclamptic women were in very low-income category whereas half of the health subjects above the average income families ($p<0.0001$). Proportion of large families in both groups was similar. However, small family percentage was higher in the healthy group than the preeclamptic group ($p<0.01$).

Body mass index and blood pressure during pregnancy: The mean body mass index for health and preeclamptic pregnant women did not differ (25.85±0.78; Table 2). The preeclamptic pregnant women had greater systolic (159 vs. 108 mm Hg) and diastolic (101 vs. 68 mm Hg) blood pressure levels than the healthy counterparts ($p<0.0001$ for both; Table 2).

Food consumption during pregnancy: Amounts of daily consumption of various foodstuffs by healthy and preeclamptic pregnant women are shown in Table 3.

Table 1: Socioeconomical characteristics of healthy and preeclamptic pregnant women

	Healthy		Preeclamptic			
Variables	n	%	n	%	χ^2	p-value
Age						
15-19	4	2.6	6	6.5	22.16	<0.0001
20-24	41	26.5	20	21.7		
25-29	68	43.9	21	22.8		
30-34	27	17.4	19	20.7		
>35	15	9.7	26	28.3		
Education level						
Elementary	97	62.6	81	88.0	18.87	<0.0001
High School	25	16.1	6	6.5		
College	33	21.3	5	5.4		
Monthly income*						
<350 TL	6	3.9	42	45.7	105.54	<0.0001
351-500 TL	27	17.4	36	39.1		
501-650 TL	18	11.6	4	4.3		
651-800 TL	26	16.8	2	2.2		
>801 TL	78	50.3	8	8.7		
Number of family members						
2-3 person	86	55.5	35	38.0	8.534	<0.014
4-5 person	48	31.0	45	48.9		
>6 person	21	13.5	12	13.0		

*1$ = 1.35 TL

Table 2: Body Mass Index (BMI) and blood pressure of the subjects[1]

	Groups			
Parameters	Healthy (n = 155)	Preeclamptic (n = 92)	t-value	p-value
BMI (kg m^{-2})	25.56±0.91	26.35±0.55	-0.63	<0.5300
Systolic pressure (mm Hg)	108.17±1.26	158.80±2.36	-18.92	<0.0001
Diastolic pressure (mm Hg)	68.19±0.79	100.54±1.47	-21.19	<0.0001

[1]Values are mean±SE

Table 3: Daily consumption amounts of various nutrients by the subjects[1]

Parameters	Groups: Healthy (n = 155)	Groups: Preeclamptic (n = 92)	t-value	p-value
Milk (mL)	183.04±12.11	73.45±11.29	6.62	<0.0001
Yogurt (g)	84.61±3.590	44.77±4.830	6.69	<0.0001
Yogurt drink (mL)	29.88±3.100	10.74±2.410	4.88	<0.0001
Cheese (g)	34.07±1.370	16.96±1.520	8.03	<0.0001
Diary desserts (g)	12.04±0.720	9.09±1.190	2.11	<0.0300
Egg (g)	29.19±1.810	17.53±2.110	4.08	<0.0001
Meat (g)	92.40±1.780	41.85±4.270	10.93	<0.0001
Chicken (g)	12.26±1.290	6.18±0.850	6.52	<0.0001
Meat product (g)	13.72±1.370	3.69±0.990	5.93	<0.0001
Fish (g)	8.53±0.480	5.80±0.580	3.66	<0.0001
Legumes (g)	14.74±0.950	22.75±2.120	-3.46	<0.0001
Bread (g)	269.03±11.46	414.13±19.03	-6.53	<0.0001
Vegetable (g)	97.51±3.560	74.46±3.770	4.22	<0.0001
Fruit (g)	360.00±14.35	232.61±12.47	6.70	<0.0001

[1]Values are mean±SE

Except for desserts, dairy products' consumption by healthy pregnant women were 2-3 folds greater than preeclamptic pregnant women ($p<0.0001$ for all). Similarly, consumption of egg and various meat types was 1.5-4 folds greater among women in the healthy group than those in the preeclamptic group ($p<0.0001$ for all). However, bread and legume consumptions of the preeclamptic women were approximately 1.5 folds greater than the healthy pregnant women ($p<0.0001$ for both). The healthy pregnant women had consumed more vegetable and fruit (by half) compared to the preeclamptic pregnant women ($p<0.0001$ for both).

