J Food Sci Nutr
Vol 9, p 383~388 (2004)

J Food Science and Nutrition

A Study on Correlation between Premenstrual Syndrome and Nutrient Intake, Exercise Habit of Women

Hye-Jin Hwang† and Yi-Sub Kwak[1]

Department of Food and Nutrition, [1]Department of Leisure and Sports Science, Dongeui University, Busan 614-714, Korea

Abstract

This study was designed to identify how the incidence and severity of premenstrual syndrome (PMS) correlate with the nutrient intakes and exercise habit of women. The subjects of this study were 299 women residing in Busan metropolitan city. Each subject was asked to complete a menstrual discomfort questionnaire (MDQ) for PMS and nutrient intakes. PMS symptom scores of women in their twenties ranked in order of severity were: behavioral change (2.45), followed by pain (2.36) and water retention (2.28), negative effects (2.20), autonomic reaction (1.91), arousal (1.87), decreased concentration (1.76) and decreased control (1.74). For women in their thirties, the symptom of pain was the most dominant (2.93) followed by autonomic reaction (2.69) and behavioral change (2.54), and for those in their forties, negative effect (3.06) was highest, followed by pain (2.97) and autonomic reaction (2.86). The overall symptoms of PMS significantly increased with age (20′: 2.07 points, 30′: 2.34 points, 40′: 2.47 points). There was no correlation of the BMI of the subjects with the symptoms of PMS, but there was a significant negative correlation between the symptoms of PMS and exercise frequency for women in their thirties and forties. Subjects in their twenties exhibited a significant negative correlation for PMS symptoms with the intake of carbohydrate ($p<0.05$), calcium ($p<0.05$) and vitamin E ($p<0.05$). For subjects in their thirties, PMS symptoms were negatively correlated with the intake of calcium ($p<0.05$) and vitamin C ($p<0.05$); and in women in their forties, calcium ($p<0.01$) and carbohydrate ($p<0.05$) intakes were negatively correlated with PMS symptoms. This suggests that PMS represents the clinical manifestation of a nutrient deficiency state, especially calcium. Therefore, we concluded that nutrient supplementation and exercise management are likely to be of benefit in relieving PMS symptoms.

Key words: premenstrual syndrome, nutrient intake, exercise habit

INTRODUCTION

Many women experience physical and mental discomfort before and after the onset of their menstrual period. Premenstrual syndrome (PMS) refers to uncomfortable physical and mental symptoms which occur 7 to 10 days prior to the start of menstruation and decline with the start of menstruation (1).

The symptoms of PMS may vary from person to person and include emotional changes such as neurosis, an excessive desire to eat, depression, fear and sorrow; physical changes including fluid retention, headache, fatigue, swelling of the breasts, weight gain, etc.; and behavioral changes such as avoidance of societal life (2). Reid and Yen (3) observed that 20 to 40% among PMS sufferers experienced temporary physical and mental feeling of incompetence, 3 to 11% of which were sufficiently serious to warrant prescriptions for medicine (4).

There have been numerous biological, psychological and social theories about the cause of PMS, such as hormonal imbalance and neurotransmitter functioning, but no causes have been confirmed thus far (5). Various treatments related to the diverse proposed causes of PMS have also been published so that various studies regarding nutritional supplements (6-8), pharmacotheraphy (9) and exercise management (10) have been investigated; nevertheless, no firm theories have been established.

This study was designed to identify the frequency of PMS among the women in the Busan metropolitan city, and to investigate the relationships between PMS and nutrient intake status, exercise habit, degree of obesity and age; by doing so, this study will provide fundamental information on nutritional supplements with respect to the improvement of the existing symptoms of PMS.

†Corresponding author. E-mail: hhj2001@dongeui.ac.kr
Phone: +82-51-890-1594, Fax: +82-51-890-1579

MATERIALS AND METHODS

Subjects

The subjects of this study included 299 women (twenties: 151, thirties: 73, forties: 75) residing in Busan metropolitan city. The participants understood the object of this study and were willing to participate in it, and they made a self-report.

Anthropometric characteristics

The height and weight of the subjects were measured with automatic instruments (Fanocs model: Fa-95) and body mass index (BMI) was calculated using weight (kg)/height $(m)^2$ (BMI, kg/m^2). PIBW (percent ideal body weight) was the percentage of ideal body weight which was measured using the Broca method [{Height (cm)-100} × 0.9].

