

Recommendations for Dietary Calcium intake and Bone Health: the Role of Health Literacy

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Abstract

Osteoporosis is a skeletal disease that involves micro-architectural deterioration of the bone matrix and depletion of bone mineral. Inadequate dietary calcium, especially in a vitamin D deficient environment, may predispose an individual to osteoporosis. Given that recommendations for daily intake (RDI) of dietary calcium differ between countries, and according to life-stages, understanding RDIs and how to achieve them is likely to be a complex process for many individuals. Health literacy, or the ability of individuals to gain access to, understand and use health-related information, will influence the capacity of individuals to meet RDIs. Furthermore, the lowest health literacy is observed in the same groups identified as having an increased risk of osteoporosis; older individuals, and those that are socially disadvantaged. It is imperative to consider the specific health literacy needs of at-risk populations when promoting recommendations for dietary calcium intake.

Keywords: Health literacy; Dietary calcium intake; Osteoporosis; Recommended daily intake

Health Literacy

Osteoporosis, a common disease of the skeleton, involves micro-architectural deterioration of the bone matrix and depletion of bone mineral; this results in an increased susceptibility to fracture [1]. Post-fracture, there is a plethora of financial, personal and psychosocial outcomes, including reduced mobility, impairment of daily activities, inability to work and loss of confidence [2,3]. A hip fracture has the most severe implications: one in five individuals die within the first year, while 60% of individuals who survive a hip fracture still require assistance to walk one year later, and 33% are totally dependent or are admitted to a nursing home [2,4]. Bone mass is an important predictor of osteoporosis, and future fracture risk [5], and calcium plays an important role in normal growth, development and maintenance of the skeleton [6], including providing a dynamic store to maintain the intra- and extra-cellular calcium pools [7]. Calcium homeostasis is regulated by an integrated hormonal system that involves calcitonin, parathyroid hormone (PTH) and the PTH receptor, and 1,25-dihydroxyvitamin D and the vitamin D receptor [7,8], along with serum ionized calcium, and the calcium-sensing receptor [9]. When plasma concentrations of ionized calcium fall below optimal levels, bone resorption increases in order to restore the mineral equilibrium.

Clearly, adequate dietary calcium intake is an essential modifiable dietary factor for both achieving optimal peak bone mass in the second to third decade of life [10] and reducing age-related bone loss in later life [11]. However, recommendations for daily intake (RDI) of dietary calcium differ between countries; such discrepancies may likely arise

from the rationale implemented by the governing bodies with responsibility for nutritional RDIs [12].

Life-stage	RDI (mg)
Babies 0-6 months	~210 (if breastfed)
	~350 (if formula fed)
Babies 7-12 months	270
Children 1-3 years	500
Children 4-8 years	700
Children 9-11 years	1,000
Adolescents 12-18 years*	1,300
Women 19-50 years*	1,000
Women 51-70 years	~1,300
Men 19-70 years	1,000
Adults over 70 years	~1,300

Table 1: Recommended dietary intake (RDI) of calcium in Australia and the United States of America, at different life-stages [13,14,25]. *Including pregnant and breastfeeding women.

For instance, whilst RDI guidelines from the United Kingdom (UK) were formulated to address nutritional needs of the population as a whole, countries such as the United States of America (USA) and Australia targeted guidelines to address fluctuations in needs related to growth and development of bone health across the life-course [13,14].

Table 1 presents the RDIs for dietary calcium according to guidelines from Australia and the USA [13,14] notably these differ from European guidelines [15] and those of the UK, which appear much lower than the RDIs from Australia and the USA.

