

Vitamin D for Healthy Term Infants

Background Paper for Saskatchewan Public Health Professionals

PURPOSE

The purpose of this paper is to provide:

- clarity on the population health recommendation for vitamin D for infants from birth to 12 months of age; and,
- guidance for public health professionals to ensure infants are receiving adequate amounts of vitamin D for optimal bone health.

RECOMMENDATION

Promote breastfeeding exclusively for the first six months of life and sustained for up to two years or longer with appropriate complementary feeding. Breastfeeding is the normal and unequalled method of feeding infants.

All infants who are breastfed or receiving breastmilk should be provided with a daily vitamin D supplement of 400 International Units (IU).

Non-breastfed infants receiving commercial infant formula do not require a vitamin D supplement.

BACKGROUND

There have been many different vitamin D recommendations made by a variety of health organizations. This has led to confusion by the public and professionals alike. Vitamin D deficiency in pregnant women, cases of rickets in infants and children, limited dietary sources, the role and variability of vitamin D production by the skin and possible functions of vitamin D beyond bone health have brought additional attention to this nutrient.

Vitamin D Needs of Infants

Vitamin D needs of Canadian infants are based on the Dietary Reference Intakes (DRIs). It has been established that an Adequate Intake (AI) of 400 IU of vitamin D is expected to meet or exceed the

needs of most infants for bone health (1) (Appendix A). There are no proven health benefits with amounts greater than 400 IU per day (2).

Current National Recommendations

Nutrition for Healthy Term Infants, the joint statement from Health Canada, Canadian Paediatric Society, Dietitians of Canada and Breastfeeding Committee for Canada, recommends a daily vitamin D supplement of 400 IU for infants who are breastfed, partially breastfed or receiving breastmilk (2)(3). The statement also indicates that non-breastfed infants receiving commercial infant formula do not require a vitamin D supplement (2)(3).

The Canadian Paediatric Society recommends a total vitamin D intake of 400 IU per day for all infants during the first year (4). Their recommended amount increases to 800 IU per day from all sources between October and April north of the 55th parallel and between the 40th and 55th parallel in individuals with risk factors for vitamin D deficiency other than latitude alone (4).

Role of Vitamin D

Vitamin D functions to assist the body in using calcium and phosphorus for building and maintaining strong bones and teeth (5). Vitamin D has other important roles related to cell growth, neuromuscular and immune function and reduction of inflammation (6).

Many studies have suggested that vitamin D may have health benefits beyond bone health however the evidence is not consistent or strong. A recent assessment suggests a probable role for decreasing dental caries and increasing birth weight as well as possible associations with the prevention of a variety of conditions such as cardiovascular disease, diabetes and colorectal cancer (7).

However, the research supporting these potential benefits is still inconclusive (1)(7). The main importance of vitamin D in infants is for the prevention of rickets.

Inadequate or Excessive Vitamin D

Low levels of vitamin D in children can cause rickets; characterized by the softening of bones and skeletal deformities (e.g., bowed legs). It can also present with other symptoms such as abnormal dentition, seizures, cardiomyopathy or congenital rickets (1)(8). In adults it can cause osteomalacia and can increase the risk of osteoporosis (5).

Excessive vitamin D from food and supplements can cause too much calcium to be deposited in parts of the body. This can lead to the calcification of kidneys and other soft tissues (6). Although this condition is rare, the upper limit for vitamin D (1000 IU in infants 0-6 months; 1500 IU in infants 7-12 months) from all sources should not be exceeded except when necessary in therapeutic management of confirmed rickets (1)(6)(Appendix A).

Risk Factors for Vitamin D Deficiency

There are many risk factors for vitamin D deficiency rickets including exclusive breastfeeding without vitamin D supplementation, maternal vitamin D deficiency, living in a temperate climate, lack of sunlight exposure and darkly pigmented skin (4)(9). Although studies on vitamin D and infants are limited, vitamin D deficiency in mothers and their infants has been found in Canada (4).

In 2007 Ward reported on 104 cases of vitamin D deficiency rickets identified through a physician survey between July 1, 2002 and June 30, 2004. Under the age of one year, rickets was most frequently reported among darker-skinned, breastfed infants. Northern location in Canada was also a risk factor for children over the age of one year. Maternal characteristics including skin colour, lack of sun exposure and inadequate vitamin D intake were contributing factors. None of the reported cases of rickets were breastfed infants who received regular vitamin D supplementation (400 IU/day) (8).

Vitamin D deficiency rickets and seizures have also been found in a limited number of exclusively formula fed infants (8)(10). These infants had multiple risk factors for vitamin D deficiency rickets including darker skin pigmentation, living north of the 54th parallel and maternal vitamin D deficiency. The mothers reported low milk consumption, did not take vitamin D supplements and presented during late autumn, winter or early spring (8)(10).