Survey of nutrient intake of subjects

In order to investigate the nutritional intake status of the respondents through normal dietary intake, the amount of food intake was investigated and reported with a questionnaire using 78 kinds of food frequency questions. Food intake frequency was divided into 8 different levels as follows: none or very rare, once a month, 2~3 times a month, once a week, 2~3 times a week, 4~6 times a week, once a day and more than twice a day. Again, these were calculated by the daily intake and nutritional intake status was analyzed by means of the NACS 2000 (nutrition analysis and consult service, Damun Information Technology Co., Ltd.) program.

Evaluation of PMS symptoms

The measuring instrument for the symptoms of PMS used in this study was the MDQ (Menstrual distress questionnaire), which was developed by Moss (11) and was divided into 8 categories: pain, decreased concentration, behavioral change, water retention, negative effects, arousal, decreased control, autonomic reaction. The higher the MDQ scores, the more uncomfortable one feels and the lower the MDQ score the less severe symptoms. A score of 1 point indicated no symptoms at all, and 5 points indicated extremely severe symptoms.

Statistical analysis

All data collected were statistically analyzed using a SPSS PC^+ package (version 10.1). For each variable, the average value and standard deviation were measured. The correlations between the symptoms of PMS and nutrient intake, developmental quotient, regularity of doing exercise and their significance were verified by calculating Pearson's correlation coefficient.

Table 1. Physical characteristics of subjects

Valuables	Age		
	20~29	30~39	40~49
Height (cm)	161.42±3.50	159.53±3.54	158.12±2.90
Body weight (kg)	51.87±5.42	55.87±5.42	56.62±4.13
BMI $(kg/m^2)^{1)}$	19.92±2.14	20.56±2.42	22.92±2.44
PIBW $(\%)^{2)}$	93.02±9.75	103.40±9.75	107.52±9.24

[1)]BMI (kg/m^2): Body mass index.
[2)]PIBW: Percent ideal body weight, ideal body weight={height (cm) − 100} × 0.9.

RESULTS AND DISCUSSION

Anthropometric characteristics of subjects

Table 1 shows the age, height and body weight of the subjects. Subjects in their twenties had an average height and weight of 161.42±3.50 cm, 51.87±5.42 kg respectively. BMI (kg/m^2) was 19.92±2.14 and PIBW (percent ideal body weight) was 93.02±9.75%. These results demonstrate that they were lower in weight than the standard set by the Korean Nutrition Society (KNS) (12) − 161 cm and 54 kg, but subjects in the thirties and forties had higher body weight for their height than the KNS standards.

Daily nutrient intakes of subjects

Table 2 shows the daily nutrient intakes and percent of Recommended Dietary Allowance (RDA). Total energy intake in the twenties age corresponded to 84.9% of the RDA, protein intake corresponded to 95.8% of the RDA, and the nutrients consumed at less than 75% of the RDA included iron (64.0% of RDA), calcium (73.0% of RDA) and vitamin B_1 (74% of RDA). In a study of female college students by Lee et al. (13), the intakes of calcium and iron were 72% and 65% of the RDA, respectively. And, according to the National Health and Nutrition Survey (14) conducted in 1998, daily iron intake of women between 20 and 29 years of age was 65.4% of the RDA for Koreans, and calcium intake was 69.7% of RDA.

The vitamin E intake was 8.76±0.43 mg α-TE and corresponded to 87.6% of RDA. Park et al. (15) reported in their study that the amount of vitamin E intake in women aged 19 to 22 was 6.9 mg, which was lower than in this study. In the thirties group, energy intake corresponded to 87.3% of RDA and protein corresponded to 98.6% of RDA; in contrast, the nutrients intakes below 75% of RDA were iron (70.7% of RDA), calcium (74.8% of RDA), vitamin B_1 (72% of RDA) and vitamin B_6 (72.1% of RDA). The nutrient intakes of subjects in their forties were similar to those of subjects in their thirties, and calories intake reached 92.2% of the RDA,

