

Poster 17

Calcium deficiency and absence of vitamin D alter bone, calcium and fat absorption, but not body weight

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Vitamin D and/or calcium previously considered as involved only with bone health are now known to have broader metabolic functions. Milk is a good source of calcium and in some countries, because of fortification, of vitamin D as well. Calcium and vitamin D deficiency is associated with disturbances of energy, carbohydrate and fat metabolism, whereas high vitamin D and calcium intakes have been reported to facilitate weight and fat loss of subjects on a hypocaloric diet. Also, PTH concentrations are said to be positively and 25(OH)-vitamin D concentrations to be negatively related to body weight, but it is unclear whether these findings are consequences or causes of overweight. Moreover, because of conflicting findings on the effect of supplemental vitamin D on plasma concentrations of 25(OH)-vitamin D, there is no consensus on the differentiation between low vitamin D status and hypovitaminosis D. We have reported how calcium and vitamin D deficiency altered plasma 25(OH)-vitamin D levels, calcium retention and bone density and quality[§]. We now report the effect of the deficient diet on fat absorption without significantly altering body weight in a model with experimentally induced osteomalacia[§]. Twenty adult female minipigs were switched from a standard regimen with 9 g calcium and 2000 IU vitamin D3 per kg to one with 6 g calcium and 6500 IU vitamin D3 (control diet) or one with 2 g calcium per kg and no vitamin D (deficient diet). Plasma 25(OH)-vitamin D levels of minipigs on the control diet rose progressively for 10 months from a base value of 74.8 ± 10.8 (SEM) nmol/L to 255.4 ± 40.2 nmol/L. Thereafter they plateaued for 3 months and then decreased to 206.1 ± 10.8 nmol/L at the end of the study (15 months). Plasma 25(OH)-vitamin D levels (nmol/L) in animals on the deficient diet dropped significantly from a base value of 60.2 ± 11.4 to 20.5 ± 8.2 after 5 months and to 15.3 ± 3.4 after 10 months. Plasma levels of 1,25(OH)₂-vitamin D were persistently higher and of PTH transiently higher than in controls. After 15 months the animals on the deficient diet were in negative calcium balance (-3.65 ± 2.23 g/7d), having lost significantly more bone mineral density (-51.2 ± 14.7 mg/cm³) than the controls (-2.3 ± 11.8 mg/cm³) whose calcium balance was positive (1.32 ± 1.26 g/7d; $p < 0.08$). The bone moisture content of the animals on the deficient diet also was higher. Animals on the deficient diet had lost an insignificant amount of weight although they absorbed slightly but significantly more fat (379.8 ± 1.4 g/7d) than the controls (370.9 ± 2.8 g/7d; $p < 0.009$) whose body weight remained constant. Our findings support the hypothesis that a diet deficient in calcium and vitamin D may affect energy metabolism in that it increases fat absorption. They do not support observations of a higher body weight gain. However an increase of fat mass at the expense of lean mass or an accumulation of abdominal fat at the expense of peripheral fat cannot be excluded.

[§] Scholz-Ahrens KE, Glüer, C-C, Bronner, F et al., 2013. Modulation of Vitamin D Status and Dietary Calcium Affects Bone Mineral Density and Mineral Metabolism in Göttingen Minipigs. ISRN Rheumatology Volume 2013, Article ID 460512, 12 pages, <http://dx.doi.org/10.1155/2013/460512>.