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.

Children (1 to 18 years):
To help meet a child’s vitamin D requirements:
- a daily 400 IU vitamin D supplement is recommended for all children.
- consumption of 200 IU of vitamin D from food sources is recommended for all children. Consumption of 2 cups (500 mL) of fluid milk or fortified soy beverage* each day will provide around 200 IU of vitamin D.

General:
Parents should be advised to look for the following when choosing a vitamin D supplement for their child:
- a single vitamin D supplement;
- 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;
- dose of 400 IU of vitamin D;
- a form suitable for the child’s stage of development; for example a liquid supplement is the most appropriate choice for infants.

* Soy beverages are not recommended for children under two years of age.

Health Benefits:
Vitamin D (calciferol) is a very important vitamin for infants and children. The primary function of this fat-soluble vitamin is to aid in the absorption of calcium and phosphorus, thus helping to form and maintain strong bones. Low vitamin D stores can lead to adverse effects such as rickets (softening of bones) in children and osteomalacia and osteoporosis in adults.

Vitamin D’s other roles in human health include modulation of neuromuscular and immune function and reduction of inflammation. Some research in the past decade has also linked vitamin D to positive health outcomes in common diseases and conditions such as multiple sclerosis and other autoimmune disorders, cancer, cardiovascular disease, diabetes, and metabolic syndrome. However, there is currently not enough evidence to suggest causality.

Vitamin D recommendations in this guideline are based on the Dietary Reference Intakes from the Institute of Medicine. At this time, bone health is the only health indicator with evidence deemed strong enough to be used for Dietary Reference Intake development for vitamin D.

See ‘Appendix A’ for more information on the Dietary Reference Intakes (Recommended Dietary Allowance [RDA], Adequate Intake [AI] and Tolerable Upper Intake Level [UL]).
Key Questions

What are the risk factors for vitamin D deficiency?

There are many risk factors for vitamin D deficiency. Infants and children at risk of vitamin D deficiency are those who are:6,7,8,9

- born to vitamin D deficient mothers
- exclusively breastfed
- inadequate in their dietary intake
- overweight or obese
- living at latitudes north of 37°N during the winter months (October through March). Alberta’s latitude falls north of 37°N.
- not exposed to sunlight
- dark skinned

Considering the above list, it can be assumed that all infants and children in Alberta would be considered at risk of vitamin D deficiency. Therefore, the same recommendations for vitamin D in this guideline apply to all healthy children and are independent of the risk factors listed.

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

Vitamin D deficiency can present with non-specific symptoms such as weakness, chronic musculoskeletal pain, fatigue or easy tiring.10 However, there are often no obvious symptoms of vitamin D deficiency until it is severe.11 The classic vitamin D deficiency disease in children is rickets, which is characterized by the softening of bones (bowed legs) and skeletal deformities.3

Should a child’s vitamin D status (blood level) be routinely tested?

It is unnecessary to do routine screening of vitamin D status on those children who are otherwise healthy.12,13,14 Parents who are concerned about their child’s vitamin D intake or status should discuss their concerns with the child’s primary health care provider.

What are common sources of vitamin D?

Vitamin D is photosynthesized in the skin by the sun when bare skin is exposed to ultraviolet B (UVB) radiation and is found in a few foods such as fatty fish and egg yolk, as well as vitamin-D fortified foods including cow’s milk and margarine.1 (See ‘What amounts of vitamin D can be found in food?’ section below.)
Can the vitamin D needs of infants and children be met through sun exposure?

Even though sun exposure can contribute to one’s vitamin D status, sun exposure is an unreliable and potentially unsafe way to meet a person’s vitamin D requirements. Latitude, season, time of day, skin pigmentation, sunscreen use and clothing have a dramatic influence on the amount of vitamin D produced by the skin.

- **Latitude and season:** At latitudes north of 37°N and south of 37°S, sunlight is insufficient to synthesize vitamin D in the skin in the winter months (October through March). Alberta’s latitude falls north of 37°N.
- **Time of day:** In the spring, summer and fall, vitamin D is only produced in the skin between approximately 10 a.m. and 3 p.m.
- **Skin pigmentation:** People with darker skin pigmentation require longer exposures to sunlight to make the same amount of vitamin D as people with lighter skin.
- **Sunscreen use:** Sunscreens absorb UVB radiation, which reduces the capacity of the skin to produce vitamin D. If sunscreen is used correctly, a sun protection factor (SPF) of 8 reduces vitamin D production in the skin by more than 95%, and an SPF of 15 reduces it by more than 98%.
- **Clothing:** Clothing absorbs most UVB radiation. Therefore, vitamin D is not made in skin covered by clothing.
- **Windows:** Vitamin D is produced in the skin only when it is directly exposed to UVB radiation. Glass and plexiglass absorb UVB radiation; therefore, exposure of the skin to sunlight that has passed through a window will not produce any vitamin D.