Table 2. Average daily nutrient intakes and %RDA of subjects

Nutrients	RDA[1)]	Age					
		20~29		30~39		40~49	
			%RDA		%RDA		%RDA
Protein (g)	55	52.73±8.62	95.8	54.24±12.12	98.6	57.47±5.46	104.4
Fat (g)		44.69±9.74		49.20±10.21		52.81±10.24	
Carbohydrate (g)		277.12±45.12		298.36±35.12		301.63±50.15	
Fe (mg)	16	10.25±3.62	64.0	11.32±3.98	70.7	11.45±4.52	71.5
P (mg)	700	767.56±173.12	109.6	756.26±110.23	108.0	796.52±135.12	113.7
Ca (mg)	700	511.14±113.15	73.0	524.21±145.12	74.8	522.54±112.16	74.6
Vitamin A (RE)	700	734.12±112.43	104.8	787.01±165.21	112.4	736.51±311.51	105.2
Vitamin B_1 (mg)	1.0	0.74±0.16	74.0	0.72±0.21	72.0	0.77±0.35	77.0
Vitamin B_2 (mg)	1.2	1.24±0.13	103.3	1.15±0.11	95.8	1.09±0.11	90.8
Vitamin B_6 (mg)	1.4	1.23±0.17	87.8	1.01±0.11	72.1	1.14±0.13	81.4
Vitamin E (mg α-TE)	10	8.76±0.43	87.6	8.64±0.82	86.4	8.56±0.15	85.6
Niacin (mg)	13	12.84±2.26	98.7	11.82±3.58	90.9	12.89±1.25	99.2
Vitamin C (mg)	70	84.25±26.24	120.3	79.54±21.62	113.6	80.76±25.35	115.4
Total energy (kcal)	2000	1698.22±324.32	84.9	1746.21±115.12	87.3	1845.12±215.32	92.2

[1)]RDA: Recommended dietary allowance (2000).

which was relatively satisfactory compared to the twenties and thirties subjects.

PMS symptoms of the subject

Table 3 shows the PMS symptoms of the subjects. The symptoms of PMS in the twenties subjects could be divided into 8 subcategories, and behavioral change (2.45) was highest, followed by pain (2.36) and water retention (2.28), negative effects (2.20), autonomic reaction (1.91), arousal (1.87), decreased concentration (1.76), decreased control (1.74). In the thirties subjects, the symptom of pain was the most dominant (2.93), followed by autonomic reaction (2.69) and behavioral change (2.54). In subjects in their forties, negative effect (3.06) was highest, followed by pain (2.97) and autonomic reaction (2.86). Among symptoms of PMS in the study of Mortola (16), fatigue was the most common symptom, and symptoms such as pain in the breast, headache, edema together with anxiety and depression followed. However, Woods et al. (17) reported that the symptoms of PMS occurred in the following order: sensitivity, change of mood, weight gain, edema, tension, skin disease, depression and pain in the breast.

Specific symptoms of PMS appear to change with age progression. It has been demonstrated that with advancing age, the severity of their breast pain, general body, discomfort and depression increases significantly. The overall symptoms of PMS increased with age significantly (20′: 2.07 points, 30′: 2.34 points, 40′: 2.47 points). Huh (18) reported that women who experienced childbirth suffered more from the symptoms of PMS than women experienced no childbirth. Nam et al. (19) reported that the numbers of childbirths and experiencing miscarriage were related to the symptoms of PMS.

The correlation between PMS and exercise frequency and physical characteristics

With regards to exercise, 64.3% of the subjects in their twenties reported that they were doing exercise (Table 4). In reporting exercise frequency, 65.6% said that they exercised once or twice a week, 30.3% '3~4 times a week', 2.0% 'everyday', 2.0% '5~6 times a week'. Exercise types for subjects in their twenties were: 41.4% stretching and 31.3% jogging. In the thirties group, 58.9% of respondents exercised, and 52.0% of the forties group exercised; exercise frequency was once or twice a week, which responded for the majority of the entire group of respondents.

Table 5 shows the correlation between PMS and the height, body weight, BMI, PIBW and exercise frequency of the subjects. BMI did not correlate significantly with the symptoms of PMS and there was a significant negative correlation between the symptoms of PMS and exercise frequency among the respondents in their thirties and forties. Nam et al. (19) reported that the women who engaged in regular exercise had fewer symptoms of PMS than those who did not exercise, and that regular exercise could reduce the symptoms of PMS by means of reducing psychological anxiety occurring before menstruation, reducing stress and increasing blood flow.

