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New Dietary Reference Intakes for Calcium Released in 2010

New Dietary Reference Intake (DRI) values for calcium that apply to Canada and the United States were announced by the Institute of Medicine (IOM) in November 2010[1]. The levels assigned for calcium are based on bone health, and recommended levels now are given as Estimated Average Requirement (EAR) and Recommended Dietary Allowance (RDA) values.

The new DRI levels for calcium, along with vitamin D, have generated much discussion, some of it in support for providing evidence-based deliberations[2] yet others critical of evidence-based medicine having too heavy a reliance on randomized controlled trials[3].

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The process of setting the revised DRIs for calcium

In 1997, the first DRI recommendations for calcium were set as Adequate Intake (AI) levels, and it was stated that there was not enough evidence to set EARs for this nutrient. Often, AIs are set based on the intake of a healthy population[4], but in the case of calcium, the IOM committee at the time did use evidence from calcium balance studies[5]. With new evidence emerging for calcium having non-skeletal effects, there was the possibility that other functions would be considered, for example, there is acknowledgement of the relationship between calcium intake and colorectal cancer risk[6]. Further, it was deemed important to re-examine the 1997 DRI values for vitamin D[7] and to include calcium because of the interdependence of these nutrients[8]. There was also indication of other potential adverse effects of calcium at intakes below the 1997 UL of 2500 mg[9]. Finally, recommendations for both nutrients had previously been set as AIs, which limited the ability to perform assessment and planning functions for these nutrients in population studies.

When DRI values were set during the time period of 1997-2004, levels were to be based on published scientific evidence for requirements after the committee decided the criteria upon which the requirement was to be based. There was to be examination of effects that would not only prevent deficiency but also on the risk of chronic disease[10]. Once the full set of DRIs were finished, a workshop was held at which time the process was examined and recommendations for improvement were made[10]. A *Risk Reduction Strategy* was proposed as the basis for subsequent DRIs, in which the "risk" is defined as nutrient intakes that are too low or too high[1].

In considering the revision of the DRIs for calcium, a commissioned evidence-based report, the AHRQ-Tufts report[11], which examined the evidence for calcium on health outcomes was provided to the committee and published with the final report[1]. This report relied mainly on randomized controlled trials which were not able to provide much information on dose-response effects for calcium. The committee, however, used other data in its deliberations. Some challenges for the committee were that many studies designed to provide evidence for dietary effects on bone gave both calcium and vitamin D as the treatment, and that other studies may not have adequately provided one of these nutrients when testing the other.

New Recommended Intake DRI Values for Calcium

The values for each age/sex group for EAR, RDA and UL are in Table 1. Calcium balance studies provided the evidence for values for ages 1 to 50 y, and for those over 50 y, values were set to prevent bone loss. For infants, an AI is given and this value indicates that infants fed human milk will receive adequate calcium. For children, estimates of desirable bone accrual were considered; EAR values, which start at 500 mg for toddlers, rise to 800 mg for children, then peak at 1100 mg for adolescents, are based on recent calcium retention data. RDA values are approximately 10-20% higher. Adolescent values are of particular concern as this is the time for the greatest consolidation of bone accrual, and while boys attain more bone mineral calcium than girls, it was deemed reasonable to set similar levels for both sexes. The calcium retention data that form the basis of the EAR were obtained using factorial estimates, and it is notable that those data for adolescents are from a Canadian study[12].

For adults, maintenance of bone through attaining neutral calcium balance is the goal. The EAR values are 800 mg for men age 19 to 70 y and for women 19 to 50 y, and the RDA for these age groups is 1000 mg. The difference in age cut-offs for men (i.e., 70 y) and women (i.e., 50 y) reflects data showing that women at 50 y experience abrupt bone loss at menopause in contrast to men at this age where bone loss is slow. For women over 50 y and men over 70 y, EAR values are 1000 mg which translates into an RDA value of 1200 mg. The higher level set for women over 50 y and men over 70 y was considered a justified public health measure in the face of supportive yet inconclusive data suggesting a higher intake of calcium would prevent bone loss and protect against fractures. Values during pregnancy and lactation are not different from other women in the same age group. The ability of pregnant and lactating women to increase calcium absorption and compensate for increased needs is well documented[1,5].

New Upper Level (UL) Values for Calcium

The IOM committee indicated there were many possible indicators of excess calcium, including hypercalcemia, hypercalciuria, vascular and soft tissue calcification, nephrolithiasis (kidney stones), prostate cancer, interactions with iron and zinc, and constipation[1]. For infants 0 to 1 y, feeding data indicated no adverse effects on calcium excretion of providing calcium intakes as high as 1000-1500 mg (Table 1). For everyone else, the UL for calcium was set based on data related to the incidence of kidney stones, largely from work conducted with post-menopausal women in trials where calcium supplements were provided[1]. Kidney stones not only cause immediate pain upon passing, but contribute to increased risk of renal and urinary tract infections as well as renal insufficiency. Kidney stone incidence in the Women's Health Initiative showed that those in the treatment group (+ 400 IU vitamin D and 1000 mg calcium), having an average intake of 2200 mg/d, experienced 17% more kidney stones than the control group[9]. Stone formation in children is rare, and UL levels are set higher to reflect that children and adolescents can safely consume more calcium than older adults.

What are Next Steps?

The committee identified many gaps including the absence of trials in which dose response relationships could be identified. The interrelationship between calcium and vitamin D with respect to bone health was difficult to separate; indeed, the committee stated that low levels of vitamin D could be overcome with high levels of calcium intake. While it was concluded in the report that in general, Canadians and Americans have adequate intakes of calcium, it was acknowledged that adolescent girls remain at risk for low calcium intakes.

It is important to note that Canadians have not been explicitly evaluated against these new intake levels. Calcium intakes of Canadians from food alone would indicate that more than 50% of Canadian women have intakes below new EAR levels, suggesting that a serious problem for inadequacy of calcium for women, and likely adolescent girls, exists in Canada[13].

There is a need for research into the nonskeletal effects of calcium and whether intakes of calcium that protect bone health are adequate to reduce the risk of other chronic conditions where calcium might be involved.

Table 1. The 2010 Dietary Reference Intake Values for Calcium.

Age/Sex Group	EAR mg/day	RDA mg/day	UL mg/day
0 – 6 mo M&F	na	200*	1000
6 – 12 mo M&F	na	260*	1500
1 – 3 y M&F	500	700	2500
4 – 8 y M&F	800	1000	2500
9 – 18 y M&F†	1100	1300	3000
19 – 50 y M&F†	800	1000	2500
51 – 70 y M	800	1000	2000
51 y and over F	1000	1200	2000
Over 70 y M	1000	1200	2000

na = not applicable (infant values are AIs which are based on the composition of breast milk)
* represents an AI rather than an RDA
† includes pregnancy and lactation values

Dietary Reference Intakes provide the reference values for assessment and planning functions in nutrition[4]. These values include the:
– EAR, which is the amount of a nutrient that meets the needs of half the healthy population, i.e., the median requirement.
– RDA, which is the amount that meets the needs of almost all (97.5%) healthy persons in the population, which is calculated as the EAR plus two standard deviations (SD) of the EAR.
– Adequate Intake (AI) level, which is set for infants age 0 to 1 year, and sometimes set for older ages if there is no sufficient evidence for setting an EAR.
– Tolerable Upper-Intake Level (UL), which is set at a level that poses no risk for adverse effects

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