

Determination of Nutritional Status Via Food Frequency Consumption (FFQ) and Serum Proteins and Anemia Parameters in Multiple Sclerosis (MS) Patients

Multiple Sklerozlu (MS) Hastalarda Besin Tüketim Sıklığı ile Beslenme Durumunun ve Serum Proteinleri ile Anemi Parametrelerin Saptanması

Gamze Akbulut¹, Gurdal Orhan², Erdem Gurkas², Nevin Sanlier¹, Makbule Gezmen-Karadag¹, Yesim Sucullu Karadag²
Hilal Yıldırım¹, Fikri Ak²

¹Gazi University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Ankara, Turkey

²Ankara Numune Education and Research Hospital, Department of Neurology, Ankara, Turkey

ABSTRACT

Objectives: The study was aimed to determine the nutritional status, serum proteins (total protein, albumin, prealbumin) and some anemia parameters (haemoglobin, iron, vitamin B₁₂, homocysteine) of the Multiple Sclerosis (MS) patients.

Methods: It was conducted on 63 MS patients (41 female, 22 male) who have applied to Ankara Numune Education and Research Hospital, Department of Neurology, Turkey. Some anthropometric and biochemical measurements were taken from the study group. Nutritional status was assessed by food frequency consumption results.

Results: The Relapsing/Remitting Multiple Sclerosis (RRMS) was mostly seen in both genders (90.5%). The mean age was found 34.9±8.59 (20-56) years in the study group. The mean body mass index (BMI) was found as 25.2±4.86 kg/m². While the mean albumin (p=0.021), prealbumin (p=0.005), homocysteine (p=0.007), haemoglobin (p<0.001) levels were found to be significantly high; the vitamin B₁₂ measurement (p=0.025) was low in males. The consumption of cheese, red meat, white bread, sugar and carbonated drinks decreased after the diagnosis period in females (p>0.05). There was no change in the consumption of egg, chicken, legumes, vegetable, fruit, margarine, butter and olive oil. Most of the two groups have consumed fish rarely before and after the diagnosis of MS.

Conclusion: It was concluded that nutritional status of MS patients improved after diagnosis and serum proteins which also indicate that adequate and balanced nutrition were in desired levels.

Key Words: Multiple sclerosis, nutrition, albumin, prealbumin, haemoglobin, iron, vitamin B₁₂, folic acid

Received: 03.20.2014

Accepted: 07.27.2014

ÖZET

Amaç: Bu çalışmada Multiple Skleroz'lu (MS) hastalarda beslenme durumunun, serum proteinlerinin (toplam protein, albumin, prealbumin) ve bazı anemi parametrelerinin (hemoglobün, demir, B₁₂ vitamini, homosistein) saptanması amaçlanmıştır.

Yöntemler: Bu çalışma Ankara Numune Eğitim ve Araştırma Hastanesi Nöroloji Bölümüne başvuran 63 MS'li (41 kadın, 22 erkek) hasta üzerinde yürütülmüştür. Çalışma grubundaki bireylerin bazı antropometrik ve biyokimyasal ölçümleri alınmıştır. Beslenme durumu besin tüketim sıklığı alınarak değerlendirilmiştir.

Bulgular: The Relapsing/Remitting Multiple Skleroz (RRMS), her iki cinsiyette de en sık görülen MS türüdür (%90.5. Hastaların ortalama yaşları 34.9±8.59(20-56)yıldır. Beden Kitle İndeksi (BKİ) ortalamaları 25.2±4.86 kg/m² olarak bulunmuştur. Erkeklerde ortalama albumin (p=0.021), prealbumin (p=0.005), homosistein(p=0.007), hemoglobün (p<0.001) düzeyleri önemli düzeyde yüksek iken, B12 vitamin düzeyi düşük bulunmuştur (p=0.025). Kadınların peynir, kırmızı et, beyaz ekme, şeker ve karbonatlı içecek tüketimleri teşhis sonrasında azalmıştır (p>0.05). Her iki cinsiyette de yumurta, tavuk, kurubaklagiller, sebze, meyve, margarin, tereyağ ve zeytinyağ tüketimleri değişmemiştir. Her iki grubunda büyük çoğunluğu balığı hem teşhis öncesi hem de sonrasında seyrek tükettiğini vurgulamıştır.