Correlation between PMS symptoms and nutrient intake of the subjects

The primary causes of PMS have been attributed to changes in hormones, mental factors, neurotransmitters and lack of nutrients, but nothing yet has been clearly confirmed. The correlations between nutrient intakes and the overall severity of symptoms of PMS are shown in Table 6. In the twenties group, the symptoms of PMS showed a significant negative correlation with the intake

Table 3. PMS symptoms of subjects

Symptoms	Age		
	20~29	30~39	40~49
Pain	**2.36±0.51**[b]	**2.93±0.47**[a]	**2.97±0.35**[a]
Headache	1.91±0.45	2.31±1.12	2.21±1.03
Back pain	2.66±0.32	2.95±0.55	2.96±0.78
Muscle spasms	2.44±0.34	2.98±0.75	2.97±0.48
Fatigue	2.69±0.76	3.11±1.31	2.98±0.76
General body discomfort	2.12±0.43[b]	3.31±0.46[ab]	3.76±0.36[a]
Decreased concentration	**1.76±0.34**	**1.88±0.77**	**2.02±0.75**
Insomnia	1.57±0.46	1.68±0.14	1.65±1.05
Absent mindedness	1.89±0.65	2.08±0.48	1.85±0.68
Confused, uncertain	1.34±0.87	1.53±0.81	1.86±0.73
Difficulty concentrating	1.43±0.71	1.52±0.75	1.96±0.71
Decreased activity	2.58±0.85	2.67±0.56	2.79±0.43
Behavior change	**2.45±0.46**	**2.54±0.89**	**2.59±0.59**
Avoid social activities	2.34±0.76	2.46±0.75	2.54±0.86
Want to be alone	2.67±0.85	2.65±0.85	2.63±0.45
Autonomic reaction	**1.91±0.77**	**2.69±0.53**	**2.86±0.89**
Fainting	1.84±0.72	2.65±0.26	2.86±0.54
Nausea	1.96±1.01	2.81±1.04	2.99±0.58
Vomiting	1.92±0.49	2.63±0.45	2.74±0.92
Water retention	**2.32±0.58**	**2.51±0.78**	**2.55±0.56**
Breast pain	2.23±0.28[b]	2.82±0.46[ab]	3.12±0.35[a]
Edema	2.28±0.79	2.23±0.99	2.16±0.57
Weight gain	2.46±0.76	2.45±0.86	2.37±0.59
Negative effect	**2.20±0.38**[b]	**2.38±0.27**[b]	**3.06±0.57**[a]
Irritable	2.34±0.79	2.33±0.65	3.54±0.89
Over-sensitivity	2.37±1.01	2.39±1.05	3.48±1.16
Depression	2.12±0.49[b]	2.83±0.43[a]	2.93±0.49[a]
Tension	1.99±0.87	1.97±0.45	2.21±0.29
Arousal	**1.87±0.55**	**1.91±0.44**	**1.90±0.51**
Exciting	2.32±0.91	2.23±0.49	2.14±0.34
Feel happy	1.37±0.76	1.49±0.65	1.58±0.62
Energetic	1.96±0.82	2.01±0.33	2.00±0.82
Decreased control	**1.74±0.77**	**1.91±0.57**	**1.86±0.75**
Difficulty in breathing	1.96±0.75	2.21±0.56	2.03±1.06
Beating heart	1.75±0.65	1.70±0.55	1.89±0.73
Eye problem	1.52±0.75	1.84±0.71	1.66±0.42
Total	**2.07±0.47**[b]	**2.34±0.57**[ab]	**2.47±0.49**[a]

Table 4. Exercise habit of the subjects N (%)

Valuables		Age		
		20~29 (n=151)	30~39 (n=73)	40~49 (n=75)
Exercise	No	52 (35.7)	30 (41.1)	27 (48.0)
	Yes	99 (64.3)	43 (58.9)	48 (52.0)
Frequency	1~2/week	65 (65.6)	30 (69.7)	26 (54.1)
	3~4/week	30 (30.3)	9 (20.9)	13 (27.0)
	5~6/week	2 (2.0)	2 (4.7)	5 (11.6)
	Everyday	2 (2.0)	2 (4.7)	4 (8.3)
Type	Jogging	31 (31.3)	11 (25.5)	13 (27.3)
	Stretching	41 (41.4)	13 (30.2)	11 (22.9)
	Tennis	5 (5.1)	3 (7.0)	4 (8.3)
	Weight training	10 (10.0)	8 (18.6)	11 (22.9)
	Swimming	7 (7.1)	5 (11.6)	5 (10.4)
	Others	5 (5.1)	4 (9.3)	4 (8.3)

