

# Nutrition Guideline

## Healthy Infants and Young Children

### Vitamin D

*For Professional Reference Only*

Applicable to: Nurses, Physicians and Other Health Professionals

#### Recommendations

##### Healthy Term Infants (Birth to 1 Year)

In order to meet an infant's vitamin D requirements:

- a [daily 400 International Unit \(IU\) vitamin D supplement is recommended](#) for all healthy term infants. This applies to exclusively breastfed, partially breastfed and formula fed infants. Health care providers may recommend higher amounts based on individual assessment.

##### Preterm Infants (Birth to 1-year Corrected Age)

In order to meet an infant's vitamin D requirements:

- a daily supplement of 400 to 1000 IU is recommended for all preterm infants (infants born at less than 37 weeks gestation). This applies to exclusively breastfed, partially breastfed and formula fed preterm infants. Primary health care providers may recommend higher amounts based on individual assessment.

##### Children (1 to 18 Years):

To help meet a child's vitamin D requirements:

- a [daily 400 IU vitamin D supplement is recommended](#).
- consumption of 200 IU of vitamin D from [food sources](#) is recommended.
- children not consuming cow's milk, infant formula or appropriate fortified plant-based beverage may need additional vitamin supplement. Parents are advised to consult with their primary health care provider.

\* Plant-based beverages are not recommended for children under two years of age.

##### General

Parents are advised to [look for the following when choosing a vitamin D supplement](#) for their child:

- a single vitamin D supplement that does not contain other vitamins or minerals;
- an eight-digit Natural Product Number (NPN) on the label, indicating that it has been assessed by Health Canada and has been found to be safe, effective and of high quality under its recommended conditions for use;
- a form suitable for the child's stage of development. For example, a liquid supplement is the most appropriate choice for infants.

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### Health Benefits

Vitamin D (calciferol) is an important fat-soluble vitamin for infants and children. The primary function of vitamin D is to aid in the absorption of calcium and phosphorus, helping to form and maintain strong bones.<sup>1</sup> Very low vitamin D levels can lead to adverse effects such as rickets (softening of bones and bowing of limbs) in children, metabolic bone disease in preterm infants, and osteomalacia and osteoporosis in adults.<sup>1</sup>

While research has investigated the role of vitamin D in diseases/conditions such as cancer, cardiovascular disease, diabetes, immune functioning and autoimmune disorders, infections, and neuropsychological functioning, there is currently not enough evidence to suggest causality.<sup>1</sup>

Vitamin D recommendations in this guideline are based primarily on the dietary reference intakes (DRI) from the Institute of Medicine.<sup>1</sup> However, available evidence has been reviewed to address the needs of the preterm infant as no intake recommendations were made by the IOM because they were considered a special population.<sup>1,2</sup> At this time, bone health is the only health indicator with evidence deemed strong enough to be used for DRI development for vitamin D.<sup>1</sup> Therefore, the scope of this nutrition guideline will focus on recommendations related to bone health.

### Key Questions

#### What are the risk factors for vitamin D deficiency?

Vitamin D<sub>3</sub> is produced from precursors in the skin in response to ultraviolet rays and is sunlight dependent. Exposure to sunlight varies considerably, and is influenced by factors such as latitude, season, skin pigmentation, clothing, and the use of sunscreen.<sup>1,3</sup>

All **infants and children** in Alberta are considered at risk for vitamin D deficiency given the province's northern latitude, current sun safety recommendations, and the limited number of [foods](#) which contain vitamin D.

**Preterm infants** are particularly at high risk of vitamin D deficiency due to low fetal stores at birth due to reduced gestation, consumption of low milk volumes,<sup>3</sup> challenges in achieving adequate intakes, and negative effects of medications on bone health.<sup>4</sup>

#### What are the symptoms of vitamin D deficiency in infants and children?

The classic vitamin D deficiency disease in children is rickets. Rickets is an end-stage condition characterized by the softening of bones manifesting as bowed legs, skeletal deformities, and stunted growth.<sup>1</sup> In addition, preterm infants may also experience hypocalcemic seizures, irritability, and fractures.<sup>5</sup>

#### Should a child's vitamin D blood serum level be routinely tested?

It is not advised to do routine screening of vitamin D status on people who are otherwise healthy.<sup>6</sup> Parents who are concerned about their child's vitamin D intake or status are advised to discuss their concerns with their child's primary health care provider.

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### How much vitamin D do infants and children require?

To support good bone health, the vitamin D requirements for infants and children are:

- Birth to one year: 400 IU (10 mcg)\* [*total from food and supplements*]
- Preterm infants, from birth to one-year corrected age: 400 – 1000 IU (10 – 25 mcg) [*total from food and supplements*]<sup>2,4</sup>
- Children 1 to 18 years old: 600 IU (15 mcg) [*total from food and supplements*]

\*Units for vitamin D can vary depending upon the reference or product label. International units (IU) are commonly used and understood; IU and mcg may both be found on product labels.

### Can the vitamin D requirements of infants and children be met through sun exposure?

Even though sun exposure can contribute to vitamin D status, sun exposure is unreliable and is a potentially unsafe way to meet a person's vitamin D requirements. In Northern latitudes such as Canada, vitamin D synthesis in the skin is absent during the winter months (October to April).<sup>1</sup> [Safe sun practices](#) to reduce the risk of skin cancer include keeping infants out of direct sunlight and using sunscreen after 6 months of age to areas of skin not covered by clothing.<sup>7</sup> If these safe sun practices are followed, sun exposure cannot be relied upon for meeting an infant's or child's vitamin D requirements regardless of latitude or season.

More information can be found at: <https://www.albertahealthservices.ca/poph/hi-poph-surv-phids-snapshot-skin-cancer.pdf> on skin cancer prevention.

### Can the vitamin D requirements of infants and children be met through food?

#### Breastmilk

No. An estimate of the typical amount of vitamin D in breastmilk is 10 IU of vitamin D per 1 cup (250 mL).<sup>8</sup> Although mothers deficient in vitamin D can increase the vitamin D content of their breastmilk to a small degree through diet, sun, and/or 400 IU of supplemental vitamin D, the amount of vitamin D present in breastmilk is not sufficient to meet the DRI for infants. It is important that breastfed infants still be supplemented with vitamin D.<sup>9</sup>

For more information on nutrition for breastfeeding mothers, refer to the *Nutrition Guideline: [Nutrition for the Breastfeeding Mother](#)*

#### Infant Formula

Health Canada requires that infant formulas sold in Canada be fortified with vitamin D;<sup>10</sup> standard formulas currently on the market contain about 100 IU per 1 cup (250 mL). Post-discharge preterm infant formula is slightly higher in vitamin D, containing about 130 IU per 1 cup (250mL).

More information can be found on the AHS Infant Compendium at:

<https://www.albertahealthservices.ca/assets/info/nutrition/if-nfs-ng-healthy-infants-infant-formula-compendium.pdf>

As formula fed infants may not meet their vitamin D requirements through infant formula alone based on the average amounts of formula consumed,<sup>11</sup> it is recommended they be supplemented with 400 IU vitamin D.

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### Food

Vitamin D is found naturally in very few foods.<sup>1</sup> The best sources are fatty fish (e.g. salmon, trout, and herring) with smaller amounts found in egg yolk.<sup>8</sup> In Canada, cow's milk and margarine must be fortified with vitamin D;<sup>12</sup> but small amounts may also be present in other fortified foods. As food sources of vitamin D are limited, the average intake of vitamin D among Canadians from foods is less than 400 IU per day.<sup>13</sup> Thus, Canadians will not meet their vitamin D requirements from food alone.

Consumption of 200 IU of vitamin D from food sources is recommended for all children (1 to 18 years). Two cups (500 mL) of cow's milk, fortified goat's milk or an appropriate fortified plant-based beverage\* would provide approximately 200 IU of vitamin D.<sup>8</sup> Children who are not drinking this amount regularly will require vitamin D from other sources. In this situation, health professionals may review food sources of vitamin D with parents and facilitate a referral to a Registered Dietitian if required.

\*Plant-based beverages are not recommended for children under two years of age.<sup>14</sup> Appropriate fortified plant-based beverage can be used as an alternative to milk for ages 2 and older.<sup>15</sup> For more information on soy or other plant-based beverages refer to the *Nutrition Guideline: [Plant-Based Beverages](#)*.

### What amounts of vitamin D can be found in food?

**Table 1. Vitamin D Content of Selected Foods<sup>8</sup>**

	Food (serving size)	Approximate vitamin D content
<b>Breastmilk</b>	Breastmilk (1 cup, 250 mL)	10 IU
<b>Best Sources</b>	Salmon, baked or broiled (2.5 ounces, 75 grams)	200 - 400 IU
	Jack mackerel, canned or pacific and jack mixed, baked or broiled (2.5 ounces, 75 grams)	200 - 400 IU
	Rainbow trout (2.5 ounces, 75 grams)	190 - 210 IU
	Atlantic herring/ Pacific sardines (2.5 ounces, 75 grams)	150 IU
<b>Good Sources</b>	Infant formula (1 cup, 250 mL)	100 IU
	Post-discharge preterm infant formula (1 cup, 250 mL)	130 IU
	Cow's milk (1 cup, 250 mL)	100 IU
	Goat's milk, fortified* with vitamin D (1 cup, 250 mL)	100 IU
	Fortified* plant-based beverage (1 cup, 250 mL)	90 IU
	Atlantic or Spanish mackerel (2.5 ounces, 75 grams)	80 IU
<b>Sources</b>	Margarine (1 teaspoon, 5 mL)	25 IU
	Egg yolk (2 large)	65 IU
	Yogurt, with vitamin D added (¾ cup, 175 grams)	40 - 80 IU
	Juice, with vitamin D added (½ cup, 125 mL)	50 IU

\* Goat's milk and plant-based beverages that are not fortified will contain insignificant amounts of vitamin D.<sup>8</sup>

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### What is the recommended level of vitamin D supplementation for healthy infants and children in Alberta?

Public health guidance for vitamin D supplementation in Alberta is based on the review of evidence-informed research by the Institute of Medicine DRIs which were developed assuming minimal sun exposure and is independent of skin pigmentation.<sup>1</sup> (See '[How much vitamin D do infants and children require?](#)' section.)

Vitamin D supplementation recommendations for children 1 year of age and older were made with the assumption that children would obtain 200 IU vitamin D daily from food sources.<sup>1</sup> Children 1 year of age and older not consuming cow's milk may need more than a 400 IU vitamin D supplement to meet the DRI. In these cases, parents are advised to consult with their primary health care provider.

A daily supplement in the range of 400 – 1000 IU is recommended for preterm infants. Parents are advised to consult with their primary health care provider for an individual recommendation.

**Table 2. Recommended Daily Vitamin D Supplement**

Age group	Recommended daily vitamin D supplement amount
<b>Healthy term infants (birth to 1 year)</b> <ul style="list-style-type: none"> <li>Exclusively or partially breastfed</li> <li>Formula/ 3.25% milk* fed</li> </ul>	400 IU
<b>Preterm infants (birth to 1 year corrected age)</b>	400-1000 IU Consult with primary health care provider for individual recommendation
<b>Children (1 – 18 years)</b>	400 IU For children not consuming 3.25% milk or appropriate fortified plant-based beverage**, consult with primary health care provider regarding possible need for additional supplementation

\* 3.25% milk is not recommended before 9 months of age<sup>9</sup>

\*\* Plant-based beverages not recommended before 2 years of age

### Why do vitamin D supplementation recommendations differ depending on the health professional or organization?

There is not an agreed upon optimal vitamin D blood serum level. While the IOM has identified >50 nmol/L 25(OH)D as sufficient, the Canadian Pediatric Society uses >75 nmol/L 25(OH)D.<sup>1,3</sup> Depending on which serum level is used as a reference, some health professionals may indicate a higher vitamin D supplementation dose (e.g. 800 IU/day) on an individual (client) level.

A daily 400 IU vitamin D supplement has been shown to support >50 nmol/L 25(OH)D in infancy.<sup>16-18</sup> A Canadian study of healthy, term, breastfed infants offered daily doses 800 IU or 1200 IU vitamin D for 11 months had no additional benefits compared to infants offered 400 IU vitamin D on bone mineral accretion at 1 and 3 years of age.<sup>18,19</sup> In all supplementation groups, 97% of infants achieved >50 nmol/L 25(OH)D.<sup>18</sup>

For **preterm infants** from birth to one-year corrected age, a daily dose of 400 IU/day is likely sufficient to maintain adequate serum vitamin D.<sup>3,4</sup> Preterm infants with identified risk factors or confirmed deficiency often receive higher doses of vitamin D supplementation. An intake of 800-1000 IU/day is likely required to normalize neonatal stores.<sup>4,20-22</sup>

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### Why do formula fed infants need a vitamin D supplement if formula contains vitamin D?

