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EVALUATION FOR MAGNESIUM AND VITAMIN B_6 SUPPLEMENTATION AMONG POLISH ELITE ATHLETES

OCENA SUPLEMENTACJI MAGNEZEM I WITAMINĄ B_6 PRZEZ POLSKICH SPORTOWCÓW WYCZYNOWYCH

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STRESZCZENIE

Współczesny sport wyczynowy często wymaga od zawodników ogromnego wysiłku, który przekracza ich maksymalne możliwości fizyczne i umysłowe. Sportowcy często mają złe nawyki żywieniowe i spożywają suplementy diety zawierające magnez i witaminę B_6 w celu uzupełnienia niedoborów żywieniowych. Celem badań było oznaczanie zawartości magnezu i witaminy B_6 w całodziennych racjach pokarmowych sportowców wyczynowych w Polsce i ocena uzasadnienia suplementacji diety. Zawartość magnezu i witaminy B_6 oznaczano w 62 zebranych i 12 odtworzonych całodziennych racjach pokarmowych profesjonalnych biegaczy. Do oznaczania magnezu i witaminy B_6 wykorzystano odpowiednio metodę spektroskopii absorpcyjno atomowej i HPLC. Analizowane całodzienne racje pokarmowe kobiet dostarczały 256 ± 111 mg magnezu i 2,04 ± 0,63 mg witaminy B_6, podczas gdy całodzienne racje pokarmowe mężczyzn dostarczały 284 ± 58 mg magnezu i 2,12 ± 0,68 mg witaminy B_6. Analiza przeprowadzona z udziałem programu komputerowego wykazała 159-181% wyższą zawartość magnezu i witaminy B_6 w porównaniu do wartości oznaczonych laboratoryjnie. Wyniki badań wykazały, że analizowane całodzienne racje pokarmowe sportowców dostarczały zbyt małych ilości magnezu, co może uzasadniać suplementację diety tym pierwiastkiem. Całodzienne racje pokarmowe pokrywały natomiast dzienne zapotrzebowanie (RDA) na witaminę B_6, dlatego też suplementacja diety tym składnikiem nie była uzasadniona.

ABSTRACT

Contemporary sport requires a lot of effort from sportsmen, frequently exceeding their maximum physical and mental efficiency. Athletes often report poor dietary habits and reach for magnesium and vitamin B supplements to avoid dietary deficiencies. The aim of this study was to determine magnesium and vitamin B_6 content in daily food rations of Polish athletes and to verify the justification of diet supplementation. Magnesium and vitamin B_6 concentrations were determined in 62 collected and 12 reconstructed daily food rations of elite Polish runners. Flame atomic absorption spectrmetry and HPLC methods were used for quantification of magnesium and vitamin B_6, respectively. The analyzed female diets provided daily 256 ± 111 mg of magnesium and 2,04 ± 0.63 mg of vitamin B_6 whereas male diets provided 284 ± 58 mg of magnesium and 2.12 ± 0,68 mg of vitamin B_6. Computer analysis calculated 159-181% higher content of magnesium and vitamin B_6 comparing to determined laboratory values. The results of this study indicate that in the analyzed daily food rations of athletes low magnesium intake was observed, thus diet supplementation with this mineral may be justified. Daily food rations fulfilled RDA for vitamin B_6, thus supplementation with this vitamin was not justified.

INTRODUCTION

Magnesium and vitamin B_6 belong to nutritive elements, which are vital for the proper functioning of living organism. Vitamin B_6 comprises a group of six chemically, metabolically, and functionally related compounds: pyridoxal, pyridoxine, pyridoxamine and their respective 5´-phosphates which serve primarily as coenzymes in human metabolism of amino acids and glycogen [8, 11, 22, 24, 31]. In addition vitamin B_6 influences magnesium absorption [18]. The vitamin B status in healthy population is generally satisfactory,

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but among the high-risk populations with decreased intake or increased needs such as professional athletes may be low [22]. Absence of micronutrients causes serious physiological problems. Clinical signs of vitamin B_6 deficiency include irritability, convulsion, muscular twitching, dermatitis and anaemia [8, 17].