Laboratory test results: Most of biochemical parameters between groups were different (Table 4). Hematocrit and hemoglobin levels did not differ between groups but preeclamptic pregnant women had greater leukocyte and erythrocyte and lower thrombocyte count than healthy pregnant women. Moreover, preeclamptic pregnant women had 1.5-2 folds greater serum urea, creatine, uric acid concentrations than healthy pregnant women. Serum chloride and copper levels were not different. Serum calcium concentration was greater whereas serum phosphorus and magnesium and iron levels were lower in healthy pregnant women than preeclamptic pregnant women. Compared to healthy pregnant women, iron binding capacity was lower whereas ferritin level was greater in preeclamptic pregnant women.

Between the groups, there were no differences in serum cholesterol and HDL-cholesterol. Triglyceride and VLDL-cholesterol levels of preeclamptic pregnant women were greater than those of healthy pregnant women. However, healthy pregnant women had greater serum LDL-cholesterol than preeclamptic pregnant women. Expectedly, serum total protein and albumin levels in healthy pregnant women were greater than preeclamptic pregnant women. Activities of SGOT, SGPT and LDH were about 4-5 folds greater for preeclamptic pregnant women than for healthy pregnant women. Blood urea and urine protein levels much greater in preeclamptic pregnant women than healthy pregnant women.

Table 4: Laboratory test results of the healthy (n = 155) and preeclamptic (n = 92) pregnant women[1]

Parameters	Groups: Healthy	Groups: Preeclamptic	t-value	p-value
Leukocyte (10^6 μL^{-1})	9.29±0.18	12.8±0.4	-7.61	<0.0001
Erythrocytes (10^6 μL^{-1})	4.11±0.01	4.30±0.01	-2.15	<0.0100
Hemoglobin (g dL^{-1})	12.6±0.1	12.4±0.2	0.67	<0.4300
Hematocrit (%)	36.1±0.2	36.3±0.7	-0.27	<0.7500
Thrombocyte (10^3 μL^{-1})	220±5	181±10	3.68	<0.0001
Urea (mg dL^{-1})	21.4±0.6	33.7±2.3	-5.22	<0.0001
Creatinine (mg dL^{-1})	0.68±0.01	1.02±0.00	-5.88	<0.0001
Uric Acid (mg dL^{-1})	3.32±0.01	6.19±0.39	-7.31	<0.0001
Chloride (mEq L^{-1})	108±1	107±1	0.53	<0.5100
Calcium (mg dL^{-1})	8.87±0.01	7.92±0.10	8.81	<0.0001
Phosphorus (mg dL^{-1})	3.37±0.01	3.79±0.12	-3.35	<0.0001
Magnesium (mEq L^{-1})	1.76±0.01	2.82±0.12	-8.78	<0.0001
Copper (µg dL^{-1})	220±4	214±10	0.54	<0.2200
Iron (mEq L^{-1})	76±4	108±17	-1.78	<0.0090
Iron-binding capacity (µg dL^{-1})	245±4	209±16	2.29	<0.0010
Ferritin (ng dL^{-1})	19.2±2.5	35.4±10.8	-2.06	<0.0400
Cholesterol (mg dL^{-1})	253±5	264±19	-0.60	<0.4100
Triglyceride (mg dL^{-1})	271±9	311±19	-1.86	<0.0400
LDL cholesterol (mg dL^{-1})	137±4	116±6	2.64	<0.0090
HDL cholesterol (mg dL^{-1})	68±1	66±3	0.88	<0.3000
VLDL cholesterol (mg dL^{-1})	53±2	61±3	-2.11	<0.0200
Total protein (g dL^{-1})	6.84±0.01	6.04±0.01	7.79	<0.0001
Albumin (g dL^{-1})	4.04±0.01	3.30±0.01	12.13	<0.0001
Globulin (g dL^{-1})	2.80±0.01	2.73±0.01	1.06	<0.2400
SGOT (U L^{-1})	17.4±0.6	103±17	-5.15	<0.0001
SGPT (U L^{-1})	13.9±0.6	81.4±13.0	-5.21	<0.0001
LDH (U L^{-1})	197±9	592±48	-8.21	<0.0001
Urine-protein (mg dL^{-1})	3.91±1.75	338±21	-15.57	<0.0001

[1]Values are mean±SE

DISCUSSION

Age is a crucial factor on the development of preeclampsia. Preeclampsia is known as a disease of young and nullipara women. Studies showed that 74-75% of women with preeclampsia are also nullipara (Clausen *et al*., 2001; Thadhani *et al*., 1999). In this study, women >35 years old were more susceptible to preeclampsia (Table 1). However, some researchers claim that age does not increase the risk of preeclampsia (Morris *et al*., 2001; Enquobahrie *et al*., 2004). The level of education may influence nutrition habits during pregnancy period. Lower education was associated with greater preeclampsia prevalence (Table 1). According to a survey done in the province of Elazig in Turkey, 50.5% of the normal pregnant women had only elementary level education. Income level of pregnant women can also alter

nutrition habits. Indeed, women at poverty were more vulnerable to preeclampsia (Table 1). However, it was reported that household income does not affect the incidence of preeclampsia (Enquobahrie *et al*., 2004).

