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Relationship between Nutritional Pattern and Occurrence of Pre-Eclampsia and Eclampsia among Primigravidae

Faaeza Hashem Abdel-Fattah*, Fatma Mohamed Nasr El-Din Shuaib**, Olfat Abdel Hamid Darwish***, Maha Mohamed Ibrahim El-Habashy**

ABSTRACT:
Background: Nutritional status during pregnancy influences the course of pregnancy, fetal development, and long-term health of the mother and child. Nutritional deficiencies are common in women of reproductive age in developing countries. Epidemiological and biological evidence suggest that acute or chronic specific nutritional deficiencies can contribute to severe maternal morbidity such as pre-eclampsia. Early detection through simple screening measures and diligent prenatal care can predict or prevent many effects of pre-eclampsia. Therefore, seeking early and regular prenatal care throughout pregnancy is essential. **Objectives:** to find out the relationship between nutritional status and occurrence of pre-eclampsia and eclampsia among primigravidae. **Methods:** in an exploratory, descriptive, retrospective study, a convenient sample of 120 pregnant women was picked up from the high-risk pregnancy outpatient clinics, pre-eclamptic unit and ICU of El-Shatby Maternity University Hospital and Gamal Abdel Nasser Health Insurance Hospital. The study subjects were divided equally into pre-eclamptic and non pre-eclamptic groups. Inclusion criteria included age between 20-35 years, primigravida, from 20-40 weeks of gestation, have no previous medical diseases and willing to participate in the study. Two validated tools were developed and used by the researchers to collect the necessary data; *an interview schedule* to collect basic data such as socio-demographic characteristics and history of pregnancy and *nutritional status assessment sheet* to assess nutritional habits and daily dietary intake. **Results:** calcium and folic acid supplementations were less taken by the study group, compared to the control group. Hemoglobin level and number of meals/day were statistically lower among the study group, compared to the control group. Animal proteins, fruits and vegetables were also statistically occasionally taken by the study group, compared to the control group. In addition, daily consumption of fats, proteins, iron, vitamins A, B_1 and B_2 was statistically less than daily requirement among the study group, compared to the control group. **Conclusion:** less adequate daily intake of proteins, fats, fruits, and vegetables among the pre-eclamptic group was a factor in the incidence of pre-eclampsia. In addition, lack of diet rich calcium and calcium supplementation during pregnancy increased the risk of pre-eclampsia**.** Moreover, low hemoglobin level was significantly linked to the occurrence of pre-eclampsia**.** Pre-eclampsia was also associated with insufficient daily intake of vitamins in the diet such as vitamin A, B_1 & B_2.

Keywords: nutritional pattern, pre- eclampsia, primigravidae

INTRODUCTION

Nutrition during pregnancy is important. Pregnant women's food has a direct effect on the course of pregnancy and normal fetal development as well as the long-term health

*Outpatient Department, El-Shatby Maternity University Hospital
**Obstetric and Gynecologic Nursing Department, Faculty of Nursing, Alexandria University
***Nutrition Department, High Institute of Public Health, Alexandria University

of the mother and child. The foods a pregnant woman eats are the main source of the nutrients for the baby.[1] Nutritional requirements during pregnancy include seven major classes of nutrients; carbohydrates, proteins, fats, vitamins, minerals, fibers, and water. These nutrient classes can be categorized as either macronutrients (needed in relatively large amounts) or micronutrients (needed in smaller quantities). The macronutrients are carbohydrates, proteins, fats, fibers, and water. The micronutrients are minerals and vitamins.[2]

In many developing countries, pregnancy associated physiologic changes can be aggravated by under-nutrition. There is a link between nutritional problems and development of pre-eclampsia.[3,4] Excess calories, over consumption of salt, insufficient proteins, reduced calcium and zinc intake, low magnesium and potassium as well as reduced folate and vitamin C intake are associated with pre-eclampsia.[5-8] Dyslipidemia of pre-eclampsia was also documented. In addition, iron has been reported as abnormal in pre-eclampsia.[9-11] Meanwhile, vitamin E has been reported to be reduced among patients with severe pre-eclampsia.[12,13]