The magnesium ion is a co-factor of many basic cellular processes, particularly those involving energy metabolism [2, 11]. Furthermore magnesium participates in the formation of bones and is essential for protein production. It also influences the metabolism of fat and the functioning of the nervous system [16, 17, 18, 25, 26, 31].

Hypomagnesemia may produce irritability and other mental changes and also may be a factor in depressed immune function, muscle atrophy, osteoporosis, hyperlipidemia, hyperglycemia and other neuromuscular and cardiovascular symptoms [1, 8, 18, 23].

Athletes, who limit the variety of the consumed products or general energy requirement in their diet are exposed to the risk of insufficient microelements and vitamins intakes [15, 16, 27]. Furthermore, prolonged strenuous exercise can increase magnesium losses in urine and sweat [17].

Results of our study conducted in 2005 indicate that 95,2% of women and 92,1% men athletes reached for magnesium supplements. Moreover 66,7% and 73,7% of runners reached for vitamin B supplements [9]. Also *Braun* et al. reported that 62% of elite German athletes use magnesium supplements [3].

The aim of our study was to evaluate the content of vitamin B_6 and magnesium in daily food rations of Polish athletes and to verify the justification of magnesium and vitamin B_6 supplementation.

MATERIALS AND METHODS

Subjects

The study population comprised 62 Polish sportspeople, members of the Polish National Team of Athletes (24 women and 38 men) in the age between 18-36 years with average body weight of women - 54 kg and of men - 66.5 kg. In the years 2002 - 2008 the respondents represented Poland at European Championships, World Championships and the Olympic Games in Athens and Beijing. General information concerning the respondents and their nutrition (24 hour recall) was gathered using the method of a questionnaire interview at training camps and sports competitions. Each respondent was taken into account individually, once only, with the use of "Album of photographs of food products and dishes" [29].

Measures

Energy value of 62 sportsmen's diets, average magnesium and vitamin B_6 content were calculated by means of a computer program 'Wikt 1.3' based on current tables of food products nutritional value prepared by the National Food and Nutrition Institute in Warsaw (2001). Afterwards 12 diets (6 diets for women and 6 for men) were chosen and reconstructed for the determination of magnesium and vitamin B_6 content. The factor determining the choice of diets was the contribution of selected nutritional components in providing energy (c.a. 10% energy from proteins, 30% from fats and 60% from carbohydrates).

Magnesium concentration was determined in lyophilized diets by flame atomic absorption spectroscopy (Philips PU 9100X spectrometer). The quality of the method was checked and confirmed by analysis of mussel reference material - NCS ZC 78005. The agreement between the analytical results for the reference material and the certified values was satisfactory, i.e. the recovery for Mg amounted to 90.0 ± 4.81%. The vitamin B_6 was determined in the free form; extraction step was performed prior to chromatographic isolations, by isocratic HPLC method with electrochemical detector [19]. The accuracy of the method for B_6 determination was estimated by analysing certified material CRM 487 Pig`s Liver. The analytical results obtained for six replicates for the fortified samples analyzed and the certified reference materials were highly satisfying; the recovery for the analytes studied was 100.5 ± 4.10%.

Statistical Analysis

U *Mann-Whitney* test was applied for calculating the differences between magnesium and vitamin B_6 content in the examined diets. Moreover, Pearson correlation was applied for comparison magnesium and vitamin B_6 concentrations in the examined food portions. All statistical analyses were carried out by using Statistica software (version 8.0, StatSoft Polska Sp. z o.o., Warsaw, Poland), and tests used a significance level of 0,05.

RESULTS

Table 1 presents the results of analyses concerning the diet weight, energy, content of vitamin B_6 and magnesium in the tested daily food portions of the athletes. In the present study, diets of both male and female athletes satisfied daily requirement of energy. Requirement of energy in the case of professional athletes reaches even 3500 – 6000 kcal/person/day [10, 13, 14, 17, 28].