To reduce the health risks associated with sun exposure, such as the risk of skin cancer, parents should be advised of recommendations for safe sun practices. Current recommendations are:

- Infants should be kept out of direct sunlight at all times of the day to reduce the risk of skin damage and dehydration.
- Children should stay out of the direct sun between 11 a.m. and 4 p.m., or any time of the day when the UV index is three or higher.
- After six months of age, sunscreen is recommended for areas of the skin not covered by clothing.

If these safe sun practices are followed, sun exposure cannot be relied upon for meeting an infant or child’s vitamin D requirements. The RDA/AIs for vitamin D were developed assuming minimal sun exposure. (See ‘How much vitamin D do infants and children require?’ section below.)

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

The daily Recommended Dietary Allowance (RDA) refers to the average daily nutrient intake level sufficient to meet the needs of almost all healthy individuals in a particular life stage and gender group. Meeting the RDA for vitamin D will support bone health. The RDA for vitamin D for infants and children is:

- **Birth to one year:** 400 IU (10 mcg) [total from food and supplements]
- **1 to 18 years old:** 600 IU (15 mcg) [total from food and supplements]

* AI rather than RDA (See ‘Appendix A’ for definitions)

IU = International Unit  mcg = microgram (sometimes presented as μg)
Can the vitamin D requirements of infants and children be met through food?

**Breastmilk and infant formula:**
An estimate of the typical amount of vitamin D in breastmilk is 10 IU of vitamin D per 1 cup (250 mL). Infant formulas are fortified with vitamin D, with most standard cow’s milk infant formulas containing 85 - 103 IU of vitamin D per 1 cup (250 mL).

Considering the average amount of breastmilk an infant consumes, an infant cannot meet his or her vitamin D requirements through breastmilk alone. Similarly, based on the average amount of formula a formula fed infant consumes, formula fed infants may not meet their vitamin D requirements through infant formula alone.

**Food:**
Vitamin D is found in very few foods naturally. The best sources include fatty fish (e.g. salmon, trout, herring). Smaller amounts are found in egg yolk.

Some foods are, however, fortified with vitamin D. In Canada, vitamin D fortification of cow’s milk and margarine is mandatory. Cow’s milk typically contains approximately 100 IU of vitamin D per 1 cup (250 mL) and margarine contains approximately 25 IU of vitamin D per teaspoon (5 mL). Plant-based beverages and goat’s milk may be fortified with vitamin D, but this is not mandatory. If they are fortified, the level of fortification would be in the range outlined in Table 2.

Consumption of 200 IU of vitamin D from food sources is recommended for all children (1 to 18 years). Canada’s Food Guide recommends consumption of 2 cups (500 mL) of fluid milk or fortified soy beverage* daily. Two cups of cow’s milk, fortified goat’s milk or fortified soy beverage* would provide approximately 200 IU of vitamin D, contributing to a child’s vitamin D requirements. Children who are not drinking this amount regularly will require vitamin D from other food sources. In this situation, health professionals should review food sources of vitamin D with parents and facilitate a referral to a Registered Dietitian if required.

*Soy beverage is not recommended for children under two years of age.
What amounts of vitamin D can be found in food?