Sonuç: MS hastalarında tanı sonrası beslenme durumunun iyileştiği ve aynı zamanda yeterli ve dengeli beslenmenin bir göstergesi olan serum proteinlerinin de istenilen düzeylerde olduğu sonucuna varılmıştır.

Anahtar Sözcükler: Multiple Sklerozis, beslenme, albumin, prealbumin, hemoglobün, demir, B12 vitamini, folik asit

Geliş Tarihi: 20.03.2014

Kabul Tarihi: 27.07.2014

Address for Correspondence / Yazışma Adresi: Assoc. Prof. Gamze Akbulut, Gazi University Faculty of Health Sciences Department of Nutrition and Dietetics Besevler, Ankara, Turkey, Phone: +90-312 216 26 01 Fax: +90-312 216 26 36 E-mail: dytgamzea@gmail.com

©Telif Hakkı 2014 Gazi Üniversitesi Tıp Fakültesi - Makale metnine <http://medicaljournal.gazi.edu.tr/> web adresinden ulaşılabilir.

©Copyright 2014 by Gazi University Medical Faculty - Available on-line at web site <http://medicaljournal.gazi.edu.tr/>

doi: <http://dx.doi.org/10.12996/gmj.2014.40>

INTRODUCTION

Multiple sclerosis (MS) is an inflammatory demyelinating disease of the central nervous system that causes neurological impairment which mainly affects young adults (2,6). Multiple sclerosis is rare in tropical areas, but quite common in developed countries. The distribution of the prevalence and incidence of MS is more complex and uneven than previously supposed and little is known about the wide variations among different ethnic groups in any country and areas at the same latitudes (11). MS is more common among women than men. The disease has a prevalence of 30-80 per 100.000 in Canada, northern Europe and the United States (19).

The cause of MS remains so far unknown. Studies revealed different risk levels depending on climate, age and gender (6). Nutritional status and dietary habits in MS patients have not been extensively studied or reported, however individual findings suggest that many patients suffer from various forms of malnutrition (5). The assessment of nutritional status is essential for a diagnosis of nutritional compromise and for the required multidisciplinary management. The assessment of body mass index (BMI) on the other hand has not proven to be a good indicator of nutritional status. It is based on acute phase proteins, producing a situation that would alter the specificity for the diagnosis of visceral protein malnutrition. Albumin and prealbumin, although widely used, should be used with caution. Increased plasma levels of prealbumin with a short half-life- can indicate an adequate response to nutritional support (22,11). Neurobehavioral and cognitive functions are related to the vitamin B₁₂ status. Multiple Sclerosis patients generally present a decrease of neuroprotective and immunoregulatory vitamins and an increase of total homocysteine concentrations (13).

In this present study, it is aimed to determine the nutritional status, serum proteins (total protein, albumin, prealbumin) and some anemia parameters (haemoglobin, iron, vitamin B₁₂, homocysteine) of the Multiple Sclerosis (MS) patients.

MATERIALS AND METHODS

This study was conducted on 63 MS patients (41 female, 22 male) who have applied to Ankara Numune Education and Research Hospital, Department of Neurology, Turkey from April to July 2012. The disease was diagnosed by a neurologist. Pregnant women, habitual smokers, alcohol drinkers, and consumers of vitamin-rich products were excluded from the study. Among the cases, individuals with other disorders in addition to MS were also excluded. The participants were informed about the subject and the purpose of the research. Each participant signed a voluntary participation form and gave informed written consent which adhered to Declaration of Helsinki protocols (World Medical Association).