Computer analysis indicated that female and male diets had provided daily 3,37±1,49 mg and 3,37±0,78 mg of vitamin B_6. The magnesium content in both female and male diets was calculated to 418±191 mg and

Table 1. Daily nutrients intakes (means ± SD) in diets of the Polish National Team of Athletes

	Diet weight [g]	Energy [kcal]	Vitamin B_6 [mg]		Mg [mg]	
			Computer analysis	Values obtained	Computer analysis	Values obtained
Female						
1	2020	1899	3,31	1.39±0.01 (1.38-1.41)	330	221±11.3 (212-233)
2	2210	2120	2,86	1.86±0.02 (1.84-1.89)	313	178±46.0 (127-215)
3	2840	3669	2,09	2.39±0.02 (2.37-2.41)	336	264±82.7 (209-359)
4	4720	4908	6,27	3.11±0.02 (3.09-3.14)	784	472±11.2 (462-484)
5	1960	2303	2,52	1.89±0.01 (1.88-1.90)	275	178±0.66 (177-178)
6	2480	2317	3,20	1.56±0.01 (1.55-1.57)	472	223±0.51 (222-223)
Average ±SD	2800±1000	2870±1176	3,37±1,49 (2,09-6,27)	2.04±0.63 (1.38-3.14)	418±191 (275-784)	256±111 (127-484)
Male						
1	3430	2988	3,50	1.24±0.00 (1.24-1.24)	619	320±2.13 (318-322)
2	3340	3523	4,02	2.63±0.01 (2.62-2.64)	567	339±4.81 (334-344)
3	3030	3730	2,99	2.36±0.02 (2.34-2.39)	436	258±3.87 (256-263)
4	3010	3102	3,64	1.57±0.01 (1.55-1.58)	435	250±0.70 (249-250)
5	3840	3850	4,09	2.04±0.02 (2.02-2.06)	579	337±19.5 (314-350)
6	2230	4120	1,99	2.74±0.01 (2.73-2.75)	327	195±5.21 (190-201)
Average ±SD	3150±500	3552±439	3,37±0,78 (1,99-4,09)	2.12±0.68 (1.24-2.75)	494±112 (327-619)	284±58.2 (190-350)

Table 2. Recommended Dietary Allowances of magnesium and vitamin B_6 for adults according to Polish, U.S., Canadian and Australian sources [4, 12, 26, 32, 33]

Dietary nutrient	Polish[a]		Australian[b]		U.S. and Canadian[c]	
	Males	Females	Males	Females	Males	Females
Magnesium [mg]	400-420	310-320	320	270	400	310–400
Witamin B6 [mg]	1,3-1,7	1,3-1,5	1.3-1.9	0.9-1.4	1.3	1.3

[a] – *Wojtasik* and *Bułhak-Jachymczyk* [4, 33]
[b] – National Health and Medical Research Council [26]
[c] – *Grandjean* [12] and *Wilmore* et al. [32]

494±112 mg, respectively. On the contrary the executed laboratory analysis showed that female and male diets had supplied daily 2.04 ± 0.63 mg and 2.12 ± 0.68 mg of vitamin B_6, respectively. The mean intake of magnesium for women and men athletes was evaluated on 256 ± 111 mg and 284 ± 58 mg/day, respectively.

DISCUSSION

The special RDA for athletes are not established [11], thus table 2 presents magnesium and vitamin B_6 RDA for adults based on Polish, U.S., Canadian and Australian data [4, 12, 26, 23, 33]. The assessment of vitamin B_6 status is the crucial step to an understanding of its nutrition role in humans. RDA for vitamin B_6 for people who train regularly may be higher than for those who are not physically active [6]. On the contrary, aaccording to *Fogelholm* [11] the data that exist are insufficient to allow for quantification of micronutrient requirements more than RDAs in athletes. RDAs have wide safety margin and should be used with caution because in some specific situations may occur inadequate. Most authors point that vitamin B_6 requirement in a sportsman's diet amounts from 1,3 to 1,9 mg/person/day [4, 12, 15, 23, 24, 26, 32, 33]. The

