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DIETARY CALCIUM AND OBESITY IN MEN

SPOŻYCIE WAPNIA A MASA CIAŁA I MASA TKANKI TŁUSZCZOWEJ U MĘŻCZYZN

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In this study the relation between calcium intake and body weight and body fat in obese men was investigated. 200 men. No significant differences in body weight, BMI, fat mass, percentage of body fat were found across subgroups and no significant correlations between calcium intake and body variables were stated. This study did not confirm the association between calcium intake and body weight and adiposity in men.

Key words: calcium, obesity, men
Słowa kluczowe: wapń, otyłość, mężczyźni

INTRODUCTION

Human studies have shown negative relations between high calcium intake and obesity-related metabolic disorders such as hypertension [13, 14] and insulin resistance syndrome [9]. Other data have shown an inverse association between calcium intake and body weight [2, 6] and the risk of becoming obese [17]. This inverse association between calcium consumption and body fat mass has been reported, particularly in women and children [4, 8].

Calcium is an essential macromineral and it is well known that its optimal intake is crucial for bone health. However, calcium intracellular concentration in adipocytes regulates lipogenesis [17]. It was suggested that a low calcium intake stimulates 1,25-dihidroxyvitamin and parathyroid hormone secretion, what causes an increase in intracellular calcium. The rise in intracellular calcium promotes lipogenesis and reduces lipolysis, resulting in an increase in fat tissue mass. Therefore, a higher calcium intake could potentially have an antiobesity effect [12].

Most of the studies investigated an association between calcium intake and body weight and body fat mass in women and in subject with normal BMI. *Zemel* in the NHANES III data analysis found an inverse relationship between calcium intake and relative risk of being in

the highest quartile of body fat for women and for men, but this association was stronger for women [17]. These studied men were not obese. In the HERITAGE Family Study no statistically significant relationship between calcium intake and body weight, BMI or body fat mass fat in non obese men was stated [7]. In this study the relation between calcium intake and body weight and body fat in obese men was investigated.

MATERIALS AND METHODS

This study is based on data obtained from 200 men, aged 20-65 y, patients of Outpatients Clinic of Metabolic Disorders National Food and Nutrition Institute in Warsaw. Only men with BMI ≥ 25 were enrolled. Subjects who consumed vitamin or mineral supplements were excluded from the analysis.

Usual dietary intake was assessed with the use of 24-hour dietary recall and food-frequency questionnaire. Diets were analyzed for content of energy and the other nutrients by using DIETETYK software based on "Food composition tables" [5]. Men with unreasonable caloric intakes (>4200 kcal or <800 kcal) were excluded from the analysis.

Standing height was measured to the nearest 0,1 cm using a stadiometer. Body weight was obtained from digital scales and recorded to the nearest 0,1 kg. Body composition was assessed by bioelectrical impedance method with TANITA foot-to-foot analyzer. Standardized conditions with regard to dietary intake, previous exercise and with bladder voiding have been respected. Our population was obese; therefore, we used equations from *Segal* [11] to calculate fatty free mass (FFM) for obese individuals. Fat mass was calculated as follows: body weight – FFM.

For statistical analysis. STATISTICA 6 software was used. Variables that were not normally distributed were log transformed before analysis. A one-way analysis of variance was used to test for differences in body weight, BMI, fat mass, percentage body fat and dietary intake between the groups with different calcium/protein index. Correlations between calcium intake and body composition variables (body weight, BMI, FM, percentage body fat) were evaluated by using *Pearson* correlation and linear regression. Simple correlations between daily calcium intake and body composition variables were controlled for confounding variables such as age, daily energy intake, percentage dietary fat, dietary protein. Results were considered significant when $p < 0,05$.

RESULTS

The mean age of the subjects was 45,1 ± 9,4 y, the mean BMI was 33,2 ± 4,8 kg/m^2.

Participants were divided into 4 groups on the basis of their calcium/protein index.

Table I. Characteristics of men and dietary intake in quartiles of calcium/protein index.

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	Quartile of calcium/protein index				
	I (n=50)	II (n=50)	III (n=50)	IV (n-50)	P
Characteristics					
Age (y)	45,7 ± 8,3	45 ± 9	46 ± 9	43 ± 10	0,5
Body weight (kg)	104 ± 18	103 ± 17	104,9 ± 19	100,9 ± 14	0,8
BMI (kg/m^2)	33,7 ± 4,9	33 ± 4,6	33,6 ± 5,2	32,3 ± 4,5	0,5
Body fat (kg)	33,3 ± 8,2	32,2 ± 7,9	33,7 ± 8,8	31,3 ± 6,7	0,6
Body fat (%)	31,7 ± 2,7	31 ± 2,6	31,7 ± 2,9	30,8 ± 2,7	0,3

			Diet		
Energy (kcal)	2407 ± 791	2228 ± 701	2399 ± 713	2316 ± 589	0,5
Protein (g)	101,4 ± 40	83,7 ± 40	90 ± 28	88,1 ± 27	0,04
Protein (%)	17,2 ± 4	15,6 ± 5	15,4 ± 4	15,5 ± 3,3	0,1
Dietary fat (%)	36,6 ± 9	33,2 ± 9	33,6 ± 10	31,2 ± 9,6	0,06
Calcium (mg)	274 ± 101	391 ± 168	647,2 ± 240	1138 ± 467	0,000
Calcium/protein (mg/g)	2,8 ± 0,6	4,6 ± 0,5	7,1 ± 1,1	12,8 ± 2,6	0,000
Calcium/1000 kcal	117 ± 37	181 ± 67	277 ± 81	492 ± 156	0,000

No significant differences in age, body weight, fat mass, percentage of body fat and energy, dietary fat, percentage of energy provided by protein were found across subgroups of men. Calcium intake, calcium/protein index, calcium/1000 kcal and protein intake differed significantly among quartiles ($p<0,001$).