All anthropometric measurements were taken by trained dieticians. During the measurement process, participants wore light clothes and had bare feet. A portable scale was used to measure the body weight to the nearest half kilogram. Height was measured to the nearest 0.1 cm with a wall-mounted stadiometer. Body mass index (kg/m²) was calculated by weight in kilograms divided by the square of height in meters. (20). Waist circumference was measured above the iliac crest and below the lowest rib margin at minimum respiration, and waist to hip ratio (WHR) was calculated (8).

A validated semi quantitative food frequency questionnaire was used in this study. Food consumption data were collected from each patient during a face-to-face interview with researchers. According to the results, every day or every other day consumption of nutrients was considered as "frequent consumption", 1 or 2 times a week as "moderate consumption", and 1 or 2 times a month/year and no consumption as "rare/no consumption".

Early-morning venous blood samples were obtained from each participant for biochemical screening tests, following a twelve-hour overnight fast. Professional staff performed venipuncture by using vacutainers to obtain 15 mL of whole blood. Blood was centrifuged for plasma separation at the hospital where the actual biochemical analyses were performed. Complete hemogram, fasting plasma glucose (FPG), total protein, albumin, vitamin B₁₂, homocysteine, folate levels were measured. The Ubbink method was used to establish plasma levels of homocysteine. Complete hemogram was analyzed by "Sysmex XE-2100 hemogram". Fasting plasma glucose (FPG), total protein and albumin were analyzed by "Roche MODULAR Analytics P800" (Roche Diagnostics, Indianapolis, IN) and vitamin B₁₂, homocysteine, folate levels were analyzed by Roche MODULAR Analytics E601 (Roche Diagnostics, Indianapolis, IN)

Data Analysis

The data analysis was carried out using SPSS version 15.0 software (SPSS Inc., Chicago, IL, USA). The descriptive statistics of means with 95% CI were used to summarise the data collected. The Kolmogorov-Smirnov test was used to determine whether outcome variables were normally distributed.

Means were analyzed by an independent sample t-test. The level of significance was set as p< 0.001.

RESULTS

This study was conducted on 63 (41 females, 22 males) MS patients between the ages of 20-56 years. The mean age was found 35.1±8.90 years for females, 34.6±8.19 years for males (p>0.05). The most of the females (80.5%) and 68.2% of the males were married. The educational status of the males was found higher than the females'. The 63.7% of the males were graduated from high school and/or had a bachelor's degree while most of the females graduated from primary school (36.6%). When the individuals were evaluated by their professions, the majority of the females were observed to be housewives (73.2%) and only 18.2% of the males were found to be retired.

Table 1 shows mean±S.D. for body weight (BW), body mass index (BMI) and waist-hip ratio (WHR), fasting plasma glucose (FPG), total protein, albumin, prealbumin, homocysteine, haemoglobin, iron, vitamin B₁₂, folic acid measurements. The mean BMI was found as 25.4±4.89 kg/m² for females and 24.8±4.89 kg/m² for males (p>0.05) and the mean WHR was found to be significantly high in men (p=0.001). While the mean albumin (p=0.021), prealbumin (p=0.005), homocystein (p=0.007), haemoglobin (p<0.001) levels were found to be significantly high; the vitamin B₁₂ measurement (p=0.025) was low in males.

Table 1. Some anthropometric and biochemical parameters of the patients

Parameters	Female (n=41) mean± SD	Male(n=22) mean ± SD	Total (n=63) mean± SD	p
BW(kg)	64.7±11.19	76.9±14.03	68.9±13.49	0.001*
BMI (kg/m²)	25.4±4.89	24.8±4.89	25.2±4.86	0.677
WHR	0.80±0.06	0.87±0.06	0.82±0.06	<0.001*
FPG (mg/dL)	86.1±15.41	87.4±8.46	86.6±13.34	0.659
T. protein (g/dL)	73.8±4.82	75.5±4.73	74.4±4.82	0.193
Albumin (g/L)	45.6±3.90	47.8±3.39	46.4±3.86	0.021**
Prealbumin (mg/dL)	24.3±4.84	29.5±7.34	26.1±6.30	0.005**
Homocysteine (µmmol/L)	10.3±3.04	13.1±4.05	11.3±3.65	0.007**
Haemoglobin (g/dL)	12.9±1.40	15.2±1.31	13.7±1.75	<0.001*
Iron (µg/dL)	78.1±41.22	97.8±45.06	84.9±43.29	0.096
Vitamin B₁₂ (pg/mL)	418.6±346.09	283.8±106.12	371.5±292.04	0.025**
Folic acid (ng/mL)	8.9±3.60	8.3±2.10	8.69±3.15	0.415