Table 1. Vitamin D content of selected foods

<table>
<thead>
<tr>
<th>Food (serving size)</th>
<th>Approximate vitamin D content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breastmilk Breastmilk (1 cup, 250 mL)</td>
<td>10 IU</td>
</tr>
<tr>
<td>Best Sources Salmon, baked or broiled (2.5 ounces, 75 grams) (Sockeye salmon has the highest levels of vitamin D)</td>
<td>200 - 700 IU</td>
</tr>
<tr>
<td>Rainbow trout (2.5 ounces, 75 grams)</td>
<td>190 - 210 IU</td>
</tr>
<tr>
<td>Atlantic herring (2.5 ounces, 75 grams)</td>
<td>160 IU</td>
</tr>
<tr>
<td>Good Sources Infant formula (1 cup, 250 mL)</td>
<td>85 - 103 IU</td>
</tr>
<tr>
<td>Cow’s milk (1 cup, 250 mL)</td>
<td>100 - 105 IU</td>
</tr>
<tr>
<td>Goat’s milk, fortified* with vitamin D (1 cup, 250 mL)</td>
<td>90 IU</td>
</tr>
<tr>
<td>Fortified* soy beverage◊ (1 cup, 250 mL)</td>
<td>78 IU</td>
</tr>
<tr>
<td>Atlantic mackerel (2.5 ounces, 75 grams)</td>
<td></td>
</tr>
<tr>
<td>Sources Margarine (1 teaspoon, 5 mL)</td>
<td>25 IU</td>
</tr>
<tr>
<td>Egg yolk (2 large)</td>
<td>50 - 90 IU</td>
</tr>
<tr>
<td>Yogurt, made with vitamin D fortified milk (¾ cup, 175 grams)</td>
<td>70 IU</td>
</tr>
<tr>
<td>Orange juice, fortified with vitamin D (½ cup, 125 mL)</td>
<td>50 IU</td>
</tr>
</tbody>
</table>

* Goat’s milk, soy beverages and other plant-based beverages that are not fortified, will contain insignificant amounts of vitamin D.21
◊ Soy beverages are not recommended for children under 2 years of age.26 Fortified soy beverage can be used as an alternative to milk for ages 2 and older.25 Plant-based beverages other than soy (e.g. rice, potato, almond etc.) are not considered replacements for milk.27

What foods in Canada are fortified with vitamin D?

Table 2. Vitamin D fortification regulations

<table>
<thead>
<tr>
<th>Food</th>
<th>Mandatory/optional</th>
<th>Fortification amount in regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Cow’s Milk (fluid, evap, dried)</td>
<td>Mandatory</td>
<td>300 - 400 IU/852 mL (88 - 117 IU/250 mL)</td>
</tr>
<tr>
<td>Margarine</td>
<td>Mandatory</td>
<td>530 IU/100 g (25 IU/5 mL)</td>
</tr>
<tr>
<td>Infant Formula</td>
<td>Mandatory</td>
<td>40 - 80 IU/100 kcal (67-134 IU/250 mL)</td>
</tr>
<tr>
<td>Goat’s Milk</td>
<td>Optional</td>
<td>300 - 400 IU/852 mL (88 - 117 IU/250 mL)</td>
</tr>
<tr>
<td>Plant-based Beverages</td>
<td>Optional</td>
<td>300 - 400 IU/852 mL (88 - 117 IU/250 mL)</td>
</tr>
</tbody>
</table>

* Assuming infant formulas contain 67 kcal per 100 mL
Nutrition Guideline
Healthy Infants and Young Children
Vitamin D
Applicable to: Nurses, Physicians and Other Health Professionals

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

Public health guidance for vitamin D supplementation in Alberta is based on the premise of meeting the RDA/AIs from the Institute of Medicine which were developed assuming minimal sun exposure and are independent of skin pigmentation.1 (See ‘How much vitamin D do infants and children require?’ section.) Vitamin D supplementation recommendations for children one year of age and older were made with the assumption that children would obtain 200 IU vitamin D daily from food sources.

Table 3. Recommended daily vitamin D supplement amount

<table>
<thead>
<tr>
<th>Age group</th>
<th>Recommended daily vitamin D supplement amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth to one year (healthy term infants)</td>
<td></td>
</tr>
<tr>
<td>Exclusively breastfed</td>
<td></td>
</tr>
<tr>
<td>Partially breastfed</td>
<td></td>
</tr>
<tr>
<td>Formula/whole milk’ fed</td>
<td>400 IU</td>
</tr>
<tr>
<td>1 – 18 years old</td>
<td>400 IU</td>
</tr>
</tbody>
</table>

* Whole milk should not be offered before 9 months of age.

Some infants and children may be advised higher levels of supplementation based on individual assessment by their primary health care provider.

If a breastfeeding mother takes a vitamin D supplement, does her breastfed baby need to take a vitamin D supplement as well?

Yes. Although mothers can satisfy their own requirements and increase the vitamin D content of their breastmilk via diet, sun, and/or supplements, it is important that breastfed babies still be supplemented with vitamin D.2 A breastfeeding mother would need to take a dose of 4000 - 6000 IU of vitamin D daily to satisfy the vitamin D needs of her infant.12 This amount would exceed the Tolerable Upper Intake Level (UL) for adults currently set at 4000 IU1 and would not be recommended unless specifically advised by the mother’s primary health care provider.

