Critical Review

What is the Best Solution to Manage Vitamin D Deficiency?

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Abstract

Nowadays, vitamin D deficiency is the most common nutritional deficiency worldwide. In addition to the skeletal effects, it is now recognized that vitamin D deficiency is associated with higher morbidity and mortality. Currently, optimizing serum concentration of 25-hydroxy vitamin D with targeted strategies is becoming one the most interesting topics of public health nutrition. It is not possible for everyone to obtain sufficient serum concentrations of vitamin D by effective solar ultraviolet B exposure or usual dietary intake. Nutritional supplements and fortified foods as an available and cost-effective way to provide the recommended amount of vitamin D. Although, vitamin D supplementation is considered a good and simple short-term solution for vitamin D deficiency treatment; however, it seems that at a population level, food fortification, using staple foods, is the best method to increase vitamin D consumption and long-term treatment of vitamin D deficiency. © 2019 IUBMB Life, 000(000):1–2, 2019

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Vitamin D deficiency is a common medical condition worldwide (1). A very high prevalence of vitamin D deficiency in all sex and age groups has been reported in all around the world (1, 2). It is estimated that more than one billion people worldwide are affected by vitamin D deficiency (2). A recent systematic review has shown that vitamin D deficiency has become an endemic public health problem globally, particularly in Middle-Eastern countries (3).

A growing body of evidence indicates that vitamin D insufficiency or deficiency is associated with several chronic and acute conditions. Inadequate sun exposure, obesity, insufficient intakes of vitamin D, gastrointestinal disorders, malabsorption, renal and liver diseases, and other various health conditions are contributing to vitamin D deficiency (1, 4, 5). Currently, optimizing serum concentration of 25-hydroxy (25-OH) vitamin D with targeted strategies is becoming one the most interesting topics of public health nutrition. Very few foods contain vitamin D, and most of them have typically a low concentration of this vitamin (6). Solar ultraviolet B (UVB) exposure as well as vitamin D supplements and fortified food products are the other source of vitamin D. It is not always possible for everyone to be exposed to the solar UVB effectively. Additionally, production of vitamin D during sun exposure could be affected by several factors, including time of day of exposure, latitude, seasonal

Abbreviations: *25-OH, 25-hydroxy; UVB, ultraviolet B*

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changes, and the degree of skin pigmentation (7). Thus, nutritional supplements and fortified foods as an available and cost-effective way to consume the recommended amount of vitamin D, without risk of unacceptably high intakes, have recently attracted considerable attention. It is suggested that higher vitamin D intakes than the recommendation of Recommended Dietary Allowance (600–800 IU vitamin D per day in most of the population) are required to reach and maintain 25-OH D levels greater than 75 nmoL/L (8, 9). Vitamin D supplementation is considered a good short-term solution for vitamin D deficiency treatment; however, it seems that at a population level, food fortification, using staple foods, is the best method to increase vitamin D consumption and long-term treatment of vitamin D deficiency.

Fortification refers to the voluntary addition of vitamins and minerals in order to enhance the nutritive value of a food at the discretion of the food manufacturer. Both optional and mandatory fortification can be used in different communities. The first step is to identify staple and healthier foods. Rice, bread (wheat), oil, corn, dairy products, and sugar are present in the food basket of the largest part of the world. Bread, which usually is made with wheat flour, is a proper choice to be used as a fortification vehicle, as it is consumed as staple food in different region of the world. Wheat flour is also used in pasta, pastries, crackers, breakfast cereals, and noodles, which all might be good choices for vitamin D fortification. Although fortification of bread with some nutrients such as iron and folic acid was previously conducted worldwide, limited experiences exist for vitamin D fortification of flour in the world. Obviously, there are some limitations for food fortification. For example, flour fortification could not be able to provide sufficient amounts to meet vitamin D requirement of children under 2 years. Additionally, bread intake among children under 5 years is less than the amount to provide the vitamin D adequate level, consequently, other strategies such as vitamin D supplementation for children under 2 years and fortification for children of 2–6 years, of other food items such as dairy products may be an appropriate approach to ensure sufficient daily consumption of vitamin D by all age groups. Considering that milk and other dairy products are important sources of calcium, fortifying them with vitamin D may be important to supply both micronutrients. However, in some countries, particularly low- and middle-income nations, because of the high milk price, the lack of nutritional knowledge, and incorrect food habits, this approach might achieve less success. In addition, vitamin D is a fat-soluble vitamin, with two critical bonds to oxygen that are affected by exposure to light, oxygen, and heat. Moreover, microorganisms in fermented dairy products such as yogurt and cheese may consume vitamin D. To prevent several noncommunicable diseases related to consumption of saturated fats in dairy products, intake of skim and low-fat dairy products instead of full fat or whole dairy products is also strongly recommended. However, being fat-soluble, vitamin D has low solubility in low-fat and non-fat products. Thus, using a new, cost-efficient, and practical method such as encapsulation to preserve nutrients within a controlled release mechanism is strongly suggested for the future. In particular, it is highly recommended to apply new and inexpensive technologies such as nanotechnology to prepare vitamin D fortified low- or non-fat dairy products. In this regard, cooking oils, which are consumed by almost all families, could be an appropriate vehicle for vitamin D fortification. However, such a measure should be preceded by the educating community people to select healthy highly unsaturated vegetable oils necessary to prevent chronic diseases related to high consumption of saturated edible oils. Designing an efficient Quality Control and Quality Assurance system should be considered for adding vitamin D to flour. To ensure that the vitamin D content of the fortified bread is adequate and remains stable under storage and distribution conditions, an appropriate test method must be established considering that flat traditional breads can be fortified. Compared with last decade, vitamin D deficiency is now a serious public health problem in the country, and immediate attention is needed to control it.

Totally, to eliminate vitamin D deficiencies, effective, well-controlled, and harmonized programs must be initiated globally particularly in low- and middle-income countries. Flour and dairy products should be mandatory fortified with vitamin D using novel, practical, and cost-effective technologies, while oils and beverages could be optionally fortified with vitamin D.

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