BW: Body weight, BMI: Body mass index, WHR: Waist hip ratio, FPG: Fasting plasma glucose

*p<0.001, ** p<0.05

The food consumption frequency of basic nutrients by MS patients has also been determined (Table 2a - 2b). While frequent consumption of milk products like yogurt is high; the milk consumption was low in female patients (p>0.05). Although there was no change in the consumption of egg, chicken, legumes, vegetable, fruit, margarine, butter and olive oil, the consumption of cheese, red meat, white bread, sugar and carbonated drinks decreased after the diagnosis period in females (p>0.05). Besides that, there was no difference in the consumption of foods except for legumes and carbonated drinks according to the diagnosis criteria in males. Most of the two groups have consumed fish rarely before and after the diagnosis of MS.

DISCUSSION

The Relapsing/Remitting Multiple Sclerosis (RRMS) is the most common form of the disease. The vast majority (~85%) of people presenting with MS are first diagnosed with relapsing/remitting. Twice as many women as men present with this variety. Approximately 50% of patients with RRMS convert to Secondary Progressive Multiple Sclerosis (SPMS) within 10 years of the disease onset (13). In this present study, RRMS was mostly seen in both genders (90.5%). Only 4.9% of the females and 13.6% of the males were diagnosed as Secondary Progressive Multiple Sclerosis (SPMS). When patients were evaluated by the year of diagnosis, only approximately 10% of the whole group (9.7% females, 9.0% males) have been first diagnosed more than 10 years ago. As MS is more common in females than males and frequently affects women during their reproductive years (10,9), the majority of the present study sample consisted of females (65%).

Table 2a. Consumption frequency of some basic nutrients according to the diagnosis status in MS female patients (n=41)

Nutrients	Before Diagnosis						After Diagnosis					
	Frequent consumption		Moderate consumption		Rare/no consumption		Recommended frequency		Moderate consumption		Rare/no consumption	
	n	%	n	%	n	%	n	%	n	%	n	%
Milk	9	22.0	5	12.2	27	65.9	8	19.5	5	12.2	28	68.3
Yoghurt	20	48.8	2	4.9	19	46.3	19	46.3	4	9.8	18	43.9
Cheese	28	68.3	3	7.3	10	24.4	25	61.0	2	4.9	14	34.1
Egg	24	58.5	12	29.3	5	12.2	24	58.5	12	29.3	5	12.2
Red meat	8	19.5	9	22.0	24	58.5	6	14.6	9	22.0	26	63.4
Chicken	10	24.4	19	46.3	12	29.3	10	24.4	20	48.8	11	26.8
Fish	-	-	5	12.2	36	87.8	-	-	7	17.1	34	82.9
Legumes	7	17.1	17	41.5	17	41.5	7	17.1	18	43.9	16	39.0
Fruit	29	70.7	8	19.5	4	9.8	30	73.2	7	17.1	4	9.7
Vegetable	22	53.7	15	36.6	4	9.8	22	53.7	15	36.6	4	9.8
White bread	38	92.7	-	-	3	7.3	34	82.9	-	-	7	17.1
Whole wheat bread	6	14.6	1	2.4	34	82.9	10	24.4	1	2.4	30	73.2
Margarine	6	14.6	2	4.9	33	80.5	6	14.6	2	4.9	33	80.5
Butter	12	29.3	4	9.8	25	61.0	12	29.3	3	7.3	26	63.4
Olive oil	25	61.0	2	4.9	14	34.1	25	61.0	2	4.9	14	34.1
Sugar	28	68.3	3	7.3	10	24.4	26	63.4	3	7.3	12	29.3
Carbonated drinks	9	22.0	1	2.4	31	75.6	7	17.1	1	2.4	33	80.5