Table 5. Correlation coefficient between PMS symptoms and physical characteristics subjects

Valuables	PMS Symptoms		
	20~29	30~39	40~49
Height (cm)	-0.163	-0.142	-0.139
Body weight (kg)	-0.167	-0.129	-0.142
BMI (kg/m^2)[1)]	-0.019	-0.010	-0.026
PIBW[2)]	-0.135	-0.135	-0.156
Exercise frequency	-0.128	-0.137*	-0.146*

[1)]BMI (kg/m^2): Body mass index.
[2)]PIBW: Percent ideal body weight, ideal body weight={height (cm) − 100} × 0.9.
*$p < 0.05$.

of carbohydrates ($p < 0.05$), calcium ($p < 0.05$), vitamin E ($p < 0.05$); while in the thirties group symptoms of PMS

Table 6. Correlation coefficient between PMS symptoms and nutrient intakes of subjects

Nutrients	PMS symptoms		
	20~29	30~39	40~49
Protein (g)	0.026	0.045	0.023
Fat (g)	-0.056	-0.042	-0.023
Carbohydrate (g)	-0.210*	-0.048	-0.219*
Fe (mg)	-0.068	-0.090	-0.091
P (mg)	0.045	0.066	0.044
Ca (mg)	-0.212*	-0.271*	-0.378**
Vitamin A (RE)	0.075	0.101	0.075
Vitamin B_1 (mg)	-0.067	-0.049	-0.028
Vitamin B_2 (mg)	-0.037	-0.053	-0.012
Vitamin B_6 (mg)	0.086	0.045	0.132
Vitamin E (mg α-TE)	-0.224*	-0.047	-0.089
Niacin (mg)	0.078	0.069	0.074
Vitamin C (mg)	-0.039	-0.246*	-0.037
Total energy (kcal)	0.069	0.065	0.056

*$p<0.05$, **$p<0.01$.

were negatively correlated with the intake of calcium ($p<0.05$) and vitamin C ($p<0.05$). In subjects of their forties, calcium ($p<0.01$) and carbohydrate ($p<0.05$) intakes were negatively correlated with PMS symptoms. This study clearly demonstrated significant negative correlations between the amount of calcium intake and the symptoms of PMS in all age groups. This is consistent with the proposal that a reduction of calcium concentrations in extra-cellular fluid due to insufficient calcium intake can influence the excitation of neuromuscular tissue involved in emotional control (20) so that the physical symptoms of PMS (6) and depression (21) are closely related. Also, there have been some reports indicating that giving calcium supplements to those with the severe symptoms of PMS relieved symptoms such as a nervous temperament, depression, anxiety, headache and pain (22).

One of the representative nutrients with respect to the symptoms of PMS is vitamin B_6, a coenzyme of neurotransmitters, and there have been some studies claiming that the symptoms of PMS are worsened with insufficient vitamin B_6 intake (23,24); however, there was no significant correlation between PMS and vitamin B_6 intakes.

In this study, there were significant negative correlations between the amount of vitamin E intake and PMS among subjects in their twenties. There have also been other studies indicating that the symptoms of PMS were improved by supplementing 400 IU of vitamin E per day (25). The symptoms of PMS have been shown to be reduced by supplementing magnesium (7). The serotonin is often involved in mood disorders and depression, and may also be involved in the same symptoms occurring prior to menstruation and may be a target for reducing PMS symptoms. Therefore, supplementing tryptophan, which is the precursor of serotonin, has been studied (8). In addition, it has been also reported that the lack of manganese intake for animals would lower their reproductive ability which would correlate with the irregular cycle of menstruation and the change of mood or symptoms of pain during the period prior to menstruation (26).

This study provided convincing evidence for significant negative relationships between the symptoms of PMS and the intake of nutrients such as calcium, vitamin E, carbohydrate and vitamin C; therefore, more research into the use of supplements of these nutrients are needed to fully characterize their efficacy for improving symptoms of PMS. There was also a negative significant correlation between the symptoms of PMS and exercise frequency among the respondents in their thirties and forties. Therefore, there should be an active effort to improve PMS with educational programs emphasizing exercise management as well as nutritional supplements.

ACKNOWLEDGEMENT

This research is supported by Dongeui University in 2004.

