Nutrition

Assessment of nutritional norms for magnesium fulfilment by food rations used for Polish soldiers' alimentation within the space of 30 years

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Received: 2013.08.12 • **Accepted:** 2013.09.24 • **Published:** 2013.09.30

Summary

Introduction: Most of the physiological and biochemical processes in the body is carried out in the presence of, or with the participation of magnesium ions. The nutrient can affect neurotransmiters' binding to receptors, stabilize membranes via binding to phospholipids, and modulate Ca2+ and K+ ionic currents through membranes. Therefore, food rations used in the feeding of the soldiers should include full coverage of the body's needs for this element, taking into account the specificity and nature of the performed service.
Aim of the work: The aim of the work was estimation of fulfilment of nutrition norms for magnesium by the food rations used for Polish soldiers alimentation within the space of 30 years.
Methods: Magnesium content was estimated in 1568 daily food rations planned for soldiers' nutrition as well as in the rations given for consumption and really consumed. Samples of daily food ration given for consumption collected in military units and magnesium content was indicated by atomic absorption spectrometry, using the FAAS flame technique. Taking into account magnesium content in post consumption wastes the supply of magnesium in really eaten ration was assessed as well. Results of the researches carried out in the Military Institute of Hygiene and Epidemiology between in the years 1975-2005were analysed.
Results: It was found that average magnesium content in the daily rations planned for soldiers' alimentation ranged, depending on the kind of ration, from 402.0±56.3 mg to 616±54.9 mg. Obtained values met from 63.8% to 174.0% of recommended amounts. Magnesium content in the rations given for consumption was lower and amounted from 354.7±63.6 mg to 496.4±78.6 mg, what met from 57.6% to 120.0% of obligatory norms. Rations really eaten delivered from 268.7mg to 428,7mg of magnesium. It covered from 46.7% to 98.2% of recommended amounts. Magnesium content in the daily rations depended on the season and ranged from 264.0±47.0 mg in rations served in spring to 480.0±40.0 mg in rations served in autumn.

Key words: magnesium, daily food ration, soldiers, military service.

Introduction

The military devotes major efforts to ensure the continuous safety, health, and performance of soldiers who deployed to serve in combat. One such effort has focused on improving the nutrient intake levels of soldiers and, thereby, the nutrient levels of ration designs. Relevant finding from nutrition studies in the civilian population has been vital in this endeavour. However, because of the unique demands from the multiple

stressors endured during any military situations, direct application of civilian derived dietary recommendation and nutritional data is not always appropriate.

Military surveys suggest that soldiers' mineral intakes may not achieve the levels recommended in the Military Daily Recommended Intakes (MRDIs). Mineral losses (mainly via sweat) will occur because of the physical (e.g. training or combat) and environmental (e.g. extreme temperatures) stressors. The combination of potentially low intakes and increased losses puts soldiers at greater risk of mineral deficiencies.

The nutrient can affect neurotransmiters' binding to receptors, stabilize membranes via binding to phospholipids, and modulate Ca2+ and K+ ionic currents through membranes [1]. Results of many studies show that dietary magnesium supplementation had no influence on serum, blood cell , or skeletal muscle magnesium concentration [2,3]. The data suggest that increased dietary intake >250-300 mg/day is counterbalanced by greater urinary and faecal losses Serum magnesium concentration significantly increased immediately after short duration, high intensity exercise [4] or prolonged endurance exercise [5]. Young men supplemented with magnesium (250 mg/d) in a blinded randomized-trial and enrolled in resistance training increased power significantly more than placebo treated controls [6]. Physically active men had significantly reduced heart rate, decreased oxygen consumption or increased endurance time and decreased oxygen uptake during submaximal exercise, with magnesium supplementation (250 mg/day) [7]. Daily, whole body magnesium losses through sweat and excreta under conditions relevant to military personnel are poorly understood. Sweat losses due to heat and physical exertion are most probable route of magnesium losses. Soldiers encounter heat stress from environmental conditions, body heat production and the clothing or equipment they wear. The loads which soldiers carry can be very heavy depending on what phase of a mission they are performing. A field study by [8] in which soldier loads were measured during actual operations in Afghanistan revealed that soldiers in the travelling phase of mission carried an average of 59.3 kg.

Heat stress increases sweat rate. Soldiers working in hot weather often have sweating rates of 0.3 to 1.2 L/hour [9]. Persons performing more intense activity while wearing more clothing or equipment often have sweating 1 to 2 L/hour (IOM 2004). Sweat magnesium concentrations during exercise measured whole body techniques vary from 12±12 mg/L [10] to 55±2 mg/L [11]. It was found a decrease in sweat magnesium concentration as the sweat rate increased.

Magnesium demand fulfilment is important in alimentation of young men, doing military service in the Polish Army. In time of military training, soldier's organism is often much and sometimes very much overloaded with exercises. Taking into consideration the fact that the process of young organism development is not finished yet, permanent monitoring of delivered food nutritive value, including mineral elements such, as magnesium, is very important. It should be underlined that in Polish soldiers' nutrition planning and its estimation in every day practice, calculation data obtained from tables of food products nutritive value are used. Dependence between this kind of data and actual magnesium content indicated analytically in daily food rations given for consumption should be stated.

The aim of the work was estimation of fulfilment of nutrition norms for magnesium by the food rations used for Polish soldiers alimentation within the space of last 30 years.