Table 2b. Consumption frequency of some basic nutrients according to the diagnosis status in MS male patients (n=22)

Nutrients	Before Diagnosis						After Diagnosis					
	Frequent consumption		Moderate consumption		Rare/no consumption		Recommended frequency		Moderate consumption		Rare/no consumption	
	n	%	n	%	n	%	n	%	n	%	n	%
Milk	4	18.2	3	13.6	15	68.2	3	13.6	4	18.2	15	68.2
Yoghurt	15	68.2	1	4.5	6	27.3	14	63.6	1	4.5	7	31.8
Cheese	13	59.1	3	13.6	6	27.3	13	59.1	2	9.1	7	31.8
Egg	11	50.0	8	36.4	3	13.6	11	50.0	8	36.4	3	13.6
Red meat	5	22.7	9	40.9	8	36.4	5	22.7	8	36.4	9	40.9
Chicken	10	45.5	9	40.9	3	13.6	10	45.5	9	40.9	3	13.6
Fish	1	4.5	5	22.7	16	72.7	1	4.5	3	13.6	18	81.8
Legumes	4	18.2	14	63.6	4	18.2	5	22.7	12	54.5	5	22.7
Fruit	16	72.7	5	22.7	1	4.5	17	77.3	4	18.2	1	4.5
Vegetable	11	50.0	6	27.3	5	22.7	12	54.5	6	27.3	4	18.2
White bread	20	90.9	1	4.5	1	4.5	20	90.9	-	-	2	9.1
Whole wheat bread	2	9.1	1	4.5	19	86.4	2	9.1	1	4.5	19	86.4
Margarine	4	18.2	-	-	18	81.8	4	18.2	-	-	18	81.8
Butter	8	36.4	2	9.1	12	54.5	8	36.4	2	9.1	12	54.5
Olive oil	9	40.9	1	4.5	12	54.5	8	36.4	1	4.5	13	59.1
Sugar	16	72.7	1	4.5	5	22.7	16	72.7	1	4.5	5	22.7
Carbonated drinks	9	40.9	5	22.7	8	36.4	7	31.8	4	18.2	11	50.0

Existing lifestyles and existing consumption behaviours could help to explain the clusters of MS, whereas imported lifestyles and imported consumption behaviours could help to explain the epidemics of MS (10). Dietary factors have been suggested as a possible cause of MS, but without strong evidence (17). There are only a few prospective studies available and most evidence is derived from case-control or epidemiological studies. Population based epidemiological studies indicate a variety of associations between MS and nutrition (17,3). Malnutrition, some vitamin deficiencies, obesity and weight loss are common and may exacerbate the clinical symptoms in MS (17). In this present study, the mean BMIs of both gender was found to be about 25 kg/m² which means majority of the patients had a normal weight.

To characterize the biochemical status of MS during a phase of clinical inactivity, neuroprotective and immunoregulatory vitamins and homocysteine levels were assessed. The men with haemoglobin < 13 g/dL and women with haemoglobin < 12 g/dL were defined as having haemoglobin deficiency or anemia according to the World Health Organization (WHO) criteria (21). In this present study, the haemoglobin concentration was found to be significantly higher in males as expected. Furthermore, there was no one with a serum iron level < 60 µg/dL, which is considered as "low concentration" (18). Serum vitamin B₁₂ level >200 pg/mL is generally a criterion of "normal level" (12). Females' vitamin B₁₂ status had been found to be significantly higher than that of the