Given the differences in RDIs according to life-stages [6], understanding RDIs and how to achieve them is likely to be a complex process for many individuals. Furthermore, health promotion messages regarding adequate dietary calcium intake differ between official vs. commercial avenues, and diffusion processes also vary, including presentation via written, oral and/or visual medium/s. The ability to decipher nutrition labels and understand how to source calcium rich food adds yet another complexity to the likelihood of meeting RDIs. As such, achieving RDIs is dependent upon the capacity of individuals to access, comprehend and apply the recommended guidelines. Studies have shown that many in the general population do not meet RDIs for dietary calcium [16,17]; however, the groups most unlikely to meet RDIs are older individuals, and the socially disadvantaged [16]; in English speaking countries, this may also include those of non-English speaking backgrounds (NESB).

Health literacy is defined by the World Health Organisation as the "...cognitive and social skills, which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health" [18]. Health literacy skills influence the uptake of health promotion messages. The measurement of health literacy is complex, and, to date, most research in this field has been undertaken using measurement tools that focus on a narrow definition of health literacy, for instance focusing on language or numeracy skills [19]. These narrow definitions of health literacy, and the application of different measurement tools, may underpin the high variability in prevalence of sub-optimal health literacy reported within the literature [20]. For instance, studies that applied the Newest Vital Sign (NVS), and the Rapid Estimate of Adult Literacy in Medicine (REALM) tools, showed that older populations have lower health literacy compared to younger populations [21]; however, the opposite was observed when the Test of Functional Health Literacy in Adults (TOFHLA) was employed [21]. To address the variability and short falls in these older unidimensional measurement tools, recently developed tools encompass a broader range of health literacy skills and abilities; these include the Health Literacy Management Scale (HeLMS) [22], Health Literacy Questionnaire (HLQ) [23], and the European Health Literacy Survey Questionnaire (HLS-EU-Q) [19]. Despite the limitations of older unidimensional health literacy tools, there was relative consistency in the suggestion that certain populations have different health literacy needs. Those with lower health literacy skills are the same groups at increased risk for osteoporosis, and subsequent fracture.

Taken in context, it is clear that health literacy plays an important role in health promotion. In order to increase the proportion of individuals that meet RDIs for dietary calcium, we need an improved understanding of how older individuals, those that are socially disadvantaged, and those from NESB, obtain, understand and use health information. By taking into account the health literacy strengths and weaknesses of these subgroups, it will enable us to inform the development of more appropriately targeted interventions, and therefore will improve the accessibility and comprehension of RDI messages for at-risk individuals. As an example, data collected using a multi-dimensional health literacy measurement tool suggests that older individuals are more likely to have a higher than average level of social support [24], thus health messages channelled through (non-

electronic) social networks may be efficacious. Similarly, individuals with lower educational attainment (a parameter of social disadvantage) are more likely to have difficulties finding, understanding and appraising health information [24], thus messages aimed at this group need to be presented in simple, user friendly formats. Finally, individuals of NESB have a reduced capacity to understand health information presented via mass media [24]; thus, resources in a variety of languages are necessary. However, data also suggested that the distribution of these resources within healthcare settings for individuals of NESB may not influence behaviour change, as this group also had a reduced capacity to navigate healthcare systems [24].

In conclusion, the majority of public health campaigns aimed at promoting adequate dietary calcium intake are likely to have limited impact on those at greatest risk, if the important role played by health literacy in the likelihood of individuals meeting RDIs is ignored.

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Conflict of Interest

None declared.