Each 1 cup (250 mL) of infant formula contains approximately 100 – 130 IU of vitamin D.<sup>10</sup> Infant formula intake usually ranges from 10 to 39 oz (300 to 1170 mL) each day for a formula fed infant from birth through 11 months of age.<sup>11</sup> Since formula intake can be variable from day to day, many infants may not consume enough to meet vitamin D needs. Supplementing all formula fed infants with vitamin D daily will ensure they will consistently meet the DRI.

(See [‘What is the likelihood of an infant or child exceeding the Tolerable Upper Intake Level for vitamin D?’](#) section for more information on total intake for formula fed infants.)

### If an infant receives both breastmilk and infant formula, does he/she require a vitamin D supplement?

Yes. If an infant is partially breastfed, it is unlikely that he or she would consume 4 cups (32 oz or 1000 mL) of formula per day, the amount that would supply 400 IU of vitamin D; therefore, supplementation is recommended.<sup>9</sup> This recommendation also applies to preterm infants.

### How long should a child continue to receive a vitamin D supplement?

It is recommended that a vitamin D supplement be provided throughout childhood (birth to 18 years) to ensure that vitamin D requirements are met. See table 1 for age specific recommendations. Achieving a daily dietary intake of 600 IU of vitamin D (DRI for over 1 year of age)<sup>1</sup> without supplementation is unlikely given the limited amounts of vitamin D in food (natural and fortified).<sup>8</sup>

### What should parents look for when choosing a vitamin D supplement?

Advise parents to look for the following when choosing a vitamin D supplement for their child:

- a single vitamin D supplement that does not contain other vitamins or minerals,<sup>9</sup> unless advised differently by the primary healthcare provider.
- an eight-digit Natural Product Number (NPN) on the label, indicating that it has been assessed by Health Canada and has been found to be safe, effective and of high quality under its recommended conditions for use;<sup>23</sup>
- dose of 400 IU of vitamin D, unless advised differently by the primary healthcare provider
- a form that is suitable for the child’s stage of development; for example, a liquid or drop form is the most appropriate choice for infants.<sup>9</sup>
- expiry date

A single vitamin D supplement is recommended unless directed otherwise by the child’s primary health care provider. Multivitamin supplements are not recommended for healthy term infants<sup>9</sup> and not needed for most children. For preterm infants, a multivitamin supplement with vitamins A, D, and C may be recommended by the child’s primary health care provider. Multivitamins, probiotics and natural health product supplements with vitamin D, including cod liver oil, may contain varying amounts and types of vitamins and minerals. These supplements may include levels of vitamins (e.g. vitamin A) and minerals that could cause toxicity if incorrectly used. If a parent has concerns, they can be advised to consult with their health care provider.

Different brands of supplements have varying strengths of vitamin D (e.g. 400 IU versus 1000 IU) and dosing methods (single drop versus a dropper full). Product labels may list vitamin D amounts in either International Units (IU) or micrograms (mcg or µg). Parents can be informed that 1 mcg = 40 IU.<sup>24</sup> In order to ensure the correct dose is purchased and provided to their child, it is important for parents to read product labels carefully and to consult with a pharmacist with any questions.

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Vitamin D supplements for infants and children are available in many forms, including liquid, drops, chewable tablets, “gummies”, lozenges, strips, and sprays.<sup>23</sup> It is important to review the recommended ages and risk information on the label of any supplement and to consider the child’s stage of development in order to ensure vitamin D is in a form that is safe for the infant or child. The most appropriate choice of vitamin D supplement for infants is a liquid form<sup>9</sup> dispensed with a dropper, as a single drop or a spray. Infants who are still learning to chew and swallow are at risk for choking; therefore, tablets and chewable supplements are not an appropriate choice. Once a child can chew and swallow safely, they can take a chewable vitamin D supplement.

Chewable or gummy supplements appear and taste like candy. Therefore, it is advised that all supplements be kept out of reach from children to reduce the risk of toxicity and choking.