males (p<0.05) and also none of the patients had folic acid deficiency (< 4 ng/mL) (4). In addition, patients with the blood homocysteine level > 12.4 µM were defined as having abnormally high homocysteine levels. We found significantly higher levels of homocysteine in males than in females' (p<0.05) as it was previously found in Salemi et al.'s study (16). Williams et al. (22) studied the nutrient intake and biochemical status of 20 severely disabled MS women. The intakes of nutrients were lower than the recommended daily amounts of iron and folate. Also they found that mean plasma levels of albumin and iron were toward the lower end of the normal range in all subjects. In this present study, the mean albumin (p=0.021) and prealbumin (p=0.005) concentrations were low in females, which means that the nutritional status of females was worse than that of the males as Saka et al. (15) found, indicating that MS patients generally have a poor nutritional status.

Consuming foods in appropriate quantities suitable for the individual needs and in various types is important for healthy nutrition of the MS patients and for decreasing the risk of its other symptoms. Milk and milk products are good resources for repairing and maintaining the bone tissues of individuals (7). Therefore, it is recommended for the adults to consume milk and milk products every day (frequent consumption). In the present study, especially the females did not consume milk and milk products with the recommended frequency.

Meat and meat products are good-quality protein resources, and they also include iron. In this study, we have seen that products like red meat, fish and chicken were consumed to a relatively lower extent especially after the diagnosis of MS. Insufficient consumption of meat and meat products may be due to their high prices, especially for people with a relatively lower socio-economical status (SES). It may also be about the news on media that emphasize that these products increase blood cholesterol and the triglyceride levels. Legumes can compete with meat, if right preparation and cooking methods are used and if they are consumed with complementary products. But in this present study, within each of the two genders, the consumption of legumes was considerably low. It may be due to the fact the study was conducted in the summer season.

It is also a pleasant result that MS patients consume fresh fruit and vegetables at the recommended frequency especially after the diagnosis period where their intakes of antioxidant vitamins should be in sufficient levels. Bread and cereals are basic energy resources of the diet. They are also rich sources of the group of B vitamins. In this study, while white bread was highly consumed, whole wheat bread was consumed at a lower degree in both genders especially before the diagnosis period. After the diagnosis, consuming whole wheat bread would become higher in both genders although it was found insignificant.

CONCLUSION

It is concluded that an adequate and balanced nutrition of MS patients is important for helping live a healthy life and improving the quality of life (QoL). Although there is no direct evidence that nutrition is a causative factor, important symptoms that affect energy and nutrient intake and nutritional status in MS patients are: reduced mobility, fatigue, poor sight, dysphagia, cognitive difficulties, depression, pressure sores and the side-effects of drugs such as nausea, vomiting and diarrhoea, dry mouth, weight gain and drug and nutrient interactions. A 'healthy eating' diet is recommended especially in RRMS in line with current healthy eating recommendations. The aim is to develop the plasma levels of essential fatty acids, antioxidants, folate and vitamin B₁₂. An approach to weight management, with highly structured menu plans, is rarely appropriate in MS, especially if cognitive function is impaired. The dietary advices provide the opportunity to reinforce the principles of healthy eating and create some changes toward reducing energy intake. It is advised to consume semi-skimmed milk rather than full-fat milk, fresh fruits and vegetables, fresh fruit juices rather than 'added sugar' drinks, fish rather than fatty-red meat, and whole wheat bread/cereals.

Acknowledgements

We would like to thank all our participants who devoted their time to participating in this study. Their helpful and wholehearted cooperation is warmly acknowledged.

Conflict of Interest

No conflict of interest was declared by the authors.