In agreement with present data (Table 2), one of the most important indications of the preeclampsia is blood pressure; systolic blood pressure >140 mm Hg and diastolic blood pressure >90 mm Hg after 20th week of the pregnancy (Lyell *et al*., 2003). Also, 30 and 15 mm Hg boost in systolic and diastolic blood pressures measured every 6 or more hours indicate the incidence of preeclampsia (Lyell *et al*., 2003; Taskin, 1998). Similarly, Wolf *et al*. (2001) determined systolic and diastolic blood pressure levels were 119 and 73 mm Hg for the preeclamptic pregnant women and 112 and 69 mm Hg for the healthy pregnant women.

In the present study, association of preeclampsia with low education and income was reflected in their food choice. Majority of the preeclamptic pregnant women were on low quality and cheap vegetable protein products instead of consuming animal products (Table 3). Sen (1985) states that 88% of pregnant women most want to consume protein sources like meat, egg and legumes however, they can not consume enough animal products because of their low economical condition. Deniz determined the ratio of pregnant women who could not consume adequate animal product as 51.5%. This ratio was 15.5% for those who consumed more than sufficient animal product. Urgell *et al*. (1998) reported a higher rate of 90-97.7% for the pregnant women who consume milk regularly every day. In the present study, among the healthy pregnant women, the ratio of one cup yogurt consumption per day and one cup yogurt consumption every other day was determined as 52.3 and 32.3%, respectively. Conversely, preeclamptic women consumed yogurt approximately in the half amount of the above ratios (Table 3). It was also observed that 34.8% of preeclamptic women did not consume cheese and 60% or more of them consumed only one match box or less cheese per day. On the other hand, 80% or more of the healthy pregnant women consumed more than one match box or more cheese every day. Deniz also reported that the total amount of dairy product consumption was 195.9 g for healthy pregnant women. Richardson and Baird (1995) claim that the risk of preeclampsia incident is higher among the pregnant women who consume less than one glass of milk per day. In another report (Duvekot *et al*., 2002) pregnant women in a control group drink 3 unit milk whereas preeclamptic women drink 2.4 unit milk per day, suggesting that low amount of dairy products consumption could increase vulnerability to preeclampsia. This research also supports argument that more than half of the women with preeclampsia do not consume milk and only ¼ of them consume 1 glass of milk or more per day.

It is recommended for pregnant women to consume 60-90 g lean red meat, white meat, fish and one egg as 2-3 meal per day because ones who do not consume meat has the highest ratio among the preeclamptic women group and most of the healthy pregnant women consume meat at least one time every day (Hally, 1998). White meat consumption was also found insufficient among the preeclamptic women group such that 80% of these women did not consume any white meat or they consumed it once or twice a month (Table 3). Fish consumption amount and ratio among the preeclamptic women was also found lower than the healthy pregnant women just like red and white meat consumption ratio. It is noteworthy that more than half of the healthy pregnant women consume fish once a week whereas almost all of the preeclamptic women do not consume any fish or they consume it once or twice a month. On the contrary of our results, Clausen *et al*. (2001) claim that meat and fish consumption do not have any positive affect on the development of preeclampsia. This research also shows that nutrition habits play an important role in the occurrence of preeclampsia since egg (very cheap but rich in protein), red and white meat and fish consumption amount and ratio was very low among the women with preeclampsia. Possibly due to economical reasons preeclamptic women tended to meet their protein need especially from legumes (Table 3).

It is recommended that pregnant women should consume 1 slice of bread and/or 30 g grain as 6-11 meals a day (Hally, 1998). Likewise due to low income, preeclamptic pregnant women consumed more bread than healthy pregnant women (Table 3) who were less economically challenged (Table 1). Indeed, a high consumption of carbohydrates and excessive energy intake during pregnancy increased the risk of preeclampsia (Clausen *et al*., 2001).

