ASSOCIATION BETWEEN DIETARY CALCIUM INTAKES AND WEIGHT LOSS





Presented By:

Prof. Mohamed S. Ismail

Institution

Current: Dept. Clin. Nutr. Univ. Of Dammam, KSA

Permanent: Nutr. Food Sci. Menoufia Univ. Egypt

Wednesday 19/08/2015

Euro Global Summit & Medicare Expo on

Weight Loss

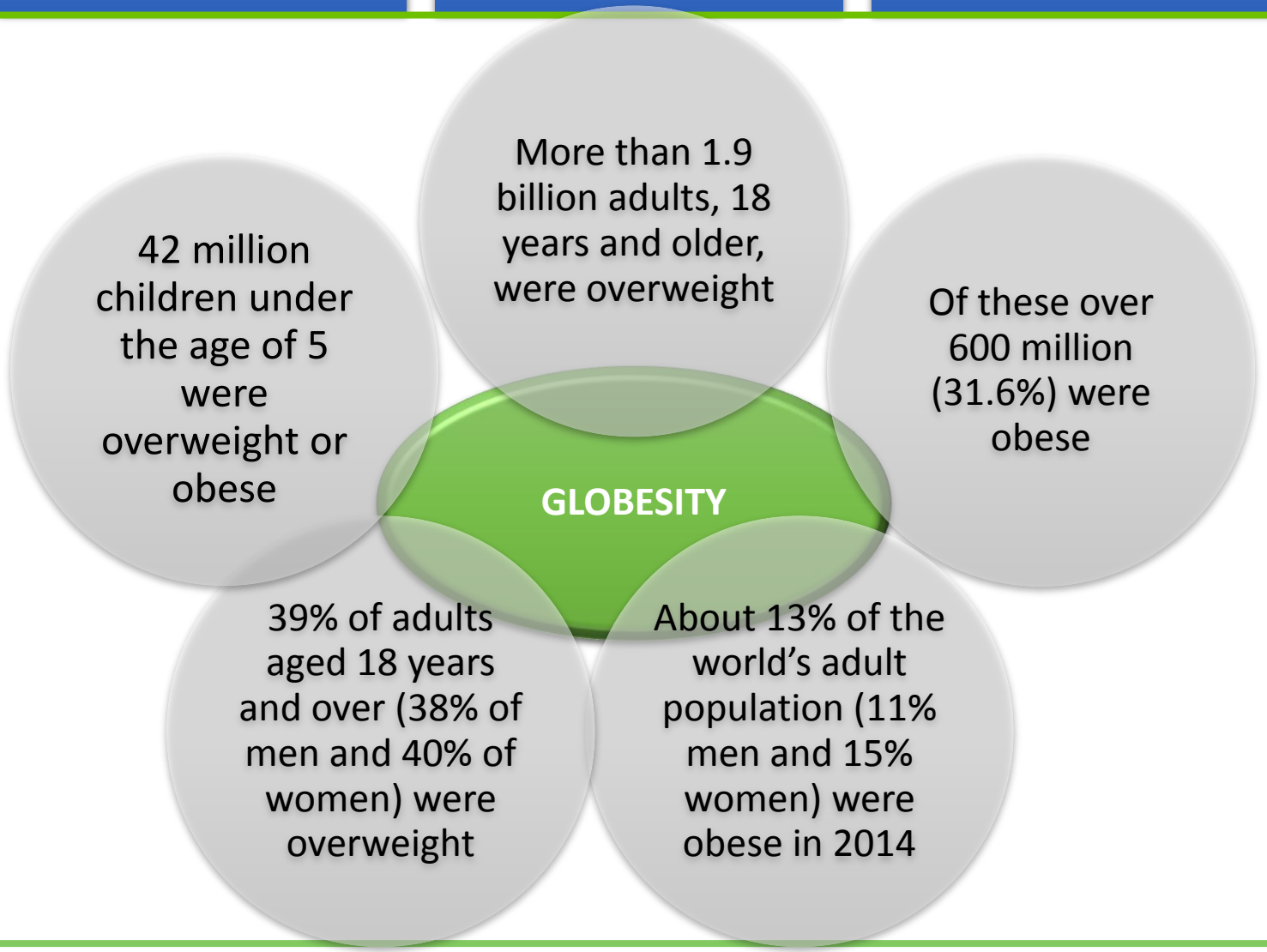
August 18-20, 2015 Frankfurt, Germany

Obesity

Obesity is the excess of body fat not body weight, simply the person become obese when energy input is more than energy output, and then the body store the excess energy in the form of fat in different regions in human body.

WHO define overweight and obesity as abnormal or excessive fat accumulation that may impair health.

WHO (2015)


More than 1.9 billion adults, 18 years and older, were overweight
42 million children under the age of 5 were overweight or obese
Of these over 600 million (31.6%) were obese
GLOBESITY
39% of adults aged 18 years and over (38% of men and 40% of women) were overweight
About 13% of the world's adult population (11% men and 15% women) were obese in 2014

WHO (2015)

Consequences of overweight and obesity

Overweight and obesity is a major risk factors for cardiovascular diseases (mainly heart disease and stroke), which were the leading cause of death in 2012; diabetes; musculoskeletal disorders (especially osteoarthritis - a highly disabling degenerative disease of the joints); some cancers (endometrial, breast, and colon).

Childhood obesity is associated with a higher chance of obesity, premature death and disability in adulthood. But in addition to increased future risks, obese children experience breathing difficulties, increased risk of fractures, hypertension, early markers of cardiovascular disease, insulin resistance and psychological effects. Overall, overweight and obesity are linked to more deaths worldwide than underweight (WHO, 2015).

Why calcium

In recent years, several studies have reported a positive relationship between calcium intakes and weight loss, the highest the calcium intakes, the highest the weight loss. This association have shown in children, men, and younger and older women.

Researchers calculated that a 300-mg increase in daily calcium intake was associated with a 3 kg difference in body weight (BW). Moreover, the effect of higher calcium intake on BW is stronger in subjects with a larger fat mass.

- Clarify the relationship between calcium and body weight
- Find out possible mechanisms
- Identify the best sources of calcium (dietary vs. supplements)

History of the relationship

Longitudinal cohort studies

Observational and Cross sectional studies

Intervention

History of the relationship

The role of specific micronutrients and food groups in the development of obesity has been acknowledged during recent years. One of the important examples of these micronutrients and food groups are calcium and dairy foods

After the first publication of epidemiological results by McCarron in 1984 and the publication by Zemel in 1998, in which a possible mechanism to explain this unexpected inverse association between calcium intake and body weight was postulated.

(Zemel 1998, 2001, 2003, Zemel et al. 2000).

Since then, this inverse relation between calcium intake and body weight has been observed in a different large populations (*Davies et al. 2000; Lin et al. 2000; Carruth et al. 2001; Buchowski et al. 2002; Heaney 2003; Skinner et al. 2003; Novotny 2004;*).

Three studies, however, found no effects (*Atkin and Davies 2000; Phillips et al. 2003; Shapses et al. 2004*).

Longitudinal cohort studies

In the Amsterdam growth and health longitudinal study, the researchers investigated whether dietary calcium intake is related to body mass index and the sum of four skinfolds, the researchers followed a cohort of men and women from age 13 years in 1977 to age 36 years in 2000. Their results showed only a slight indication of a weak inverse relation of calcium intake with body composition in this population. No differences were observed between the middle (800–1,200 mg/day) and high (>1,200 mg/day) groups of calcium intake, suggesting a threshold of approximately 800 mg/day above which calcium intake has no additional beneficial effect on body composition.

(Boon et al. 2005)

Observational studies

The results of some studies have suggested the occurrence of possible effects and relationships dosage/effect of calcium intake on body weight and body composition. It has been claimed that calcium intake may explain 3 to 10% of body weight variation. Analyzing the data from NHANES III, it was observed that an increase in calcium intake from 400 mg to 1,000 mg for a year in obese American subjects caused a reduction of 4.9 kg. In middle aged women it was observed that the probability of overweight is reduce from 14.6% to 4.1% and of becoming obese reduces from 1.4 to 0.2%, when calcium intake increases from 10 to 20 mg calcium/g of protein.

Besides that the weight gain/year reduces from 0.425 to -0.011 kg when the ingestion increases from 9 to 20 mg calcium/g of protein. According to ***Eagan et al. (2006),*** in young normal weight people it is expected a body fat gain of 1.26 kg in 18 months in response to the ingestion of 500 mg of calcium from dairy products/day while in response to an ingestion of 1,200 mg/day it is expected a weight loss of 0.631 kg.

A study conducted on 1771 healthy, early postmenopausal women showed significant inverse trends between BMI and increasing dairy intake. The researchers concluded that in early postmenopausal women, a low dietary calcium intake may increase the risk of osteoporosis, but its negative effect can be offset by the greater BMI found in women with a low calcium intake

(Varenna et al. 2007).

Intervention studies in human

A study investigated the effect of calcium and vitamin D-supplemented orange juice on weight loss and reduction of visceral adipose tissue in overweight and obese adults. After 16 week, the reduction of visceral adipose tissue was significantly greater in the calcium and vitamin D group than in the control group. The findings of this study suggest that calcium and/or vitamin D supplementation contributes to a beneficial reduction of visceral adipose tissue

(Jennifer et al. 2012).

Intervention trial investigated the effect of calcium plus vitamin D3 supplementation on anthropometric and metabolic profiles during energy restriction in 53 healthy, overweight and obese adults with very-low calcium consumption. Subjects were assigned in an open-label, randomized controlled trial to receive either an energy-restricted diet supplemented with 600 mg elemental calcium and 125 IU vitamin D3 or energy restriction alone for 12 weeks. The results showed significant and greater decrease in fat mass loss, visceral fat mass and visceral fat area in calcium + vitamin D group. The researchers concluded that calcium plus vitamin D3 supplementation for 12 weeks augmented body fat and visceral fat loss in very-low calcium consumers during energy restriction

(Zhu et al. 2013).

A study carried out 25 girls (BMI 33 kg/m^2) and 17 boys (BMI of 28 kg/m^2) 12–15 y, participated in two 3-wk controlled feeding sessions. In one session, 756 mg Ca/d was consumed; in the other session, an additional 650 mg Ca/d was provided as dairy or calcium carbonate supplements. Total energy and macronutrient intakes were controlled and were the same for the 2 sessions for each subject. The results revealed no effects of quantity or source of calcium on energy or fat balance. The data of this study lend little evidence to support the proposed mechanisms for the relation between an increase in calcium intake from calcium carbonate or dairy and weight loss or weight maintenance in

Children

(Weaver et al. 2011).

Observational studies and randomized clinical trials have indicated that a high-calcium diet is associated with a significantly greater decrease in ABDOMINAL OBESITY, suggesting body fat redistribution. The exact mechanism by which dietary calcium intake induces abdominal obesity reduction is still not clear

Torres and Sanjuliani (2012)

Table 1. Human Studies of Calcium and Weight

Author	Type of Study	Population	Results
Zemel et al	Reanalysis of NHANES III data set (SORT C)	380 women 7114 men	RR of being in the highest quartile for body fat was reduced as calcium intake increased. RR in second quartile of Ca^{2+} intake was 0.75, in third RR quartile was 0.40, and in highest quartile of Ca^{2+} intake RR was 0.16 ($P < .0009$ for women, $P < .0006$ for men)
Davies et al	Reanalysis of 5 clinical studies (2 cross-sectional, 2 longitudinal, 1 RCT) of calcium and bone density (SORT C)	Total sample size among all studies: 780 women in 3rd, 5th, 8th decades	Negative associations between calcium and body weight found in all studies for all 3 age groups. OR for being overweight (BMI >26) was 2.25 for young women who were in the lower half of calcium intakes. In RCT, calcium-treated women had significant weight loss over 4 years. Authors estimate that a 1000-mg difference in calcium intake may be responsible for an 8-kg difference in body weight.
Heaney et al	Extension of reanalysis of above studies (SORT C)	Young women (3rd decade) n = 348 Midlife women (5th decade) n = 216	Young women: at 25% for calcium intake, there was a 15% prevalence of overweight and a 1.4% prevalence of obesity. At a calcium intake equal to the current RDA, the prevalence of overweight was only 4% and obesity 0.2%. In midlife women, there was a significant decrease in yearly weight gain with increasing calcium intakes.

Skinner et al	Prospective cohort study examining children's body fat and calcium intake from 2 months old to 8 years old (SORT B)	52 white child-mother pairs completed entire study (25 boys, 27 girls)	Dietary calcium was negatively related to body fat percentage in both boys and girls (P = .02 to 0.04). Models including dietary calcium predicted 28% to 34% of variability in body fat percentage.
Drapeau et al	Prospective cohort study (Quebec Family Study) measured twice (between 1989 and 1994 and also between 1995 and 2000) (SORT B)	248 volunteers between 18 and 65 years old (112 men, 136 women)	Increases in consumption of fruit and lowfat milk were associated with lower body fat and lower body weight.
Loos et al	Cross-sectional study within a larger prospective cohort study (the HERITAGE Family Study) (SORT B)	362 men (109 black, 253 white) and 462 women (201 black, and 261 white)	Significant inverse associations were found for all men and white women between calcium intake and percentage of body fat. There was no significant association seen in black women.
Zemel et al	Randomized, placebo-controlled trial for 24 weeks. (SORT B, RCT but small sample size)	32 obese adults (27 women, 5 men)	All subjects were placed on a calorie-deficient diet. Then participants were randomized to 1 of 3 arms: standard diet, 400 to 500 mg calcium with a placebo; high-calcium diet, standard diet supplemented with 800 mg of calcium; and high-dairy diet, 1200 to 1300 mg of dietary calcium with placebo supplemented. Participants on the high-dairy diet lost the most weight and the most truncal fat. The participants on the high calcium diet lost the second highest amount and the participants on the standard diet lost the least amount.

Shapses et al	Randomized placebo-controlled trial for 25 weeks. Data combined from 3 separate trials. (SORT B, RCT with larger sample size, but not powered to detect differences)	100 premenopausal and postmenopausal women	Subjects were randomized to receive either 1000 mg of calcium in a supplement or a placebo. Weight loss was encouraged with behavior modification and nutrition education. Women participated in support groups and a subset of postmenopausal women was encouraged to consume one third of their calories with a meal replacement drink. There were no significant differences in body weight or change in body fat between the 2 groups.

NHANES III, National Health and Nutrition Examination Study III; RCT, randomized control trial; BMI, body mass index; SORT, strength of recommendation; RDA, recommended daily allowance; OR, odds ratio; RR, resistance ratio.

Proposed Mechanisms of Action

There are 2 main physiologic mechanisms proposed to explain how calcium intake can affect body weight or body fat.

- The first is the effect of dietary calcium on intracellular calcium levels in adipocytes, and
- The second is the effect of dietary calcium on fatty acid absorption from the gastrointestinal tract.

1- Effect of Dietary Calcium on Adipocytes

Ninety-nine percent of a body's calcium content is stored in the extracellular space. The majority of extracellular calcium is stored in bones and teeth. Intracellular cytosolic soluble calcium mediates many metabolic pathways, including platelet aggregation and insulin resistance. Calcitropic hormones, such as parathyroid hormone (PTH) and 1,25-hydroxy vitamin D, regulate intracellular calcium.

Low dietary calcium intake stimulates high levels of PTH and 1,25-hydroxy vitamin D, which in turn stimulate high levels of intracellular calcium in adipocytes stimulating lipogenesis and inhibiting lipolysis. ***High dietary calcium intake depresses the levels of PTH and 1,25-hydroxy vitamin D, thereby causing lower levels of intracellular calcium and inhibiting lipogenesis and stimulating lipolysis.***

Therefore, calcium intake may directly affect whether adipocytes store or break down fat. Results of studies in transgenic mice are consistent with the preceding observations. High-calcium diets were associated with a 51% decrease in adipocyte fatty acid synthase expression and activity and a 3- to 5-fold increase in lipolysis in mice. In mice subjected to calorie restriction, low-calcium diets impeded body fat loss, and high-calcium diets accelerated fat loss.

Zemel (2002)
Zemel (2003)
Shi et al. (2002)

2- Change in Fat Absorption

The second proposed mechanism by which calcium may impact body weight is that increased dietary calcium seems to bind more fatty acids in the colon, thereby inhibiting fat absorption. Welberg et al, (1994) in a small study, showed that calcium supplementation increased the percentage of excretion of total fat as related to fat intake. The calcium supplementation in this study was either 2 or 4 g.

Denke et al (1993) supplemented 13 men with approximately 2 g of calcium per day. The percentage of dietary fat excreted per day increased from 6% to 13% with calcium supplementation.

The Nestle Company supplemented chocolate with 900 mg of calcium and tested the fecal fat content of 10 men in a double-blind crossover study. Calcium supplementation of chocolate increased fecal fat from 4.4 to 8.4 g per day (*P* .0001). These studies show a small effect of calcium on fat absorption that probably contributes to the antiobesity effects but does not explain it entirely. The degree of fecal fat loss in these studies of high calcium supplementation is only approximately 3% of that induced by medications such as orlistat

Dairy versus Calcium Supplements

Several of the previously reviewed studies suggest that calcium from dairy products affects weight loss more than calcium derived from dietary supplements.

Preliminary data point to some other component in dairy products, possibly whey protein, effecting the weight-loss effect of calcium. Whey protein provides a multitude of bioactive substances that may work synergistically with the calcium to alter lipid metabolism.

Sarina Schrager, 2005

- There are a strong and positive relationship between dietary calcium intake and weight loss
- The trial for long time was positive
- No need to increase the intake above 125% of requirements
- Milk may contain other active compounds
- Among children the effect was inconsistent and it may be due to using calcium in growth
- The balanced and sufficient diet is mandatory.


THANKS