REFERENCES

1. Buchter B, Dunkel M, Li J. Multiple Sclerosis: A Disease of Affluence? *Neuroepidemiology* 2012;39:51-6.
2. Castro-Borrero W, Graves D, Frohman TC, Flores AB, Hardeman P, Logan D, et al. Current and emerging therapies in multiple sclerosis: a systematic review. *Ther Adv Neurol Disord* 2012;5:205-20.
3. Coo H, Aronson KJ. A systematic review of several potential non-genetic risk factors for multiple sclerosis. *Neuroepidemiology* 2004;23:1-12.
4. de Benoist B. Conclusions of a WHO technical consultation on folate and vitamin B12 deficiencies. *Food Nutr Bull* 2008;29(Suppl):238-44.
5. Habek M, Hojsak I, Brinar VV. Nutrition in multiple sclerosis. *Clin Neurol Neurosurg* 2010;112:616-20.
6. Hersh C, Rae-Grant A. Extended-release dalfampridine in the management of multiple-sclerosis-related walking impairment. *Ther Adv Neurol Disord* 2012;5:199-204.
7. Kim K, Reicks M, Sjöberg S. Applying the theory of planned behavior to predict dairy product consumption by older adults. *J Nutr Educ Behav* 2003; 35:294-301.
8. Lohman TG, Roche AF, Martorell R. *Anthropometric Standardization Reference Manual*. Kinetics Books, Champaign, Illinois. 1998; pp. 1-50.
9. McCombe PA, Greer JM. Female reproductive issues in multiple sclerosis. *Mult Scler* 2013;19:392-402.
10. Mirza M. The etiology and the epidemiology of multiple sclerosis. *Erciyes Medical Journal* 2002;24:40-7.
11. Moghtaderi A, Rakhshanzadeh F, Shahraki-Ibrahimi S. Incidence and prevalence of multiple sclerosis in southeastern Iran. *Clin Neurol Neurosurg* 2012; Epub ahead of print.
12. Morris MS, Jacques PF, Rosenberg IH, Selhub J. Folate and vitamin B-12 status in relation to anemia, macrocytosis, and cognitive impairment in older Americans in the age of folic acid fortification. *Am J Clin Nutr* 2007;85:193-200.
13. Olerup O, Hillert I, Fredrikson S, Olsson T, Kam-Hansen S, Möller E, et al. Primarily chronic progressive and relapsing/remitting multiple sclerosis: two immunogenetically distinct disease entities. *PNAS* 1989;86:7113-17.
14. Ruiz-Santana S, Arboleda Sánchez JA, Abilés J. Spanish Society of Intensive Care Medicine and Coronary Units-Spanish Society of Parenteral and Enteral Nutrition (SEMICYUC-SENPE). [Guidelines for specialized nutritional and metabolic support in the critically-ill patient. Update. Consensus of the Spanish Society of Intensive Care Medicine and Coronary Units-Spanish Society of Parenteral and Enteral Nutrition (SEMICYUC-SENPE): nutritional assessment]. *Med Intensiva*. 2011;35 Suppl 1:12-6.
15. Saka M, Saka M, Koseler E, Metin S, Bilen S, Aslanyavrusu M, et al. Nutritional status and anthropometric measurements of patients with multiple sclerosis. *Saudi Med J* 2012;33:160-6.
16. Salemi G, Gueli MC, Vitale F, Battaglieri F, Guglielmini E, Ragonese P, et al. Blood lipids, homocysteine, stress factors, and vitamins in clinically stable multiple sclerosis patients. *Lipids Health Dis*. 2010;9:19.
17. Schwarz S, Leweling H. Multiple sclerosis and nutrition. *Mult Scler* 2005;11:24-32.
18. Shine JW. Microcytic anemia. *Am Fam Physician* 1997;55:2455-62.
19. Valenzuela-Landaeta K, Rojas P, Basfi-Fer K. Nutritional assessment for cancer patient. *Nutr Hosp*. 2012;27:516-23.
20. WHO/FAO. *Diet, Nutrition and the Prevention of Chronic Diseases*, WHO Technical Report Series, 916, Geneva, 2003.
21. WHO/UNICEF/UNU. *Iron deficiency anaemia assessment, prevention, and control: a guide for programme managers*. Geneva, Switzerland: World Health Organization, 2001.
22. Williams CM, Lines CM, McKay EC. Iron and zinc status in multiple sclerosis patients with pressure sores. *Eur J Clin Nutr* 1988;42:321-8.