REFERENCES

1. Greene R, Dalton K. 1953. The premenstrual syndrome. *BMJ* 1: 1007-1057.
2. Halbrich U, Endicott J, Nee J. 1982. The diversity of premenstrual changes as reflected in the premenstrual assessment form. *Acta Psychiatrica Scandinavia* 65: 46-65.
3. Reid RL, Yen SS. 1981. Premenstrual syndrome. *Am J Obstet Gynecol* 139: 85-104.
4. Hylan TR, Sundell K, Judge R. 1999. The impact of premenstrual symptomatology on functioning and treatment-seeking behavior: experience from United States, United Kingdom and France. *J Womens Health Gend Based Med* 8: 1043-1052.
5. O'Brien PM. 1993. Helping women with premenstrual syndrome. *BMJ* 301: 1471-1475.
6. Thys-Jacobs S. 2000. Micronutrients and the premenstrual syndrome. *J Am Coll Nutr* 19: 220-227.
7. Facchinetti F, Borella P, Sances G, Fioroni L, Nappi RE, Genazzani AR. 1991. Oral magnesium successfully relieves premenstrual mood changes. *Obstet Gynecol* 78: 177-181.
8. Steinberg S, Annable L, Young SN. 1999. A placebo-controlled clinical trial of L-tryptophan in premenstrual dysphoria. *Biol Psychiatry* 45: 313-320.
9. Diegoli MS, da Fonseca AM, Diegoli CA, Pinotti JA. 1998. A double-blind trial of four medications to treat severe premenstrual syndrome. *Int J Gynaecol Obstet* 62: 63-67.
10. Timomen S, Procope BJ. 1971. Premenstrual syndrome and physical exercise. *Acta Obstetrica Gynecologica Scandinavica* 8: 331-337.
11. Moss RH. 1968. The development of a menstrual distress questionnaire. *Psychosom Med* 13: 853-867.

12. Korean Nutrition Society. 2000. Recommended dietary allowance.
13. Lee EY, Kim CH, Paik HY. 1999. Under-reporting in dietary assessment by 24-hour recall method in Korean female college students. *Korean J Nutrition* 32: 957-966.
14. Ministry of Health and welfare. 1999. '98 National Nutrition Survey Report.
15. Park SM, Yu JG, Lee JY. 1998. Analysis of factors to influence requirements of vitamin E and vitamin C in young and healthy men and women. *Korean J Nutrition* 31: 729-738.
16. Mortola J. 1998. Premenstrual syndrome-pathophysiological considerations. *N Engl J Med* 338: 256-257.
17. Woods NF, Most A, Dery GK. 1982. Prevalence of perimenstrual symptoms. *Am J Public Health* 72: 1257-1264.
18. Huh MH. 1985. A study on symptom and causes of premenstrual syndrome. *MS thesis*. Seoul Natl Univ.
19. Nam YS, Kim MJ, Lee CG. 2003. The effects of delivery rate, abortion rate and exercise frequency on premenstrual syndrome in middle-aged women. *Korean J Physical Education* 42: 819-827.
20. Carman JS, Crews E, Bancroft A. 1980. Calcium and calcium regulating hormones in the biphasic periodic psychoses. *J Operational Psychiat* 22: 5-17.
21. Coelho R, Silva C, Maia A. 1999. Bone mineral density and depression: a community study in women. *J Psychosom Res* 46: 29-35.
22. Thys-Jacobs S, Starkey P, Bernstein D. 1998. Calcium carbonate and the premenstrual syndrome: effects on premenstrual and menstrual symptoms. *Am J Obstet Gynecol* 179: 444-452.
23. Wyatt KM, Dimmock PW, Jones PW, O'Brian PM. 1999. Efficacy of vitamin B-6 in the treatment of premenstrual syndrome: systematic review. *BMJ* 318: 1375-1381.
24. Bar W. 1984. Pyridoxine supplements in the premenstrual syndrome. *Practitioner* 228: 425-427.
25. London RS, Murphy L, Kitlowski KE, Reynolds MA. 1987. Efficacy of α-tocopherol in the treatment of premenstrual syndrome. *J Reprod Med* 32: 400-402.
26. Penland JG, Johnson PE. 1993. Dietary calcium and manganese effects on menstrual cycle symptoms. *Am J Obstet Gynecol* 168: 1417-1423.

(Received August 3, 2004; Accepted November 16, 2004)