References

1. WHO (2007) Prevention and management of osteoporosis: report of a WHO scientific group. World Health Organisation Scientific Group on the prevention and management of osteoporosis.
2. Otmar R, Kotowicz MA, Brennan SL, Bucki SG, Korn S, et al. (2013) Personal and psychosocial impacts of clinical fracture in men. *J Men's Health* 10: 22-27.
3. Pasco JA, Sanders KM, Hoekstra FM, Henry MJ, Nicholson GC, et al. (2005) The human cost of fracture. *Osteoporos Int* 16: 2046-2052.
4. International Osteoporosis Foundation. Impact of osteoporosis
5. Marshall D, Johnell O, Wedel H (1996) Meta-analysis of how well measures of bone mineral density predict occurrence of osteoporotic fracture. *BMJ Open* 312: 1254-1259.
6. Flynn A (2003) The role of dietary calcium in bone health. *Proc Nutr Soc* 62: 851-858.
7. Peacock M (2010) Calcium metabolism in health and disease. *Clin J Am Soc Nephrol* 5: S23-S30.
8. Jurutka PW, Whitfield GK, Hsieh JC, Thompson PD, Haussler CA, et al. (2001) Molecular nature of the vitamin D receptor and its role in regulation of gene expression. *Rev Endocr Metab Disord* 2: 203-216.
9. Brown EM (2007) The calcium-sensing receptor: physiology, pathophysiology and CaR-based therapeutics. *Subcell Biochem* 45: 139-167.
10. Heaney RP, Abrams S, Dawson-Hughes B, Looker A, Marcus R, et al. (2000) Peak bone mass. *Osteoporos Int* 11: 985-1009.
11. Tang B, Eslick G, Nowson C, Smith C, Bensoussan A (2007) Use of calcium or calcium in combination with vitamin D supplementation to prevent fractures and bone loss in people aged 50 years and older: a meta-analysis. *Lancet* 370: 657-666.
12. Weaver CM (1999) Nutrition and bone health: The US perspective. *Nutrition Bulletin* 24: 122-126.
13. Food and Nutrition Board (2011) Institute of Medicine (USA), Dietary reference intakes for calcium and vitamin D. In: Ross AC, Taylor CL,

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- Yaktine AL, Del Valle HB (eds) Washington, D.C.: National Academy Press.
14. Medical Scientific Advisory Committee (2015) Osteoporosis Australia. Calcium Factsheet.
 15. European Food Safety Authority (2015) Scientific opinion on dietary reference values for calcium. *EFSAJ* 13: 4101.
 16. Ma J, Johns RA, Stafford RS (2007) Americans is not meeting current calcium recommendations. *Am J Clin Nutr* 85: 1361-1366.
 17. Pasco JA, Sanders KM, Henry MJ, Nicholson GC, Seeman E, et al. (2000) Calcium intakes among Australian women: Geelong Osteoporosis Study. *Aust NZ J Med* 30: 21-27.
 18. Nutbeam D (1998) Health promotion glossary. *Health Promotion Int* 13: 349-364.
 19. Soerensen K, Van den Broucke S, Pelikan JM, Fullam J, Doyle G, et al. (2013) Measuring health literacy in populations: illuminating the design and development process of the European Health Literacy Survey Questionnaire (HLS-EU-Q). *BMC Public Health* 13: 948.
 20. Jordan JE, Osborne RH, Buchbinder R (2011) Critical appraisal of health literacy indices revealed variable underlying constructs, narrow content and psychometric weaknesses. *J Clin Epidemiol* 64: 366-379.
 21. Barber MN, Staples M, Osborne RH, Clerehan R, Elder C, et al. (2009) Up to a quarter of the Australian population may have suboptimal health literacy depending upon the measurement tool: results from a population-based survey. *Health Promotion Int* 24: 252-261.
 22. Jordan JE, Buchbinder R, Briggs AM, Elsworth GR, Busija L, et al. (2013) The health literacy management scale (HeLMS): a measure of an individual's capacity to seek, understand and use health information within the healthcare setting. *Patient Education Counselling* 91: 228-235.
 23. Osborne RH, Batterham RW, Elsworth GR, Hawkins M, Buchbinder R (2013) The grounded psychometric development and initial validation of the Health Literacy Questionnaire (HLQ). *BMC Public Health* 13: 1-17.
 24. Beauchamp A, Buchbinder R, Dodson S, Batterham RW, Elsworth GR, et al. (2015) Distribution of health literacy strengths and weaknesses across socio-demographic groups: a cross-sectional survey using the Health Literacy Questionnaire (HLQ). *BMC Public Health* 15: 678.
 25. National Health and Medical Research Council (of Australia) (2006) Nutrient reference values for Australia and New Zealand including recommended dietary intakes. NHMRC: Canberra.