

## 8. Abstract

Multiple sclerosis (*Lat. Sclerosis Multiplex* - SM) is a disease of the central nervous system of the autoimmune origin. In people with MS, T lymphocytes are directed towards a host's myelin sheath. Macrophages infiltrate around the nervous cells in the central nervous system (CNS). The reactive forms of oxygen are produced excessively, which, especially at the low number of antioxidants in the CNS, leads to an oxidative stress, damage to mitochondria and, in consequence, to a demyelinating damage to axons. Demyelinating foci lead to the development of neurological disorders that are transient in an initial phase, but when a disease progresses, they perpetuate. Symptoms differ in particular patients depending on the type of MS, disease duration and the disease-affected regions of the CNS. Vision deficiencies, numbness, paresthesia, hyperesthesia of one or several extremities can occur. There are also vertigo, frequent constipations or sexual dysfunctions. One fourth of patients suffer from depression. Expanded Disability Status Scale (EDSS) is the tool most frequently used to assess the clinical condition of patients with MS. Nutrition is a basic life function. To maintain good health, all essential nutrients should be provided. In case of autoimmune disorders with inflammation in their course, a special attention is paid to pro- or anti-inflammatory components of a diet, mainly essential unsaturated fatty acids (UFAs), antioxidative vitamins: A, E and C, vitamin D as well as minerals, such as: Zn, Cu, Se. Elements Mg, Se, Cu and Zn play a structural role in the organism. Additionally, these components are essential to maintain the acid-base and water-electrolyte balance. They take part in muscle-nerve transmission, build numerous enzymes in the organism and are responsible for proper functioning of every cell at the level of cellular membranes or organelles. In the environment there are also harmful elements such as Cd or Pb, which affect negatively the function of the nervous system and trigger an oxidative stress.

The main objective of the study was to evaluate correlations between the concentrations of chosen elements (Se, Zn, Cu, Mg, Cd, Pb), the total antioxidative status in the blood, and nutritional and environmental factors, medications taken and MS patients' clinical status.

The study included 71 people constituting a control group and 101 patients with MS from the neurological out-patient clinic 'KENDRON' in Białystok. The control group was selected appropriately according to the study group of patients with MS with regard to sex, age and body mass, the percentage of smokers and non-smokers. The study participants were within the age range of 19 to 60 years old. The venous blood was taken from the participants of the study, in case of patients with MS during remission of the disease. The study participants were questioned about the age, gender, cigarette smoking, medications and dietary supplements. They completed the questionnaire about the frequency of consuming food groups compiled according to the directives about Human Nutrition of the Scientific Committee of the National Scientific Academy and the 24-hour dietary recall. Dietary histories were input to the computer program Dieta 5.0, and the results were elaborated according to the recommendations of the Institute of Food and Nutrition by using the method of probability estimate. The physical condition of MS patients was assessed according to the EDSS scale. The study was approved by the Bioethics Commission of the Medical University of Białystok nr R-I-002/70/2011 as well as by patients included in the study.

The concentration of elements was determined by flameless atomic absorption spectrometry with electrothermal atomization in a graphite cuvette (Se, Cu, Cd, Pb) and atomization in an acetylene air flame (Zn, Mg) with the Zeeman correction background in the apparatus of Z-2000 Hitachi firm, Japan. Accuracy of the methods determining elements was checked on the certified reference materials: Seronorm 1309438 – human serum, 1406264 – whole blood. The total antioxidative status was assayed by spectrophotometry using a spectrophotometer of Hitachi U-2001 firm, Japan and a kit of reagents of Randox firm. The results obtained were elaborated statistically by means of the computer program of Statistica 12. The level of significance of 0.05 (or 5%) was chosen.

The analysis of the 24-hour dietary recall showed that a diet of people with MS is improper and needs modification. Insufficient consumption of polyunsaturated fatty acids, fiber, vitamins: A, D, E, folic acids, B<sub>12</sub>, C and macro elements, such as: K, Ca, Mg. MS patients' diet should be modified to be supplemented with foods –

good sources of nutrients mentioned above. Patients with multiple sclerosis made many nutritional mistakes compared to healthy people. They more frequently consumed highly processed meat products compared to healthy people and hydrogenised fats and foods containing simple sugars. Thus, patients with MS must be educated about nutrition in their disease.

The results proved that a proper serum concentration of MG correlates with a better clinical status of MS patients assessed with the EDSS scale. In patients with MS, a decreased serum concentration of Se, Cu and Zn and the impaired relation of copper and zinc in the serum as well as an increase the molar relation of Cu/Zn correlate with patients' worse clinical state. Additionally, cigarette smoking and taking immunomodulating medications influence the total decreased antioxidative status in patients with MS compared to the control group. It was shown that patients with MS had the increased concentration of Pb in the blood compared to healthy people and an improper relation of Pb to antioxidative elements. Impaired proportional molar relations of Cu/Zn and Se/Pb, Cu/Pb and Zn/Pb can be used as potential markers of oxidative stress and inflammatory process occurring in the course of MS. The stepwise multiple linear regression analysis demonstrated that frequent consumption of individual food group products may affect up to 37% the concentration of the elements examined in patients with MS. Based on the results obtained and conclusions drawn from the study, an attempt has been made to formulate dietary guidelines for patients with MS.