Methods

Magnesium content was estimated in 1568 daily food rations planned for soldiers' nutrition as well as in the rations given for consumption and really consumed. Samples of daily food ration given for consumption collected in military units and magnesium content was indicated by atomic absorption spectrometry, using the FAAS flame technique. Taking into account magnesium content in post consumption wastes the supply of magnesium in really eaten ration was assessed as well. Results of the researches carried out in the Military Institute of Hygiene and Epidemiology between in the years 1975-2005were analysed.

Results and discussion

It was found that average magnesium content in the daily rations planned for soldiers' alimentation ranged, depending on the kind of ration, from 402.0±56.3 mg to 616±54.9 mg. Obtained values met from 63.8% to 174.0% of recommended amounts. Magnesium content in the rations given for consumption was lower and amounted from 354.7±63.6 mg to 496.4±78.6 mg, what met from 57.6% to 120.0% of obligatory norms. Rations really eaten delivered from 268.7mg to 428,7mg of magnesium. It covered from 46.7% to 98.2% of recommended amounts. Magnesium content in the daily rations depended on the season and ranged from 264.0±47.0 mg in rations served in spring to 480.0±40.0 mg in rations served in autumn.

Magnesium supply in food rations planned for alimentation of Polish soldiers doing military service in the UN Peace keeping missions was higher and amounted as follows: 477.2±70.2 mg in UNDOF (Syria) what made 129% of the norm, 543±56.4mg in UNIFIL (South Lebanon) what made 146.8% of the norm and 702.3±133.6 mg in KFOR (Kosovo) what made 121.9% of the norm. The main sources of magnesium in the diet were cereal products, potatoes, milk and dairy products. Magnesium shortage in the soldiers' diet can result from both imperfect menu planning and improper alimentation fulfilment.

Table 1: Magnesium content in daily food rations planned, given and consumed.

Year	No	Mg content in planned DFR	Mg content in given DFR	Mg content in consumed DFR	DRI/MRI
1975-1976	70	447.0± 51.4	446.2±43.2	363.5±33.6	370
1977-1978	96	447.0±49.8	420.0±39.8	-	370
1986	120	646.0±56.2	381.5±38.6	-	370
1988-1989	60	500.0±50,3	400.0±41.2	-	370
1989-1990	100	402.0±56.3	456.5±42.1	-	370
1991-1992	120	-	362.0±40.0	299.0±29.1	370
1993-1994	120	-	369.0±44.2	309.0±30.2	370
1995	70	-	371.0±44.8	302.0±29.9	370
1996	70	-	452.0±49.7	341.0±31.1	370
1999	40	465.7±47.3	354.7±38.2	-	370/548.5*
2000	40	556.7±57.8	423.5±63.6	413.6±58.2	370/564.7*
2003	50	611.0±52.8	476.4±43.3	-	370/691.3*
2004	40	616.0±54.9	496.4±39.7	428.7±53.7	370/691.3*
2006	72	435.7±49.7	392.4±44.1	318.2±30.1men 268.7±25.9 women	370/681.7*

DRI – Dietary Recommended Intake
*Military Recommended Intake

Table 2: Magnesium content in daily food rations planned for consumption for Polish soldiers serving outside Poland.

Year	Mission	No	Mg content in planned DFR	DRI/MRI
1990-1991	UNDOF – Syria	120	477.2	370
1994-1995	UNIFIL – Lebanon	120	543.3	370/530*
2001	KFOR – Kosovo	30	702.3	370/578*

DRI – Dietary Recommended Intake
*Military Recommended Intake

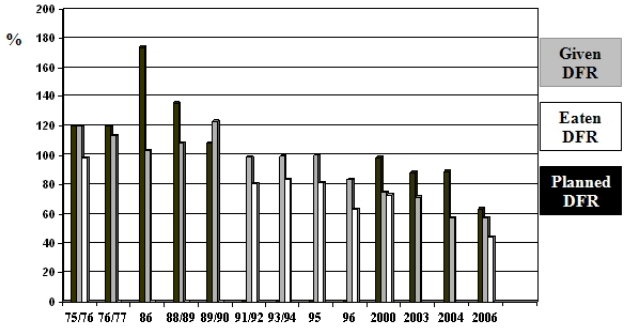

Figure 1: The percentage of coverage standards for magnesium

Mean magnesium contents both in food rations planed and given for consumption and in meals really eaten met the requirements and even exceeded norms obligatory in Poland for young men working hard. It should be pointed out that norms for magnesium obligatory in Polish Army provide for significantly higher values compared to the norms for Polish population. It was found realization military norm for magnesium in full, except 2003-2007 period. It should be underlined that within the space of last 30 years magnesium supply with the daily food rations increased, and recommended, in the regularly improved, norms magnesium amounts increased as well. Therefore values indicated in our researches as shortage met the norms obligatory in Poland in full and don't present any risk of magnesium deficiency occurrence among soldiers.

Study concerning of magnesium intake of U.S. Army Rangers during a 7-day field training exercise showed less value of magnesium in comparison to Dietary Recommended Intake. It was found that both men and women had likely inadequate dietary intakes of magnesium. The low magnesium intake is of particular concern, as almost 60% of men and 75% of women had dietary intakes less than Estimated Average Requirement (EAR) [12].

Conclusions

1) Magnesium shortage in the soldiers' diet can result from both imperfect menu planning and improper alimentation

2) It was found that during the last 30 years magnesium supply with the daily food rations increased, and recommendations for magnesium intake increased too.

3) Values indicated in our researches as shortage, supplemented by additional, individual consumption, met the norms obligatory in Poland and don't give any risk of magnesium deficiency for soldiers.

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