Pre-eclampsia is part of a spectrum of hypertensive disorders that complicate pregnancy.[14] It occurs in up to 5% of all pregnancies and in 10% of first pregnancies. Its greatest impact is in developing countries, where it accounts for 20–80% of the strikingly increased maternal mortality.[15,16] Pre-eclampsia usually occurs in the second half of pregnancy and can be mild or severe.[3] Mild pre-eclampsia is characterized by high blood pressure (140/90 or more), swelling (pitting edema 1+or more), and protein in urine (proteinuria 0.3 g or more) (1+ or more on dipstick). Severe pre-eclampsia occurs when the systolic blood pressure is ≥160 mmHg; the diastolic blood pressure is ≥ 110 mmHg. It is also accompanied by proteinuria (i.e., urinary excretion of ≥0.5 g protein in a 24-h specimen or 3^+ to 4^+ on dipstick).[17]

Patients with severe pre-eclampsia display end-organ effects and may complain of severe headache that is frontal and throbbing. Visual disturbances and severely impaired vision can also manifest.[3,15,18] Manifestations also include altered mental status, nausea or vomiting, dizziness, dyspnea and oliguria with less than 500 ml per 24 hours, as well as rapidly increasing or nondependent edema, which results in rapid weight gain. In addition, they include gastrointestinal complaints of sudden, new-onset, and constant epigastric pain as well as clonus as a sign of neuromuscular irritability.[14,19] On the other hand, eclampsia is an extension of pre-eclampsia process. Women with eclampsia suffer convulsions or "fits", coma, heart failure, shock, fat and bleeding in their livers, and often death. [17]

The most serious consequences of pre-eclampsia and eclampsia include brain damage, blindness, pulmonary edema, cardiovascular complications, and seizures or other neurological manifestations. They also include kidneys and liver damage, which leads to kidney failure and liver rupture. [3, 19] In addition, HELLP syndrome (hemolysis, elevated liver enzymes, and low platelet count) affects 4% -14% of women with pre-eclampsia and lead to mortality or serious morbidity in 25% of affected women. This condition can be life threatening for baby too.[8,15,20] Pre-eclamptic mothers may experience preterm birth and babies born are often smaller than normal. Severe intrauterine fetal growth restriction may also occur, leading to higher prevalence of intrauterine asphyxia, placental abruption and intrauterine fetal death.[16,21,22]

Women who start their pregnancy well nourished are less likely to develop pre-eclampsia. Early detection through simple screening measures (rollover test) and diligent prenatal care can also predict or prevent many effects of pre-eclampsia.[3,19] Moreover, a meta-analysis reported an approximate 15% reduction in pre-eclampsia among pregnant women taking low-dose (75 mg) acetylsalicylic

acid (ASA).[15] On the other hand, treatment of mild pre-eclampsia may be limited to bed rest, with careful daily monitoring of weight, blood pressure, and urine protein via dipstick. Severe pre-eclampsia may require medications to prevent seizures such as magnesium sulfate. Antihypertensive drugs are reserved for patients with very high diastolic blood pressures (over 110 mmHg) because they decrease the amount of blood reaching the fetus, placing it at risk for oxygen deprivation.[23]

Nursing care plan includes assessment of subjective data such as age, medical and obstetric history, pattern of nutrition, as well as level of consciousness and orientation. It also includes psychosocial condition and social support. On the other hand, objective data involve inspection (pitting edema), palpation (fundal height, position and presentation of the fetus, site of edema), auscultation (fetal heart rate) and percussion to know the patellar reflex. Other objective assessments comprise vital signs and blood pressure, urinary output, urine analysis for protein, weight, level of consciousness, clonus, and bleeding tendencies. In addition, vaginal examination should be performed to determine if the patient is in labor. [24,25]

The most important nursing diagnosis of the nursing care plan is that high risk of seizures related to vasospasm and increased blood pressure. Interventions of this diagnosis are to monitor blood pressure every 4 hours, record the patient's level of consciousness, assess signs of eclampsia, monitor for signs and symptoms of labor and collaboration with the medical team in the provision of anti-hypertensive drugs.[24,25]

The epidemiology of pre-eclampsia, being more common in poor women, long ago suggested that nutrients might be involved in the disorder. Numerous conflicting hypotheses were advanced but the testing of these hypotheses has either

been done poorly or not at all. Review of the available data indicates very few studies that provide useful insights.[16]

The aim of this study is to find out the relationship between nutritional status and occurrence of pre-eclampsia and eclampsia among primigravidae.