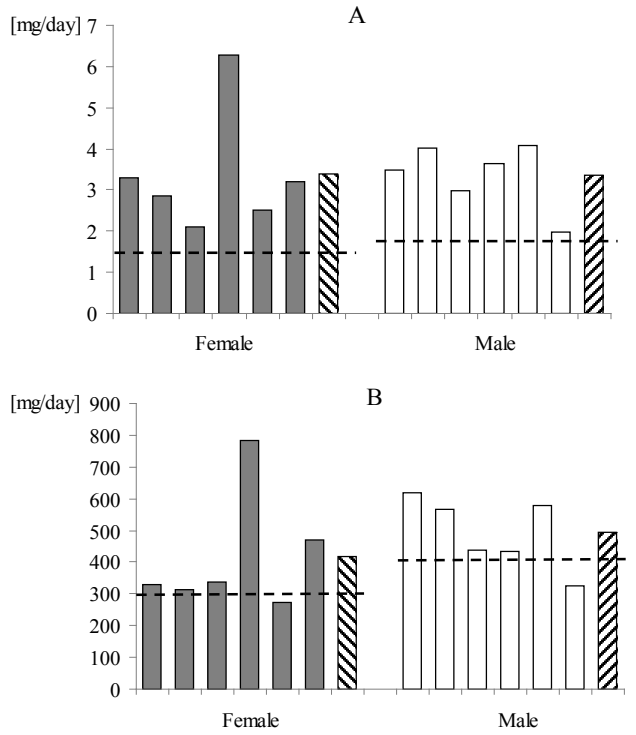

Fig.1. Realization of RDA [-----] for vitamin B_6 [A] and magnesium [B] by examined diets of women and men athletes (average of women diets average of men diets) according to *Wojtasik* and *Bułhak-Jachymczyk* [4, 33]

analyzed female and male runners diets fulfilled RDA for vitamin B_6 (Fig. 1 A.).

The obtained results reaffirm the data cited by *Manore*, who indicated that average vitamin B_6 content in athletes diets amounts 1,5 – 5,4 mg/person/day depending on type of implemented measurement methodology [24].

Magnesium occurring in most foods, is essential for human metabolism and is a critical component in the processes that create muscular energy from carbohydrate protein and fat. The adult RDA for magnesium is 300 – 420 mg per day [4, 12, 15, 23, 24, 26, 32, 33]. The analyzed female and male athletes diets didn't fulfil RDAs for magnesium if laboratory evaluated results are taken into consideration (Fig. 1 B.).

It is possible that athletes training in hot and humid environments could lose a large amount of magnesium in sweat. Inadequate diet may cause magnesium deficiency and in the result poor physical performance [11, 17].

The obtained magnesium concentration in athletes diets was lower than reported by *Zalcam* et al. [35] but similar to data presented by *Lukaski* [23]. *Zalcaman* et al. reported that average intake of magnesium with daily food rations of male adventure racers amounts to 325 mg. *Lukaski* [23] reported that magnesium content in athletes diets varies considerably from 164 mg/day in female runners diets to 646 mg in male skiers diets.

Deficiency of trace minerals in sportspeople's diets requires additional supplementation [11, 22, 27]. It has been confirmed by the questionnaire research and the results obtained by *Burns* et al. [5] and *Tian* et al. [30] that the majority of sportspeople help themselves using dietary supplements playing important role in vitamin and minerals supply. The results of conducted analyses justify magnesium, but not vitamin B supplementation among Polish professional runners. Magnesium supplementation can prevent dietary deficiency of the analyzed micronutrient helping to avoid the negative effects on athlete's performance.

In our study statistically significant correlations between concentration of vitamin B_6 and magnesium in daily food rations of athletes were not found. We observed statistically significant differences ($p<0,05$) between calculated and laboratory determined content of vitamin B_6 and magnesium in both female and male diets.

Levine et al. [21] indicated that differences between computer calculation of nutritive value of diets and laboratory analysis exist. The occurred differences can result from varied factors such as type of the computer program used [20], environmental changes influencing food composition or different food processing techniques [7].

CONCLUSIONS

1. The results of the present study indicate that the dietary intake of magnesium is lower than the recommended values, thus supplementation with this mineral seems to be justified.
2. The analyzed diets fulfilled RDA for vitamin B_6, thus supplementation with this vitamin is not justified.
3. Sport nutritionist and dieticians must be aware of potential differences between calculated and real content of vitamins and minerals in the analyzed daily food rations of athletes.

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