Age and intake of energy, protein, calcium, calcium/protein index, calcium/1000 kcal were not statistically significant correlated with body weight, BMI, fat mass, percentage of body fat in studied men. The results of regression analysis showed that only percentage of energy provided by fat was statistically significant correlated with BMI ($r=0,17$, $p<0,05$), body fat mass ($r=0,15$, $p<0,05$), percentage of body fat ($r=0,19$, $p<0,01$) in overweight and obese men.

DISCUSSION

This study showed that calcium intake, expressed as energy-adjusted calcium intake or as calcium/protein index, was not associated with body weight and adiposity in overweight and obese men. Also body weight, BMI and body fat were not statistically significant different between quartiles of calcium/protein index.

There is a growing body of literature supporting the hypothesis that low calcium intake may increase overall adiposity [2, 8, 9, 17]. However, most of these studies were conducted in children, adolescents and premenopausal women and in subjects without obesity. Results of studies with men are inconclusive. *Zemel* in analysis of data from the NHANES III found that odds ratios for being in the highest quartile of body fat were the highest in the lowest quartiles of calcium intake for women. For men a significant inverse relationship between dietary calcium and body fat was stated, although the simple dose-response relationship was not evident. These men were not obese [17]. In the HERITAGE Family Study, the studies group comprised of non obese men, a significant inverse association was found only for percentage of body fat. Men in the high calcium intake had less body fat than men in the low calcium intake [7]. However, in the Health Professionals Follow-up Study, a prospective cohort study of men aged 40-75 y, BMI around 25, baseline or change in intake of calcium was not significantly associated with weight change [10]. In the Quebec Family Study no significant differences in body weight, BMI, percentage body fat and body fat mass were found across subgroups of calcium intake in men aged 20-65 y, with BMI < 30 [4]. This study showed that for men, after control for age, energy intake, and percentage dietary fat, dietary protein, there were no significant associations between daily calcium intake and body weight and body-composition variables.

Calcium intake could affect body weight and body fat mass in many ways. Its simplest effect is the inhibition of fat absorption [15]. It seems that the main effect of calcium is mediated

by its effect on the control of intracellular calcium. Evidence has shown that the product of the agouti gene, expressed in human adipocytes, stimulates calcium current into the cells and promotes energy storage in adipocytes by stimulating the expression and activity of fatty acid synthase, an enzyme involved in lipogenesis, and by inhibiting lipolysis [16]. The entrance of calcium into the cells is reduced by calcitriol, which inhibits lipolysis. Higher intake of calcium reduces calcium's entrance into the cells by decreasing concentration of 1,25-dihydroxyvitamin D, and, in this way, inhibits fatty acid synthesis and stimulates lipolytic activity [17].

The relation between dietary calcium intake and adiposity is reported mainly in women, not in men. This association may be affected by sex hormones. Variations in plasma estrogen concentrations were recently found to be related with those in intestinal calcium absorption [1, 3]. This could affect dietary calcium availability and result in significant metabolic changes in long term.

It should be mentioned that this study was observational; to examine the calcium intake-adiposity relation the randomized controlled trials should be conducted.

CONCLUSIONS

This study did not reveal significant association between calcium intake and body weight and adiposity in obese men.

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Summary

Increased calcium intake has been associated with lower body weight, BMI and adiposity, mostly in children, youth and women. In men results are inconclusive. In this study the relation between calcium intake and body weight and body fat in obese men was investigated. 200 men, the mean age 45,1 ± 9,4 y, the mean BMI 33,2 ± 4,8 kg/m^2, were divided into 4 groups on the basis of their calcium/protein index. No significant differences in body weight, BMI, fat mass, percentage of body fat were found across subgroups and no significant correlations between calcium intake and body variables were stated. This study did not confirm the association between calcium intake and body weight and adiposity in men.

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Streszczenie

Badania wskazują, iż podaż wapnia powiązana jest z masą ciała, BMI, masą tkanki tłuszczowej. Stwierdza się to głównie u dzieci, osób młodych i kobiet, w przypadku mężczyzn badania nie dają jednoznacznych wyników. Badanie to miało na celu ocenę zależności pomiędzy spożyciem wapnia a masą ciała, BMI, masą tkanki tłuszczowej u mężczyzn z nadwagą i otyłością. Oceniana grupa liczyła

200 mężczyzn, w wieku 45,1 ± 9,4 lat, o BMI 33,2 ± 4,8 kg/m^2. Podzielono ich na 4 grupy wg kwartyli współczynnika wapń/białko. Nie stwierdzono statystycznie istotnych różnic w masie ciała, BMI, masie tkanki tłuszczowej i procentowej zawartości tkanki tłuszczowej pomiędzy grupami spożycia wapnia, jak również masa ciała, BMI, masa tkanki tłuszczowej i procentowa zawartość tkanki tłuszczowej nie były statystycznie istotnie powiązane ze spożyciem wapnia. Badanie to nie wykazało istnienia statystycznie istotnego powiązania pomiędzy spożyciem wapnia a masą ciała i zawartością tkanki tłuszczowej u mężczyzn.

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