Vitamin D<sub>3</sub> comes from animal sources and vitamin D<sub>2</sub> from plant sources.<sup>1</sup> This may be a consideration for families following a vegetarian diet. Both vitamin D<sub>3</sub> and D<sub>2</sub> appear to be equally effective at lower doses.<sup>25,26</sup>

### What recommendations can be provided to parents who feel that their child does not tolerate a vitamin D supplement?

There is little information available on this issue. Expert opinion and best practice suggests that some things a parent may try include:

- give the supplement with breastmilk, formula or other food or try giving on an empty stomach to see if one way is tolerated better
- if possible, split the dose up during the day into smaller amounts
- offer the supplement at different times of the day
- try another brand of vitamin D supplement
- instead of a brand using a dropper for dosing, try one that delivers it as a drop or spray

### What is the likelihood an infant or child will exceed the tolerable upper intake level for vitamin D?

It is unlikely that excessive amounts of vitamin D would be obtained through food. As shown in Table 3, the combination of estimated amounts of vitamin D obtained from food and recommended supplemental amounts do not exceed the tolerable upper intake level (UL) for any of the age groups listed.

Potential risks related to high 25-OH-D concentrations are unknown, and the established upper tolerable intake of 1000 IU/ day for healthy term infants may be considered an upper intake for preterm infants as well.<sup>2</sup>

**Table 3. Estimated total Vitamin D intake (food and supplements) and Tolerable Upper Intake Level**

Age group	Estimated daily amount of vitamin D from food	Recommended daily vitamin D supplement amount	Estimated intake from food and supplements combined	Daily UL for vitamin D <sup>1</sup>
0 – 6 months	up to 470 IU*	400 IU	400 – 870 IU	1000 IU
7 – 12 months	up to 470 IU*	400 IU	400 – 870 IU	1500 IU
1 – 3 years	232 IU <sup>◇</sup>	400 IU	632 IU	2500 IU
4 – 8 years	220 IU <sup>◇</sup>	400 IU	620 IU	3000 IU
9 – 18 years	168 – 316 IU <sup>◇</sup>	400 IU	568 – 716 IU	4000 IU

\* Food intake value listed is an estimate based on the typical range of consumption of breastmilk, infant formula and/or whole milk.

<sup>◇</sup> Food intake value listed is based on the median vitamin D intake from the 2004 Canadian Community Health Survey report for Alberta<sup>24</sup>

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Prolonged sun exposure does not result in the production of excess quantities of vitamin D that would cause toxicity.<sup>1</sup> Once maximum cutaneous production occurs, excess vitamin D is degraded, preventing vitamin D toxicity.<sup>27</sup>

Incorrect supplement use would be the most likely cause of exceeding the UL, specifically the consumption of multiple supplements and/or the accidental consumption of incorrect dosages of vitamin D. (See '[What should parents look for when choosing a vitamin D supplement?](#)' section for more information on how to choose an appropriate supplement and dose.) Advise parents not to “double up” to make up for missed doses. Preterm infants often require higher vitamin D supplementation dosages which may be at the upper limit. Special care should be taken to ensure that the correct dosage is being offered.

#### Is vitamin D toxicity a concern for healthy infants and young children?

Toxicity is usually caused by very high intakes of supplemental vitamin D over long periods of time. There are limited studies on the toxicity of vitamin D in a young (0 – 2 years) population for several reasons, including: ethical reasons using a vulnerable population; studies are relatively short in duration (less than six months); incomplete monitoring or reporting of adverse outcomes; and lack of statistical power. In addition, there are very few reports over the last 35 years of vitamin D toxicity.<sup>1</sup> Given that little is known about vitamin D toxicity in infants and young children and that it may not have any noticeable symptoms, it is best to recommend to parents and care providers to stay within the dosage recommendations. If vitamin D toxicity is suspected, recommend parents to see their primary health care provider.

#### Are there any handouts on vitamin D for healthy infants and children that I can use with my clients?

For infant nutrition resources visit Nutrition Education Materials at [www.ahs.ca/nutritionhandouts](http://www.ahs.ca/nutritionhandouts) and click on **Infants**.

For more information related to healthy infants and children see [Healthy Parents Healthy Children](#).



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