

Special Article - Calcium Deficiency

Calcium Deficiency Poses a Multifaceted Health Threat: Necessity of Calcium Intake and Physical Activity

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The Global Threat of Worsened Calcium Deficiency and Raising Burden on Health

Calcium, an essential nutrient for human body, serves as an important regulator for a wide array of human physiological functions including neurotransmission, cardiac rhythm, muscle contraction, respiration, bone mineral density, vascular tension and blood clotting [1]. Calcium deficiency and insufficiency are highly prevalent in many countries and predispose to the risk of several chronic disease [2,3]. Evidence from clinical and experimental studies has highlighted the risk of inadequate dietary calcium intake and unfavorable health impact of long-term calcium insufficiency. For example, calcium deficiency has been indicated to be closely associated with the incidence of bone health, cancers, cardiovascular disease, obesity, and higher mortality at various stages of life including infancy, childhood, adolescence, adulthood, seniority, and even pregnancy and lactation [1]. Calcium is considered an important ingredient of bone, accounting for approximately 30-35% of bone mass and much of bone strength. Adequate dietary calcium intake during childhood is pertinent for optimal peak bone mass to promote bone reserve and osteoporosis [4]. Not surprisingly, low calcium intake in certain populations may adversely affect development of peak bone mass in adolescents and young adults and the retention of bone mass in the elderly [5,6]. To this end, skeleton usually gains up to 49g per year in adolescent boys and 325g per year in adolescent girls. With increased age in particular in the elderly, bone loss occurs at a rate of about 1% per year, resulting in an approximate 15g calcium loss per year [7,8]. It appears that average calcium intake is normally lower in women than men [5]. In 2002, the Food and Agriculture Organization of the United Nations (FAO) and World Health Organization (WHO) recommended a 1300mg daily intake of calcium for postmenopausal women and men over 65 years [9]. This recommended level of intake was much higher than what older adults were able to consume through diets. Recently, Balk and colleagues [5] systematically reviewed the global dietary calcium intake in adults and reported an average national dietary calcium intake between 175 and 1233mg/day across 74 countries with data. Many countries in Asia have an average dietary calcium intake less than 500mg/day. Countries in Africa and South America often display low calcium intake between roughly 400

and 700mg/day. Only Northern European countries maintain the dietary calcium intake >1000mg/day [10]. Therefore, geographical factors are crucial in determining populations whose calcium intake needs improvement and the national strategic guideline for optimal calcium intake. However, the majority of findings concerning calcium alone or in combination with vitamin D remain controversy for health outcomes. Dose-response relationships between intakes of calcium or with vitamin D and health outcomes were rarely documented. Precisely, there is a paucity of research on the point at how much dose of dietary calcium intake and supplementation on health outcomes becomes more beneficial than harmful, thus limiting the capacity to effectively balance the risk and optimize benefits of regular calcium intake. Therefore, much research is warranted for these topics.

Health Benefits of Dietary and Supplementation Calcium Intake and Physical Activity

An adequate intake of calcium not only helps to lower the risk of osteoporosis and bone health in the end, but also protects against major diseases, such as hypertension, cancer, kidney stones, insulin resistance, and diabetes. At the same time, physical activity is one of the most important and readily implementable endeavors for enhancing quality of life and limiting premature mortality [11]. Physical activity and dietary calcium intake have shown a rather significant interaction in enhancing bone accretion, which may potentially modify bone metabolism to offer an array of beneficial health outcomes. In this perspective, researches have evidenced that physical activity is much superior to other major environmental factors in maintaining peak bone mass [12-14]. In addition, a significant positive correlation exists between levels of physical activity and bone fractures such as hip and vertebral fractures [15]. It is perceived that calcium alone is unlikely to be beneficial for bone fractures though the co-administration of calcium and vitamin D (which display only modest fracture risk benefits) [16]. Given that, calcium intake is normally lower in women, especially menopausal women, than that from men [5]. Physical activity should thus be a favorable effect modifier for the association between calcium intake and bone density in peri-menopausal and postmenopausal women. Consequently, calcium and vitamin D status are associated with not only the intensity of physical activity, but also the frequency of outdoor physical activity, with close tie between the two. Noticeably, increased outdoor physical activity among individuals at different ages should be encouraged not only at home but also outdoors to promote a more active life style to achieve optimal rescue against calcium or vitamin D deficiency. Of note, whether a dose-dependent response relationship exists between dietary calcium supplement and physical activity requires further scrutiny.

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