The increase in hematocrit level and decrease in hemoglobin level may indicate preeclampsia (Bolte *et al*., 2001; Kumru *et al*., 2003). However, the subject population did not have difference in hematocrit and hemoglobin levels (Table 4). Decrease of thrombocyte count (Table 4) also points out severe preeclampsia (Bolte *et al*., 2001). A study by Kumru *et al*. (2003) however found no difference in thrombocyte count between healthy and preeclamptic women.

Serum uric acid concentration is another important indication regarding degree of the disease (Bolte *et al*., 2001). Similar to the data (Table 3), Lyell *et al*. (2003) reported that mean uric acid level was 4.03 and 3.02 mg dL^{-1} for preeclamptic women and healthy

pregnant women, respectively. Increased serum creatinine level is also proposed for indication of preeclampsia (Bolte *et al*., 2001). Despite elevation in serum creatinine level in preeclamptic pregnant women in this study, others reported no difference between healthy and preeclamptic pregnant women (Kumru *et al*., 2003; Kisters *et al*., 2000). Hall *et al*. (1997) claim that preeclamptic women consume 79-2,696 mg calcium in their diets and there is no relationship between calcium consumption and preeclampsia. Opposite to the data (Table 4), Wolf *et al*. (2001) stated that there was no difference in serum ionized and total calcium levels. Serum magnesium level decreases as pregnancy progresses and this decrease is evident, especially among preeclamptic women (Wolf *et al*., 2001). It is shown that plasma magnesium level is low among preeclamptic women (Kisters *et al*., 2000). Conversely, preeclamptic women in this study population had greater serum magnesium level than their healthy counterparts (Table 4).

In this study, markers showing serum iron level and iron status were abnormal among preeclamptic women (Table 4). Serum ionized iron and ferritin level were higher among the preeclamptic women than the healthy pregnant women. It was also observed that ferritin level increased whereas transfer level decreased among the preeclamptic women with anemia. Increase of iron may indicate hemolysis which is a symptom of preeclampsia (Robert *et al*., 2003).

Pregnant women whose serum triglyceride level is >133 mg dL^{-1} and whose serum cholesterol level is >205 mg dL^{-1} have 4.15 and 3.6 times higher risk of preeclampsia, respectively (Enquobahrie *et al*., 2004). This suggests that increase of triglyceride level may result in endothelial dysfunction and cause oxidative stress and it may also spoil activity of lipoprotein lipase enzyme and this can increase the risk of preeclampsia. In agreement with literature, preeclamptic pregnant women had higher serum triglyceride and cholesterol levels than health pregnant women.

Lipoprotein level of preeclamptic women is 5 times higher than healthy pregnant women (Mori *et al*., 2003). They also claim that high protein level may cause vascular defects in placenta which also results in decrease in fetal growth and development. In preeclampsia cases, HDL level decreases and triglyceride, LDL cholesterol and LDL increases (Robert *et al*., 2003). Likewise, Enquobahrie *et al*. (2004) state that preeclamptic women have an increase in LDL cholesterol, triglyceride and LDL/HDL levels but there is a decrease in HDL cholesterol levels. Meanwhile, this study reveals no increase in cholesterol and HDL levels, a decrease in LDL cholesterol and an increase in triglyceride and VLDL cholesterol levels of the preeclamptic women (Table 4). Although, triglyceride and VLDL cholesterol levels are high in preeclamptic cases, they are not a parameter to determine the degree and prognosis of preeclampsia (Demirci *et al*., 1999).

In severe preeclampsia, increase of Lactic Dehydrogenase level (LDH) indicates liver dysfunction and the existence of hemolysis (Lyell *et al*., 2003; Bolte *et al*., 2001). This study also shows an increase in LDH levels of the preeclamptic pregnant women compared with the healthy pregnant women (Table 4). The significant decrease of serum albumin levels of preeclamptic women indicates liver dysfunction or structural defect of capillary veins (Bolte *et al*., 2001).

Proteinuria is a symptom not only diagnosis preeclampsia but also determines the degree of this disease. It is also confirmed by the other researchers that discharged protein amount with urine within 24 h is >300 mg L^{-1} for medium level preeclampsia cases and >5000 mg L^{-1} for severe preeclampsia cases (Bolte *et al*., 2001). In agreement with the present study (Table 4), Kisters *et al*. (2000) reported that urine protein level was 1440 and 130 mg L^{-1} for preeclamptic and healthy pregnant women, respectively.

CONCLUSION

Education levels and economic conditions affect nutrition habits and risk for preeclampsia. Women during pregnancy should be encouraged to consume more dairy products, meat, fish and egg which have positive effect on proliferation, body growth and fetal development.