Why do formula fed infants need a vitamin D supplement if formula has vitamin D in it?

Each 1 cup (250 mL) of infant formula contains approximately 100 IU of vitamin D.6,22,23 Therefore, a formula fed infant drinking less than 4 cups (32 oz or 1000 mL) of formula each day would not receive 400 IU of vitamin D.34 Infant formula intake usually ranges from 10 to 39 oz (300 to 1170 mL) each day for a formula fed infant from birth through eleven months of age.35 This equates to an estimated vitamin D intake of 120 to 470 IU each day, indicating that formula fed infants may not meet the daily Adequate Intake (AI) of 400 IU vitamin D. Since formula intake can be variable from day to day, supplementing all healthy term, formula fed infants with 400 IU of vitamin D daily will ensure they will consistently meet the AI. (See ‘If following the vitamin D supplementation recommendations outlined in this guideline, could an infant or child exceed 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.

How long should a child continue to receive a 400 IU vitamin D supplement?

Given the eating patterns of many children, achieving a daily dietary intake of 600 IU of vitamin D (RDA for over one year of age) is unlikely. The 2004 Canadian Community Health Survey reports a median range of vitamin D intake for children and adolescents in Alberta from 220 IU to 316 IU daily. This indicates that supplementation is required in order to meet the RDA. It is recommended that a 400 IU vitamin D supplement be provided throughout childhood (birth to 18 years) to ensure that vitamin D requirements are met.

For vitamin D recommendations for adults, refer to the Nutrition Guidelines for Primary Care: Calcium and Vitamin D.

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

Vitamin D supplements for infants and children are available in many forms, including liquid/drops, chewable tablets or “gummies”, tablets that can be swallowed, dissolvable tablets, lozenges, strips, and sprays.

Parents should be advised to look for the following when choosing a vitamin D supplement for their child:

- a single vitamin D supplement;
- 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;
- dose of 400 IU of vitamin D;
- a form that is suitable for the child’s stage of development; for example a liquid supplement is the most appropriate choice for infants.

A single vitamin D supplement should be chosen unless directed otherwise by the child’s primary health care provider. Multivitamin supplements are not recommended for babies and not needed for most children. Parents who choose to provide a multivitamin supplement to their child should be advised to consult with a pharmacist to choose an appropriate product. Multivitamin and natural health product supplements, including cod liver oil, 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.

Different brands of supplements have varying strengths of vitamin D (e.g. 400 IU versus 1000 IU). 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. Liquid vitamin D supplements have dosages indicated on the label in millilitres (mL), in drops, or can be listed “per dropper” amount. The name of the supplement is not necessarily descriptive of the dosing amount (e.g. a supplement may have “drop” in the name, but the dose is per
Parents should be instructed to read product labels carefully and to consult with a pharmacist with any questions, in order to ensure the correct dose is chosen and provided.

The most appropriate choice of vitamin D supplement for infants is a liquid supplement. Tablets and chewable supplements can put infants who are still learning to chew and swallow at risk for choking. Once a child can chew and swallow safely, they can take a chewable vitamin D supplement. 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 the vitamin D form is safe for the infant or child.

Chewable or gummy supplements appear and taste like candy, therefore as with all supplements, should be kept out of reach of children to reduce the risk of toxicity or choking.

There are two forms of vitamin D available in vitamin D supplements. They are vitamin D₃ and vitamin D₂, and are from animal and plant sources respectively. At this time, it would appear that at low doses vitamin D₂ and D₃ are equally effective¹,¹² and thus vitamin D₂ or vitamin D₃ can be used as a vitamin D supplement for children.

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

While there is little information available on this issue, some suggestions to ease the child’s sensitivity to vitamin D include:

- give the supplement around feeding time rather than on an empty stomach, or try mixing with food or beverage;
- try offering the supplement at different times of the day;
- ask a pharmacist about using another vitamin D preparation.

If following the vitamin D supplementation recommendations outlined in this guideline, could an infant or child exceed the Tolerable Upper Intake Level for vitamin D?