Based on individual assessment of the mother and infant, a clinical practitioner (i.e., physician, nurse practitioner or dietitian) may recommend a total vitamin D intake higher than 400 IU/day for infants with multiple risk factors.

Sources of Vitamin D

Sunlight

Sunlight is the primary source of vitamin D in humans (2). Vitamin D is synthesized in the body when skin is exposed to ultraviolet B radiation (6). However, sunlight is not a recommended source of vitamin D for infants. Current practice advises that infants avoid direct sunlight due to the risk of cancer and other negative health effects (11).

Breastmilk

The vitamin D content of human milk is variable and related to the mother's vitamin D status (6). Breastmilk is roughly estimated to contain 10 IU of vitamin D per 250 mL (12). Infants are unlikely to meet their vitamin D requirements through breastmilk (6). It would take doses of vitamin D higher than the current recommendations (DRIs) to increase a mother's vitamin D level sufficiently to make her breast milk adequate in vitamin D (13) (14). Further studies are needed to determine appropriate and safe dosages (13)(14).

Breastfeeding is the normal and unequalled method of infant feeding (2). However, without supplementation of vitamin D an infant's vitamin D stores will be depleted (2).

Commercial Infant Formula

In Canada, it is mandatory for commercial infant formula to contain between 40-100 IU of vitamin D

per 100 kcalories (27-67 IU per 100 mL) (15). Most formulas indicate on their labels a vitamin D content of 40 IU per 100 mL of formula (60 IU per 100 kcal). However, due to necessary overage, commercial infant formulas currently on the market typically contain 50 IU per 100 mL (75 IU per 100 kcal) (Health Canada, personal communication, Nov 6 2014).

Formula intake of infants varies over the first year of life (Appendix C). Therefore an infant may consume more or less than 400 IU of vitamin D per day depending on their formula intake. The AI of 400 IU represents an overall vitamin D intake that may vary over the first year of life (1). As such, consumption of somewhat less than 400 IU per day for a period of time within the first year is not a cause for concern (Health Canada, personal communication, Nov 6 2014).

Complementary Foods

An infant's intake of vitamin D from complementary foods may be limited. Current infant nutrition guidelines recommend the introduction of complementary foods at about six months of age with an emphasis on iron-rich foods being the first foods at this stage (2). Vitamin D is found naturally in very few foods (e.g., fatty fish, fish liver oil, and egg yolk) (1)(5). In Canada, cow's milk and margarine are fortified with vitamin D under mandatory requirements (5). Some milk products may contain vitamin D if they are made from fortified cow's milk (e.g., yogurt). Other foods, such as orange juice, may also be fortified to

varying degrees (5). See Appendix B for a list of food sources of vitamin D.

CONCLUSION

Vitamin D is a nutrient that requires attention in the first year of life to ensure adequate intake for the prevention of rickets in infancy. At this time, the scientific data available indicate a key role for calcium and vitamin D in bone health and provide a sound basis for the DRIs (1). The data do not, however, provide compelling evidence of a causal link to other health outcomes or that intakes greater than those established in the DRI process have benefits for health (1). Based on the available evidence, all infants who are breastfed or receiving breastmilk should be provided with a daily vitamin D supplement of 400 IU. Additional supplementation for infants with multiple risk factors can be determined by a clinical practitioner (i.e., physician, nurse practitioner or dietitian) on an individual case by case basis.

FOR MORE INFORMATION

Health Canada: <http://www.hc-sc.gc.ca/fn-an/nutrition/vitamin/vita-d-eng.php>

Nutrition for Healthy Term Infants: <http://www.hc-sc.gc.ca/fn-an/nutrition/infant-nourisson/index-eng.php>

Information for Parents: <http://healthycanadians.gc.ca/healthy-living-vie-saine/infant-care-soins-bebe/nutrition-alimentation-eng.php>

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APPENDIX A

Dietary Reference Intakes (DRI)

The Dietary Reference Intakes (DRI) is a comprehensive set of scientifically based nutrient reference values for healthy populations. They are a standard established by the Institute of Medicine (IOM) for use in Canada and the United States.

DRI is a term that describes four types of reference values:

- Estimated Average Requirement (EAR)
- Recommended Dietary Allowance (RDA)
- Adequate Intake (AI)
- Tolerable Upper Intake Level (UL)

EAR

The EAR is the median usual intake value that is estimated to meet the requirement of half the healthy individuals in a specific life-stage and gender group (the other half of the individuals in the group would not have their needs met). The EAR is used to calculate the RDA.

RDA

The RDA is the average daily intake level that is sufficient to meet the nutrient requirement of 97 to 98 percent of healthy individuals in a particular life-stage and gender group.

The RDA is used as a goal for usual intake of individuals. An RDA can only be set for a particular nutrient if there is sufficient scientific evidence to establish an EAR for that nutrient.

AI

The AI is a recommended average daily intake level based upon observed and experimentally calculated estimates of nutrient intake by a group (or groups) of apparently healthy people. In these cases, the groups are assumed to be in an adequate nutritional state.

An AI is derived for a nutrient if sufficient scientific evidence is not available to establish an EAR and set an RDA. An AI incorporates substantially more judgment than is used in establishing an EAR and RDA. An AI indicates that more research is needed to determine requirement. An AI is expected to meet or exceed the needs of most individuals in a particular life-stage and gender group. The AI can be used as the goal for an individual's intake but has limited use to assess.

UL

The UL is the highest level of continuing daily nutrient intake that is likely to pose no risk of adverse health effects in almost all individuals in the specific life-stage group. The nutrient in which data are not currently sufficient to establish a UL should not be interpreted as meaning that high intakes pose no risk of adverse effects.

- Intake at the UL is, by definition, safe but not intended to be a recommended level of intake.
- As intake increases above the UL, the potential risk of adverse effects increases
- At intakes between the RDA and UL, the risks to the individual of inadequacy and of excess are both close to zero.

Vitamin D

The DRIs for vitamin D are based on maintaining skeletal health and have been set using the assumption that sun exposure is minimal.

Age group	Recommended Dietary Allowance (RDA) per day		Tolerable Upper Intake Level (UL) per day	
	IU	mcg	IU	mcg
Infants 0-6 months	400*	10*	1000	25
Infants 7-12 months	400*	10*	1500	38
Children 1-3 years	600	15	2500	63
Children 4-8 years	600	15	3000	75
Children and Adults 9-70 years	600	15	4000	100
Adults > 70 years	800	20	4000	100
Pregnancy & Lactation	600	15	4000	100

*Adequate Intake

Note: Biological activity of 40 IU is equal to 1 mcg

APPENDIX B

Selected Food Sources of Vitamin D*

Food	Serving Size	Vitamin D Content*
Breastmilk	250 ml (1 cup)	10 IU
Commercial Infant Formula	250 ml (1 cup)	125 IU [†]
Fortified Cow's Milk	250 ml (1 cup)	100 IU
Salmon	30 g (1 oz)	103 IU
Rainbow Trout	30 g (1oz)	84 IU
Northern Pike (Jackfish)	30 g (1oz)	38 IU
Egg Yolk	1 yolk	25 IU
Yogurt made with Vitamin D fortified milk	60 g (1/4 cup)	23 IU
Orange Juice fortified with Vitamin D	60 ml (1/4 cup)	25 IU
Margarine	5 ml (1 tsp)	25 IU

*Food processing, labelling and fortification in Canada is covered by the Food and Drug Act under the jurisdiction of Health Canada and the Canadian Food Inspection Agency. Check food labels.

[†]Includes 25% overage.

For more information see the Canadian Nutrient File: <http://webprod3.hc-sc.gc.ca/cnf-fce/index-eng.jsp>.

APPENDIX C

Estimated energy requirement (EER) in relation to volume of commercial infant formula for infants birth to one year at the 3rd percentile and 97th percentile based on weight-for-age (WHO Growth Standards).

Infant Age	EER of Infants (kcal)	Formula Amount, ml (oz)
	<i>Percentile on Growth Chart</i>	
	<i>3rd – 97th</i>	<i>3rd – 97th</i>
Birth	280-449	414-651 (14-22)
2 Weeks	315-520	473-769 (16-26)
1 Month	342-582	503-858 (17-29)
2 Month	431-698	651-1035 (22-35)
3 Month	484-787	710-1153 (24-39)
4 Month	401-739	591-1094 (20-37)
5 Month	446-775	651-1153 (22-39)
6 Month	342-707	503-1035 (17-35)
7 Month	326-700	473-1035 (16-35)
8 Month	344-744	503-1094 (17-37)
9 Month	190-591	296-887 (10-30)
10 Month	208-618	296-917 (10-31)
11 Month	226-653	325-976 (11-33)
12 Month	0-410	0-621 (0-21)

Dietitians of Canada. Infant Nutrition: Infant Formula Knowledge Pathway. How much infant formula do healthy full-term formula fed infants of different ages consume? In Practice-based Evidence in Nutrition (PEN). Last updated: March 19, 2014 <December 2014> Available from: www.pennutrition.com. Access by subscription only.

Note: Estimated Energy Requirement is defined as the daily requirement for energy based on calculations that account for energy intake and expenditure, age, gender, weight, height, and physical activity level.