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REFERENCES

Bolte, A.C., H.P. van Geijn and G.A. Dekker, 2001. Management and monitoring of severe preeclampsia. Eur. J. Obstet. Gynecol. Reprod. Biol., 96: 8-20.

Clausen, T., M. Slott, K. Solvoll, C.A. Drevon, S.E. Vollset and T. Henriksen, 2001. High intake of energy, sucrose, and polyunsaturated fatty acids is associated with increased risk of preeclampsia. Am. J. Obstet., 185: 451-458.

Demirci, F., U. Yildirim, S. Eren and H. Gorgen, 1999. Preeklamside serum lipid profili. Klinik Bilimler Doktor, 5: 124-127.

Dudek, S., 1997. Nutrition Handbook for Nursing Practice. 3rd Edn., Lippineott, New York.

Duvekot, E.J., C.J.M. de Grott, K.W.M. Bloemenkamp and S.G. Oei, 2002. Pregnant women with a low milk intake have an increased risk of developing preeclampsia. Eur. J. Obstet. Gynecol. Reprod. Biol., 105: 11-14.

Enquobahrie, D.A., M.A. Williams, C.L. Butler, I.O. Frederick, R.S. Miller and D.A. Luthy, 2004. Maternal plasma lipid concentrations in early pregnancy and risk of Pre-eclampsia. Am. J. Hypertens., 17: 574-581.

Hall, L.L., M.A. Smith, P. Connor and M. Luttrell, 1997. Calcium consumption and the incidence of preeclampsia in patients followed by family practice physicians. J. Am. Diet Assoc., 97: A26-A26.

Hally, S.S., 1998. Nutrition in reproductive health. J. Nurse-Midwifery, 43: 459-470.

Kisters, K., M. Barenbrock, F. Louwen, M. Hausberg, K.H. Rahn and M. Kosch, 2000. Membrane, intracellular and plasma magnesium and calcium concentrations in preeclampsia. Am. J. Hypertens, 13: 765-769.

Kumru, S., S. Aydin, M. Simsek, K. Sahin, M. Yaman and G. Ay, 2003. Comparison of serum copper, zinc, calcium and magnesium levels in preeclamptic and healthy pregnant women. Biol. Trace Elem. Res., 94: 105-112.

Lyell, D.J., G.M. Lambert-Masserlian and L.C. Giudice, 2003. Prenatal screening, epidemiology, diagnosis, and management of preeclampsia. Clin. Lab. Med., 23: 413-442.

Mori, M., A. Mori, Y. Saburi, M. Sida and H. Ohta, 2003. Levels of lipoprotein (a) in normal and compromised pregnancy. J. Perinat. Med., 31: 23-28.

Morris, C.D., S.L. Jacobson, R. Anand, M.G.A. Ewell and J.C. Hauth *et al*., 2001. Nutrient intake and hypertensive disorders of pregnancy: Evidence from a large prospective cohort. Am. J. Obstet. Gynecol., 184: 643-651.

Prentice, A., 2000. Calcium in pregnancy and lactation. Annu. Rev. Nutr., 20: 249-272.

Richardson, B.E. and D.D. Baird, 1995. A study of milk and calcium supplement intake and subsequent preeclampsia in a cohort of pregnant women. Am. J. Epidemiol., 141: 667-673.

Robert, J.M., J.L. Balk, L.M. Bodnar, J.M. Belizan, E. Bergel and A. Martinez, 2003. Nutrient involvement in preeclampsia. J. Nutr., 133: 1684S-1692S.

Steel, R.G.D. and J.H. Torrie, 1981. Principles and Procedures of Statistics. 2nd Edn., McGraw-Hill Int. Book Co., Tokyo.

Swensen, A.R., L.J. Harnack and J.A. Ross, 2001. Nutritional assessment of pregnant women enrolled in the special supplemental program for women, infants and children. J. Am. Diet. Assoc., 101: 903-908.

Thadhani, R., M.J. Stampfer, D.J. Hunter, J.E. Manson, C.G. Solomon and G.C. Curhan, 1999. High blood mass index and hypercholesterolemia: Risk of hypertensive disorders of pregnancy. Obstet. Gynecol., 94: 543-550.

Urgell, M.R., J.F. Benavides, R.G. de Aguero Laborda and E.F. Gonzales, 1998. Maternal nutritional factors: Significance for the fetus and the neonate. Early Human Dev., 53: S61-S76.

Wolf, M., E. Kettyle, L. Sandler, J.L. Ecker, J. Roberts and R. Thadhani, 2001. Obesity and preeclampsia: The potential role of inflammation. Obstet Gynecol., 98: 757-762.