SUBJECTS AND METHODS

This is an exploratory, descriptive, retrospective study, which was conducted at the high-risk pregnancy outpatient clinics as well as pre-eclamptic units and ICUs of El-Shatby Maternity University Hospital and Gamal Abdel Nasser Health Insurance Hospital.

The study comprised a convenient sample of 120 pregnant women who were divided equally into two groups. ***The study group*** included pregnant women with mild pre-eclampsia; severe pre-eclampsia and eclampsia, 20 women from each category, while the ***control group*** involved 60 pregnant women free from pre-eclampsia and eclampsia. Women whose age ranged between 20-35 years, primigravidae, from 20-40 weeks of gestation, have no previous medical diseases and willing to participate in the study were selected

Two tools were developed and utilized for data collection; tool one: a structured interview schedule which involved data related to socio-demographic characteristics such as age, level of education, occupation, residence, etc. as well as history of pregnancy such as follow–up visits, and nutritional supplementations. Tool two: nutritional status assessment sheet, which included data about laboratory investigations such as hemoglobin level (Hb) and albumenurea as well as dietary intake (nutritional habits and daily dietary intake).

Permissions for data collection were obtained from the responsible authorities of the study settings. Tools were developed by the researcher after extensive review of relevant and recent literature and were tested for content validity by a jury of 10 experts in the related field. An informed

oral consent to participate in the study was obtained from each woman and confidentiality of the collected data was ensured.

A pilot study was carried out on 12 women (6 women from each study setting), who were excluded from the study subjects. The aim of this pilot study is to ascertain the relevance of the tools; detect any problem peculiar to the statements and estimate the time needed to complete the tools. Following this pilot study, the tools were reconstructed and made ready for use.

Data were collected over a period of 8 months starting from the beginning of February till the end of September 2009. Women of the study group were interviewed and assessed during their attendance in high-risk pregnancy outpatient clinic (mild pre-eclamptic women), stay in pre-eclamptic unit (severe pre-eclamptic women) or stay in ICU (eclamptic women). Women of the control group were interviewed and assessed during their attendance in antenatal clinic.

The average time needed to complete the interview schedule and physical assessment ranged between 45 to 60 minutes depending upon the degree of understanding and response of the interviewee. Interview and physical assessment were conducted individually and in total privacy to assure confidentiality of information and its utilization only for the purpose of the research.

Both groups were assessed for hemoglobin level, blood pressure to assess degree of hypertension and albumenurea to assess the amount of protein loss. Dietary intake was assessed by 24 hour recall; kinds and amount of food taken during the last 24 hours were roughly reported by each woman then calculated by the researcher with the help of nutritional specialist and book into the amount of different essential nutritional elements. Then comparison between both groups was done. Analysis of data was

carried out by the researcher. The collected data was categorized, coded, computerized, tabulated and analyzed using arithmetic mean and standard deviation as well as Chi Square test at 5% level.

RESULTS

Table 1 shows number and percent distribution of women according to their socio-demographic characteristics. The mean age of the study and the control groups was approximately equal (24.9 $\pm$ 3.70 & 24.7 $\pm$ 4.08 years) respectively. Housewives as well as illiterate women or those who read and write represent 80% & 40% respectively of the study group, compared to 46.67% & 16.67% respectively of the control group.

The table also illustrates that 41.67% & 38.33% of the study group were rural dwellers and had extended families respectively, compared to 6.67% & 18.33% of the control group respectively. In addition, both groups had small family size (81.67% & 91.67%) respectively and un-crowded houses (75% & 95%) respectively. On the other hand, family income was just enough among 66.67% & 55% of the study and the control groups respectively, while it was less than enough among 25% & 23.33% of them respectively.

Statistically significant differences were found between both groups in relation to level of education (P= 0.017), occupation and residence (P= 0.000), as well as family type (P= 0.015), and crowding index (P= 0.002)

Table 1: Percent distribution of women according to their socio-demographic characteristics

Socio-demographic characteristics	Study group (n=60)		Control group (n=60)		χ^2/FET (P)
	No	%	No	%	
Age:					
20-	31	51.67	37	61.67	1.529
25-	21	35.00	15	25.00	(0.466)
30-35	08	13.33	08	13.33	
Mean & SD	24.9 ± 3.70		24.7 ± 4.08		t-test (P) 0.281 (0.779)
Level of education:					
Illiterate or read & write	24	40.00	10	16.67	
Primary & preparatory	25	41.67	33	55.00	8.154
Secondary & technical	11	18.33	17	28.33	(0.017)*
Occupation:					
Housewife	48	80.00	28	46.67	14.354
Working	12	20.00	32	53.33	(0.000)*
Residence:					
Urban	35	58.33	56	93.33	20.053
Rural	25	41.67	04	06.67	(0.000)*
Family type:					
Nuclear	37	61.67	49	81.67	5.910
Extended	23	38.33	11	18.33	(0.015)*
Family size:					
Small (2-5)	49	81.67	55	91.67	2.596
Large (> 6)	11	18.33	05	08.33	(0.107)
Crowding index:					
Un-crowded (<2)	45	75.00	57	95.00	9.412
Crowded (≥2)	15	25.00	03	05.00	(0.002)*
Family income:					
More than enough	05	08.33	13	21.67	7.261
Just enough	40	66.67	33	55.00	(0.119)
Less than enough	15	25.00	14	23.33	

χ^2 (P): Chi Square Test & P for χ^2 FET (P): Fisher Exact Test & P for FET
*: Significant ≤ 0.05

Table 2 clarifies number and percent distribution of women according to their history of pregnancy. Pregnancy was not followed –up by the vast majority of the study and the control groups (88.33% 91.67%) respectively. On the other hand, nutritional supplementations were taken by the majority of both groups (83.33% & 78.33%) respectively. Meanwhile, iron was taken by 55.32% &56% of the study and the control groups respectively. Calcium and folic acid were taken by 38% & 22% of the study group, compared to 76.6% & 55.32% of the control group. Protein was taken by only 4.26%&2% of both groups respectively. The relationship between both groups was not statistically significant in relation to history of pregnancy.

Table 2 : Percent distribution of women according to their history of pregnancy

History of pregnancy	Study group (n=60)		Control group (n=60)		χ^2/FET (P)
	No	%	No	%	
Follow-up :					
Yes	07	11.67	05	08.33	0.370
No	53	88.33	55	91.67	(0.543)
Nutritional supplementations:					
Yes	50	83.33	47	78.33	0.484
No	10	16.67	13	21.67	(0.487)
Types of Nutritional supplementations: #	**(n=50)**		**(n=47)**		
Iron	28	55.32	26	56.00	
Calcium	19	38.00	36	76.60	7.003
Protein	02	04.26	01	02.00	(0.072)
Folic acid	11	22.00	28	55.32	

More than one response
χ^2 (P): Chi Square Test & P for χ^2
FET (P): Fisher Exact Test & P for FET
*: Significant ≤ 0.05

Table 3 illustrates number and percent distribution of women according to their laboratory investigations. Hemoglobin level was less than 11 gm among 76.67% of the study group, compared to 45% of the control group. In addition, urine analysis for albumen showed that 86.67% of the study group had albuminuria ranging from 1+ to 3+, compared to none of the control group. The difference between both groups was highly statistically significant in relation to hemoglobin level and albuminurea (P=0.000).

Table 3: Number and percent distribution of women according to their laboratory investigations

laboratory investigations	Study group (n=60)		Control group (n=60)		χ^2/FET (P)
	No	%	No	%	
Hemoglobin level (gm):					
≥ 11	14	23.33	33	55.00	12.626
<11	46	76.67	27	45.00	(0.000)*
Albuminurea:					
Free	08	13.33	60	100.0	
1+	11	18.33	00	00.00	91.765
2 +	24	40.00	00	00.00	(0.000)*
3 +	17	28.34	00	00.00	

χ^2 (P): Chi Square Test & P for χ^2
FET (P): Fisher Exact Test & P for FET
*: Significant ≤ 0.05

Table 4 describes number and percent distribution of women according to their nutritional habits. Number of meals/day was less than three as reported by 40% of the study group, compared to 8.33% of the control group. It was three as reported by 33.33% of the former, compared to 66.67% of the latter. On the other hand, meat, poultry, fish and eggs as well as milk and diary products were sometimes taken daily by 78.33% & 71.67% respectively of the study group, compared to 36.67% & 41.67% respectively of the control group. In addition, fruits and vegetables were sometimes taken by 50% of the former, compared to 31.67% of the latter. The difference between both groups was statistically significant in relation to number of meals/day (P=0.000) and daily intake of milk and diary products (P=0.001), meat, poultry, fish and eggs (P=0.000) as well as fruits and vegetables (P=0.041)

Table 4: Number and percent distribution of women according to their nutritional habits

Nutritional habits	Study group (n = 60)		Control group (n = 60)		χ^2/FET (P)
	No	%	No	%	
Number of meals/day:					
- <3	24	40.00	05	08.33	
- 3	20	33.33	40	66.67	19.147
- >3	16	26.67	15	25.00	(0.000)*
Carbohydrate rich foods:					
- Always	24	40.00	24	40.00	0.000
- Sometimes	36	60.00	36	60.00	(1.000)
Butter & oils:					
- Always	14	23.33	09	15.00	1.345
- Sometimes	46	76.67	51	85.00	(0.246)
Meat, poultry, fish & Eggs:					
- Always	13	21.67	38	63.33	21.313
- Sometimes	47	78.33	22	36.67	(0.000)*
Milk & diary products:					
- Always	17	28.33	35	58.33	10.995
- Sometimes	43	71.67	25	41.67	(0.001)*
Fruits & vegetables:					
- Always	30	50.00	41	68.33	4.174
- Sometimes	30	50.00	19	31.67	(0.041)*

χ^2 (P): Chi Square Test & P for χ^2
FET (P): Fisher Exact Test & P for FET
* : Significant ≤ 0.05

Table 5 shows number and percent distribution of women according to their daily dietary intake of food elements. Daily intake of calories and carbohydrates was less than 2800 cal & 400 gm respectively among 98.33% & 95% respectively of the study group and 95% & 96.67% respectively of the control group. In addition, daily consumption of fats and proteins was less than 73gm & 70 gm respectively among 96.67% & 66.67% respectively of the former, compared to 36.67% & 33.33% respectively of the latter. A statistically significant differences were found between both groups in relation to daily intake of fats (P=0.000) and proteins (P=0.001).

Table 5: Number and percent distribution of women according to their daily dietary intake of food elements

daily dietary intake of food elements	Study group (n = 60)		Control group (n = 60)		χ^2/FET (P)
	No	%	No	%	
Energy (cal):					
<2800	59	98.33	57	95.00	2.034
2800- 3000	01	01.67	01	01.67	(0.362)
>3000	00	00.00	02	03.33	
Carbohydrates (gm):					
<400	57	95.00	58	96.67	0.209
≥400	03	05.00	02	03.33	(0.648)
Fats (gm):					
< 73	58	96.67	22	36.67	48.6
≥ 73	2	03.33	38	63.33	(0.000)*
Proteins (gm):					
< 70	40	66.67	20	33.33	14.28
> 70	20	33.33	40	66.67	(0.001)*

χ^2 (P): Chi Square Test & P for χ^2
FET (P): Fisher Exact Test & P for FET *: Significant ≤ 0.05

Table 6 shows number and percent distribution of women according to daily dietary intake of minerals. Less than 1000 mg of calcium was taken daily by 90% & 75% of the study and the control groups respectively. Less than 27 mg of iron was also taken daily by 100% & 93.33% of both groups respectively. Meanwhile, 2000 mg or less of sodium was taken daily by equal percent (91.67%) of both groups. A statistically significant difference was found between both groups concerning daily intake of iron (P=0.042).

Table 6: Number and percent distribution of women according to their daily dietary intake of minerals

Daily dietary intake of minerals	Study group (n = 60)		Control group (n = 60)		χ^2/FET (P)
	No	%	No	%	
Calcium (mg):					
<1000	54	90.00	45	75.00	
1000-1300	03	05.00	10	16.67	5.087
>1300	03	05.00	5	08.33	(0.079)
Iron (mg):					
< 27	60	100.0	56	93.33	4.138
≥ 27	00	00.00	04	06.67	(0.042)*
Sodium (mg):					
≤ 2000	57	91.67	55	91.67	0.536
> 2000	03	08.33	05	08.33	(0.464)

χ^2 (P): Chi Square Test & P for χ^2
FET (P): Fisher Exact Test & P for FET * : Significant ≤ 0.05

Table 7: Number and percent distribution of women according to their daily dietary intake of vitamins

Daily dietary intake of vitamins	Study group (n = 60)		Control group (n = 60)		χ^2/FET (P)
	No	%	No	%	
A (Retinol microgram):					
< 770	11	18.33	02	02.33	6.988
≥770	49	81.67	58	96.67	(0.008)*
B1(Thiamin-mg):					
< 1.4	46	76.67	36	60.00	3.851
≥ 1.4	14	23.33	24	40.00	(0.049)*
B2(Riboflavin-mg):					
< 1.4	10	16.67	02	03.33	5.926
≥ 1.4	50	83.33	58	96.67	(0.015)*
B3 (Niacin-mg):					
<18	47	78.33	39	65.00	2.627
≥ 18	13	21.67	21	35.00	(0.105)
B9 (Folic acid-microgram):					
< 400	49	81.67	48	80.00	
400-600	09	15.00	08	13.33	0.736
> 600	02	03.33	04	06.67	(0.692)

χ^2 (P): Chi Square Test & P for χ^2
FET (P): Fisher Exact Test & P for FET
* : Significant ≤ 0.05

Table 7 describes number and percent distribution of women according to their daily dietary intake of vitamins. Daily intake of vitamin A was 770 microgram or more among 81.67% of the study group, compared to 96.67% of the control group. Meanwhile, daily intake of vitamin B_1&B_2 was less than 1.4 mg among 76.67% & 16.67% respectively of the study group, compared to 60% & 3.33% respectively of the control group. The relationship between both groups was statistically significant regarding daily intake of vitamins A(P=0.008), B_1(P=0.049), and B_2 (P=0.015).

DISCUSSION

Nutritional status during pregnancy influences the course of the pregnancy, fetal development, and the long-term health of the mother and child.[26] Women are more likely to suffer from nutritional deficiencies because of their increased requirements during reproductive period, particularly those of low socio-economic status. Globally, 50 percent of all pregnant women are anemic, and at least 120 million women in less developed countries are underweight.[27] Underweight can lead to increased rates of illness and mortality.[28]

The exact causes of pre-eclampsia and eclampsia are not known. For many years, diet has been suggested to play a role in pre-eclampsia. The hypotheses have been diverse and often mutually exclusive. Thus, increased and reduced dietary sodium, protein, fats or carbohydrates were proposed as possible etiological factors. Rarely were these hypotheses appropriately tested in trials. Not surprisingly, many care providers became disenchanted with these hypotheses and the role of nutrition has not been extensively studied in recent years.[16,29]

The present study revealed that the daily dietary intake of both groups did not satisfy the nutritional requirement of pregnancy. The diet of pre-eclamptic group was less adequate in proteins and fats as compared to the non-pre-eclamptic group (Table 4 & 5). The defect in the daily intake of proteins and fats among the pre-eclamptic group may be a factor in the

incidence of pre-eclampsia rather than the defect in total energy. This finding is partially in accordance with that of Morris et al (2001) in their study in the United States, where they found no difference in energy intake between cases with pre-eclampsia and controls.[30]

Insufficient daily intake of animal proteins in the present study is supported by Haas (2003) who emphasized that pre-eclampsia is caused by insufficient good quality proteins in the diet.[31] Despite this emphasis, no studies indicated reduced protein intake in women with or destined to develop pre-eclampsia. This is supported by trials of protein supplementation that did not reduce the incidence of pre-eclampsia.[16] However, protein supplementation was rarely received by both groups in the present study (table 2).

In contrast, the studies of Kramer (2003)[32] and McKeown (2001)[33] were misinterpreted as indicating that too much protein is bad for women. The major problem with these studies was that the women used powdered protein supplements, not dietary food sources; therefore, protein supplements didn't work. They added that in order to supply the pregnant body with what it needs; dietary protein along with high-complex carbohydrates and all the other nutrients need to come from real food.

Significantly less daily intake of total fat among the study group in the present study contradicts the study of El-Moselhy et al (2011) in Cairo- Egypt, which reported that much fat was significantly dietary risk factor for pre-eclampsia.[34] Earlier studies suggested that fat metabolism play a role in the development of pre-eclampsia. ladipo (2000)[4] and Roberts et al (2003)[6] suggested that omega-3 (n-3) fatty acids, as found in marine fats, have been to be important in the prevention of pre-eclampsia. They found that omega-3 (n-3) fatty acids were lower in erythrocytes of women with pre-eclampsia. On the other hand, the study of Clausen et al (2001)[35] and Roberts et al (2003)[16] reported that high intake of polyunsaturated fatty acids, total free fatty

acids and other lipids increases the risk for pre-eclampsia.

Moreover, Michel (2001)[36], Michel (2002)[37] as well as Froi and Jorgen (2001)[38] emphasized that women should eat lots of fish because it is an excellent source of protein and omega fatty acids, that would assist in preventing pre-eclampsia. In addition, Haas (2003) emphasized that protein and omega fatty acids should also come from varied sources such as pumpkin seeds and flax, from which a woman could obtain the necessary nutrients.[31]

Fruits and vegetables were significantly less consumed daily by the study group, compared to the control group in the present study (Table 4). They provide vitamins and minerals, which their deficiencies may lead to pre-eclampsia. This finding is in harmony with that of El-Moselhy et al (2011) who found that inadequate fresh fruits and vegetables were significant dietary risk factors for pre-eclampsia.[34]

Lack of diet rich calcium and calcium supplementation intake was thought to increase the risk of developing pre-eclampsia in the present study (Table 2 & 6). This finding is supported by a Cochrane review, which done by Hofmeyr et al (2007). They concluded that high blood pressure was reduced with calcium supplementation rather than with placebo.[39] Kumar et al (2009) also concluded that calcium supplementation appears to reduce the occurrence of pre-eclampsia in primigravidae who have a daily dietary calcium intake less than the recommended dietary allowances.[40] Degraff (2009) added that a higher calcium supplementation during pregnancy, which does not exceed the upper intake limit (2500 mg/d), is tolerable and safe.[41]

Anemia was significantly linked to the occurrence of pre-eclampsia in the present study, where the majority of the study group had low hemoglobin level (Table 2). Malnutrition among the study group such as taking less than 3 meals and deficient daily intake of iron were also significantly related to

the disorder (Table 4 & 6). This finding is similar to that of Sifakis and Pharmakides (2000)[42] and Rayman et al (2002)[11] who reported that iron status parameters were found to be abnormal in pre-eclampsia.

Significantly lower daily intake of vitamin A (Retinol) by the study group was thought to contribute to the occurrence of pre-eclampsia in the present study (Table 7). This finding is in line with that of Zhang et al (2001) in their study in Lima, Peru, which confirmed decreased plasma concentration of retinol among women with pre-eclampsia as compared with normotensive pregnant women.[43] However, consumption of excessive amounts of vitamin A may cause birth defects.[44]

Significantly insufficient daily intake of vitamin B_1 (Thiamin) may also be associated with pre-eclampsia in the present study (Table 7). This lower intake will subsequently lowers energy level, which leads to pre-eclampsia as indicated by the study carried out by Roberts et al (2003).[16]

The daily intake of vitamin B_2 (Riboflavin) was also found to be significantly lower among the pre-eclamptic group b in the present study (Table 7). Similarly, it was reported that women who are deficient in this vitamin are more likely to develop pre-eclampsia than women with normal levels. Therefore, vitamin B_2 supplementation may correct the deficiency.[45] Moreover, the daily intake of vitamin B_3 (Niacin) was less than required for pregnancy among a sizeable percent of the study group. (Table 7) This finding is not reassuring because one of the most vital functions of Niacin is its important role for the building of placenta.[46,47] So, its deficiency will lead to abnormal placental development, which is being central to the development of pre-eclampsia.[15,16,20]

Lack of folic acid supplementation was thought to increase the risk of pre-eclampsia in the present study, although the majority of pre-eclamptic and non-pre-eclamptic groups consumed less folic acid rich diet. (Table 2 &7) This finding is in harmony with that of Wen et

al (2008) in their study in Canada, which concluded that supplementation of multivitamins containing folic acid in the second trimester of pregnancy, is associated with reduced risk of pre-eclampsia.[48]

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the present study, it can be concluded that less adequate daily intake of proteins, fats, fruits, and vegetables among the pre-eclamptic group was a factor in the incidence of pre-eclampsia, rather than the defect in total energy. In addition, lack of diet rich calcium and calcium supplementation during pregnancy increased the risk of pre-eclampsia**.** Moreover, low hemoglobin level was significantly linked to the occurrence of pre-eclampsia**.** Pre-eclampsia was also associated with insufficient daily intake of vitamins in the diet such as vitamin A, B_1 & B_2.

Based on the findings of the present study, it was recommended that maternity nurses should emphasize regular antenatal visits to screen pregnant women and identify those who are at high risk for pre-eclampsia. During which they should give them health teaching about the importance of nutrition as well as kinds and amounts of foods that should be taken or avoided.

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