### Table 4. Estimated total Vitamin D intake (food and supplements) and Tolerable Upper Intake Level

<table>
<thead>
<tr>
<th>Age group</th>
<th>Estimated daily amount of vitamin D from food</th>
<th>Recommended daily vitamin D supplement amount</th>
<th>Estimated intake from food and supplements combined</th>
<th>Daily Tolerable Upper Intake Level (UL) for vitamin D³</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 6 months</td>
<td>up to 470 IU*</td>
<td>400 IU</td>
<td>400 - 870 IU</td>
<td>1000 IU</td>
</tr>
<tr>
<td>7 - 12 months</td>
<td>up to 470 IU*</td>
<td>400 IU</td>
<td>400 - 870 IU</td>
<td>1500 IU</td>
</tr>
<tr>
<td>1 - 3 years</td>
<td>232 IU○</td>
<td>400 IU</td>
<td>632 IU</td>
<td>2500 IU</td>
</tr>
<tr>
<td>4 - 8 years</td>
<td>220 IU○</td>
<td>400 IU</td>
<td>620 IU</td>
<td>3000 IU</td>
</tr>
<tr>
<td>9 - 18 years</td>
<td>168 - 316 IU○</td>
<td>400 IU</td>
<td>568 - 716 IU</td>
<td>4000 IU</td>
</tr>
</tbody>
</table>

* Food intake value listed is an estimate based on the typical range of consumption of breastmilk, infant formula and/or whole milk. Vitamin D intake from vitamin D containing solids was not included as no estimates of consumption are available. (See ‘Why do formula fed infants need a vitamin D supplement if formula has vitamin D in it?’ section for estimates of formula intake.)

○ Food intake value listed is based on the median vitamin D intake from the 2004 Canadian Community Health Survey report for Alberta.³⁶ (See ‘Can the vitamin D requirements of infants and children be met through food?’ and ‘What amounts of vitamin D can be found in food’ sections for more information on food sources of vitamin D.)
As shown in Table 4, the combination of estimated amounts of vitamin D obtained from food and recommended supplemental amounts do not exceed the UL for any of the age groups listed.

It is unlikely that excessive amounts of vitamin D would be obtained through food. Data on usual intakes from food gathered in Alberta in 2004 indicates that less than 3% of children age 1-18 years (for the majority of age categories, closer to 0%) exceeded the UL for vitamin D. In 2004, the UL was even more conservative than it is now (2000 IU versus 2500-4000 IU), and therefore it is likely that even less children would exceed the UL with the new recommendations.

Prolonged sun exposure does not result in the production of excess quantities of vitamin D that would cause intoxication. Once maximum cutaneous production occurs, additional sun exposure will not result in additional net input to the system. The same UVB that produces vitamin D in the skin also degrades it, causing a steady-state that generally limits cutaneous production.

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.)

**What are the symptoms of vitamin D toxicity in infants and children?**

Vitamin D toxicity is a rare event but can cause symptoms such as feeding difficulties, irritability, diarrhea, and poor weight gain. Vitamin D toxicity can also raise blood calcium levels, causing heart rhythm abnormalities and mental changes such as confusion.

**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 [http://www.albertahealthservices.ca/nutrition/Page11115.aspx](http://www.albertahealthservices.ca/nutrition/Page11115.aspx) and click on Infants.

For more information related to healthy infants and children see [Healthy Parents Healthy Children](http://www.albertahealthservices.ca/nutrition/Page11115.aspx).
Appendices

Appendix A – Dietary Reference Intakes from the Institute of Medicine

The Institute of Medicine is an independent, non-profit organization that works outside of government to provide unbiased and authoritative advice to Canadian and American health professionals and the public.42 The Dietary Reference Intakes (DRI) are “a common set of reference values [on macro and micro nutrients] based on scientifically grounded relationships between nutrient intakes and indicators of adequacy, as well as the prevention of chronic diseases, in apparently healthy populations.”20

The Institute of Medicine uses the following terms within their DRI recommendations:

Recommended Dietary Allowance (RDA):
“The average daily dietary nutrient intake level that is sufficient to meet the nutrient requirements of nearly all (97-98%) healthy individuals in a particular life stage and gender group.”20

Adequate Intake (AI):
“The recommended average daily intake level based on observed or experimentally determined approximations of estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate; used when an RDA cannot be determined.”20

Tolerable Upper Intake Level (UL):
“The highest average daily nutrient intake level that is likely to pose no risk of adverse health effects to almost all individuals in the general population. As intake increases above the UL, the potential risk of adverse effects may increase.”20
References:


