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Vitamin A

Fact Sheet for Health Professionals

This is a fact sheet intended for health professionals. For a reader-friendly overview of Vitamin A, see our [consumer fact sheet on Vitamin A](#).

Introduction

Vitamin A is the name of a group of fat-soluble retinoids, including retinol, retinal, and retinyl esters [1-3]. Vitamin A is involved in immune function, vision, reproduction, and cellular communication [1,4,5]. Vitamin A is critical for vision as an essential component of rhodopsin, a protein that absorbs light in the retinal receptors, and because it supports the normal differentiation and functioning of the conjunctival membranes and cornea [2-4]. Vitamin A also supports cell growth and differentiation, playing a critical role in the normal formation and maintenance of the heart, lungs, kidneys, and other organs [2].

Two forms of vitamin A are available in the human diet: preformed vitamin A (retinol and its esterified form, retinyl ester) and provitamin A carotenoids [1-5]. Preformed vitamin A is found in foods from animal sources, including dairy products, fish, and meat (especially liver). By far the most important provitamin A carotenoid is beta-carotene; other provitamin A carotenoids are alpha-carotene and beta-cryptoxanthin. The body converts these plant pigments into vitamin A. Both provitamin A and preformed vitamin A must be metabolized intracellularly to retinal and retinoic acid, the active forms of vitamin A, to support the vitamin's important biological functions [2,3]. Other carotenoids found in food, such as lycopene, lutein, and zeaxanthin, are not converted into vitamin A.

The various forms of vitamin A are solubilized into micelles in the intestinal lumen and absorbed by duodenal mucosal cells [5]. Both retinyl esters and provitamin A carotenoids are converted to retinol, which is oxidized to retinal and then to retinoic acid [2]. Most of the body's vitamin A is stored in the liver in the form of retinyl esters.

Retinol and carotenoid levels are typically measured in plasma, and plasma retinol levels are useful for

assessing vitamin A inadequacy. However, their value for assessing marginal vitamin A status is limited because they do not decline until vitamin A levels in the liver are almost depleted [3]. Liver vitamin A reserves can be measured indirectly through the relative dose-response test, in which plasma retinol levels are measured before and after the administration of a small amount of vitamin A [5]. A plasma retinol level increase of at least 20% indicates an inadequate vitamin A level [3,5,6]. For clinical practice purposes, plasma retinol levels alone are sufficient for documenting significant deficiency.

A plasma retinol concentration lower than 0.70 micromoles/L (or 20 micrograms [mcg]/dL) reflects vitamin A inadequacy in a population, and concentrations of 0.70–1.05 micromoles/L could be marginal in some people [5]. In some studies, high plasma or serum concentrations of some provitamin A carotenoids have been associated with a lower risk of various health outcomes, but these studies have not definitively demonstrated that this relationship is causal.

Recommended Intakes

Intake recommendations for vitamin A and other nutrients are provided in the Dietary Reference Intakes (DRIs) developed by the Food and Nutrition Board (FNB) at the Institute of Medicine of the National Academies (formerly National Academy of Sciences) [5]. DRI is the general term for a set of reference values used for planning and assessing nutrient intakes of healthy people. These values, which vary by age and gender, include:

- **Recommended Dietary Allowance (RDA):** Average daily level of intake sufficient to meet the nutrient requirements of nearly all (97%–98%) healthy individuals; often used to plan nutritionally adequate diets for individuals.
- **Adequate Intake (AI):** Intake at this level is assumed to ensure nutritional adequacy; established when evidence is insufficient to develop an RDA.
- **Estimated Average Requirement (EAR):** Average daily level of intake estimated to meet the requirements of 50% of healthy individuals; usually used to assess the nutrient intakes of groups of people and to plan nutritionally adequate diets for them; can also be used to assess the nutrient intakes of individuals.
- **Tolerable Upper Intake Level (UL):** Maximum daily intake unlikely to cause adverse health effects.

RDAs for vitamin A are given as retinol activity equivalents (RAE) to account for the different bioactivities of retinol and provitamin A carotenoids, all of which are converted by the body into retinol (see Table 1). One mcg RAE is equivalent to 1 mcg retinol, 2 mcg supplemental beta-carotene, 12 mcg dietary beta-carotene, or 24 mcg dietary alpha-carotene or beta-cryptoxanthin [5].

Table 1: Recommended Dietary Allowances (RDAs) for Vitamin A [5]

Age	Male	Female	Pregnancy	Lactation
0–6 months*	400 mcg RAE	400 mcg RAE		
7–12 months*	500 mcg RAE	500 mcg RAE		
1–3 years	300 mcg RAE	300 mcg RAE		
4–8 years	400 mcg RAE	400 mcg RAE		
9–13 years	600 mcg RAE	600 mcg RAE		
14–18 years	900 mcg RAE	700 mcg RAE	750 mcg RAE	1,200 mcg RAE
19–50 years	900 mcg RAE	700 mcg RAE	770 mcg RAE	1,300 mcg RAE
51+ years	900 mcg RAE	700 mcg RAE		

*Adequate Intake (AI), equivalent to the mean intake of vitamin A in healthy, breastfed infants.

International Units and mcg RAE

Vitamin A is listed on the new Nutrition Facts and Supplement Facts labels in mcg RAE [8]. The U.S. Food and Drug Administration (FDA) required manufacturers to use these new labels starting in January 2020, but companies with annual sales of less than \$10 million may continue to use the old labels that list vitamin A in international units (IUs) until January 2021 [9]. To convert IU to mcg RAE, use the following [7]:

- 1 IU retinol = 0.3 mcg RAE
- 1 IU supplemental beta-carotene = 0.3 mcg RAE
- 1 IU dietary beta-carotene = 0.05 mcg RAE
- 1 IU dietary alpha-carotene or beta-cryptoxanthin = 0.025 mcg RAE

RAE can only be directly converted into IUs if the source or sources of vitamin A are known. For example, the RDA of 900 mcg RAE for adolescent and adult men is equivalent to 3,000 IU if the food or supplement source is preformed vitamin A (retinol) or if the supplement source is beta-carotene. This RDA is also equivalent to 18,000 IU beta-carotene from food or to 36,000 IU alpha-carotene or beta-cryptoxanthin from food. Therefore, a mixed diet containing 900 mcg RAE provides between 3,000 and 36,000 IU vitamin A, depending on the foods consumed.

Sources of Vitamin A

Food

Concentrations of preformed vitamin A are highest in liver and fish oils [2]. Other sources of preformed vitamin A are milk and eggs, which also include some provitamin A [2]. Most dietary provitamin A comes from leafy green vegetables, orange and yellow vegetables, tomato products, fruits, and some vegetable oils [2]. The top food sources of vitamin A in the U.S. diet include dairy products, liver, fish, and fortified cereals; the top sources of provitamin A include carrots, broccoli, cantaloupe, and squash [4,5].

Table 2 suggests many dietary sources of vitamin A. The foods from animal sources in Table 2 contain primarily preformed vitamin A, the plant-based foods have provitamin A, and the foods with a mixture of ingredients from animals and plants contain both preformed vitamin A and provitamin A.

Table 2: Selected Food Sources of Vitamin A [11]

Food	Micrograms (mcg) RAE per serving	Percent DV*
Beef liver, pan fried, 3 ounces	6,582	731
Sweet potato, baked in skin, 1 whole	1,403	156
Spinach, frozen, boiled, ½ cup	573	64
Pumpkin pie, commercially prepared, 1 piece	488	54
Carrots, raw, ½ cup	459	51
Ice cream, French vanilla, soft serve, 1 cup	278	31
Cheese, ricotta, part skim, 1 cup	263	29
Herring, Atlantic, pickled, 3 ounces	219	24
Milk, fat free or skim, with added vitamin A and vitamin D, 1 cup	149	17
Cantaloupe, raw, ½ cup	135	15
Peppers, sweet, red, raw, ½ cup	117	13
Mangos, raw, 1 whole	112	12
Breakfast cereals, fortified with 10% of the DV for vitamin A, 1 serving	90	10
Egg, hard boiled, 1 large	75	8
Black-eyed peas (cowpeas), boiled, 1 cup	66	7
Apricots, dried, sulfured, 10 halves	63	7
Broccoli, boiled, ½ cup	60	7
Salmon, sockeye, cooked, 3 ounces	59	7

Tomato juice, canned, ¾ cup	42	5
Yogurt, plain, low fat, 1 cup	32	4
Tuna, light, canned in oil, drained solids, 3 ounces	20	2
Baked beans, canned, plain or vegetarian, 1 cup	13	1
Summer squash, all varieties, boiled, ½ cup	10	1
Chicken, breast meat and skin, roasted, ½ breast	5	1
Pistachio nuts, dry roasted, 1 ounce	4	0

*DV = Daily Value. FDA developed DVs to help consumers compare the nutrient contents of foods and dietary supplements within the context of a total diet. The DV for vitamin A on the new Nutrition Facts and Supplement Facts labels and used for the values in Table 2 is 900 mcg RAE for adults and children age 4 years and older [8], where 1 mcg RAE = 1 mcg retinol, 2 mcg beta-carotene from supplements, 12 mcg beta-carotene from foods, 24 mcg alpha-carotene, or 24 mcg beta-cryptoxanthin. FDA required manufacturers to use these new labels starting in January 2020, but companies with annual sales of less than \$10 million may continue to use the old labels that list a vitamin A DV of 5,000 IU until January 2021 [9,10]. FDA does not require the new food labels to list vitamin A content unless vitamin A has been added to the food. Foods providing 20% or more of the DV are considered to be high sources of a nutrient, but foods providing lower percentages of the DV also contribute to a healthful diet.

The U.S. Department of Agriculture's (USDA's) [FoodData Central](https://fdc.nal.usda.gov/) [11] lists the nutrient content of many foods and provides a comprehensive list of foods containing vitamin A in IUs arranged by [nutrient content](#) and by [food name](#), and foods containing beta-carotene in mcg arranged by [nutrient content](#) and by [food name](#).

Dietary supplements

Vitamin A is available in multivitamins and as a stand-alone supplement, often in the form of retinyl acetate or retinyl palmitate [2]. A portion of the vitamin A in some supplements is in the form of beta-carotene and the remainder is preformed vitamin A; others contain only preformed vitamin A or only beta-carotene. Supplement labels usually indicate the percentage of each form of the vitamin. The amounts of vitamin A in stand-alone supplements range widely [2]. Multivitamin supplements typically contain 750–3,000 mcg RAE (2,500–10,000 IU) vitamin A, often in the form of both retinol and beta-carotene.

About 28%–37% of the general population uses supplements containing vitamin A [12]. Adults aged 71 years or older and children younger than 9 are more likely than members of other age groups to take supplements containing vitamin A.

Vitamin A Intakes and Status

According to an analysis of data from the 2007–2008 National Health and Nutrition Examination Survey (NHANES), the average daily dietary vitamin A intake in Americans aged 2 years and older is 607 mcg RAE [13]. Adult men have slightly higher intakes (649 mcg RAE) than adult women (580 mcg RAE). Although these intakes are lower than the RDAs for individual men and women, these intake levels are considered to be adequate for population groups.

Data from NHANES III, conducted in 1988–1994, found that approximately 26% of the vitamin A in RAEs consumed by men and 34% of that consumed by women in the United States comes from provitamin A carotenoids, with the remainder coming from preformed vitamin A, mostly in the form of retinyl esters [5].

The adequacy of vitamin A intake decreases with age in children [4]. Furthermore, girls and African-American

children have a higher risk of consuming less than two-thirds of the vitamin A RDA than other children [4].

Vitamin A Deficiency

Frank vitamin A deficiency is rare in the United States. However, vitamin A deficiency is common in many developing countries, often because residents have limited access to foods containing preformed vitamin A from animal-based food sources and they do not commonly consume available foods containing beta-carotene due to poverty [2]. According to the World Health Organization, 190 million preschool-aged children and 19.1 million pregnant women around the world have a serum retinol concentration below 0.70 micromoles/L [14]. In these countries, low vitamin A intake is most strongly associated with health consequences during periods of high nutritional demand, such as during infancy, childhood, pregnancy, and lactation.

In developing countries, vitamin A deficiency typically begins during infancy, when infants do not receive adequate supplies of colostrum or breast milk [14]. Chronic diarrhea also leads to excessive loss of vitamin A in young children, and vitamin A deficiency increases the risk of diarrhea [5,15]. The most common symptom of vitamin A deficiency in young children and pregnant women is xerophthalmia. One of the early signs of xerophthalmia is night blindness, or the inability to see in low light or darkness [2,16]. Vitamin A deficiency is one of the top causes of preventable blindness in children [14]. People with vitamin A deficiency (and, often, xerophthalmia with its characteristic Bitot's spots) tend to have low iron status, which can lead to anemia [3,14]. Vitamin A deficiency also increases the severity and mortality risk of infections (particularly diarrhea and measles) even before the onset of xerophthalmia [5,14,16].

Groups at Risk of Vitamin A Inadequacy

The following groups are among those most likely to have inadequate intakes of vitamin A.

Premature Infants

In developed countries, clinical vitamin A deficiency is rare in infants and occurs only in those with malabsorption disorders [17]. However, preterm infants do not have adequate liver stores of vitamin A at birth and their plasma concentrations of retinol often remain low throughout the first year of life [17,18]. Preterm infants with vitamin A deficiency have an increased risk of eye, chronic lung, and gastrointestinal diseases [17].

Infants and Young Children in Developing Countries

In developed countries, the amounts of vitamin A in breast milk are sufficient to meet infants' needs for the first 6 months of life. But in women with vitamin A deficiency, breast milk volume and vitamin A content are suboptimal and not sufficient to maintain adequate vitamin A stores in infants who are exclusively breastfed [19]. The prevalence of vitamin A deficiency in developing countries begins to increase in young children just after they stop breastfeeding [3]. The most common and readily recognized symptom of vitamin A deficiency in infants and children is xerophthalmia.

Pregnant and Lactating Women in Developing Countries

Pregnant women need extra vitamin A for fetal growth and tissue maintenance and for supporting their own metabolism [20]. The World Health Organization estimates that 9.8 million pregnant women around the world have xerophthalmia as a result of vitamin A deficiency [14]. Other effects of vitamin A deficiency in pregnant and lactating women include increased maternal and infant morbidity and mortality, increased anemia risk, and slower infant growth and development.

People with Cystic Fibrosis

Most people with cystic fibrosis have pancreatic insufficiency, increasing their risk of vitamin A deficiency due to difficulty absorbing fat [21,22]. Several cross-sectional studies found that 15%–40% of patients with cystic fibrosis have vitamin A deficiency [23]. However, improved pancreatic replacement treatments, better nutrition, and caloric supplements have helped most patients with cystic fibrosis become vitamin A sufficient [22]. Several studies have shown that oral supplementation can correct low serum beta-carotene levels in people with cystic fibrosis, but no controlled studies have examined the effects of vitamin A supplementation on clinical outcomes in patients with cystic fibrosis [22-24].

Vitamin A and Health

This section focuses on three diseases and disorders in which vitamin A might play a role: cancer, age-related macular degeneration (AMD), and measles.

Cancer

Because of the role vitamin A plays in regulating cell growth and differentiation, several studies have examined the association between vitamin A and various types of cancer. However, the relationship between serum vitamin A levels or vitamin A supplementation and cancer risk is unclear.

Several prospective and retrospective observational studies in current and former smokers, as well as in people who have never smoked, found that higher intakes of carotenoids, fruits and vegetables, or both are associated with a lower risk of lung cancer [1,25]. However, clinical trials have not shown that supplemental beta-carotene and/or vitamin A helps prevent lung cancer. In the Carotene and Retinol Efficacy Trial (CARET), 18,314 current and former smokers (including some males who had been occupationally exposed to asbestos) took daily supplements containing 30 mg beta-carotene and 7,500 mcg RAE (25,000 IU) retinyl palmitate for 4 years, on average [26]. In the Alpha-Tocopherol, Beta-Carotene (ATBC) Cancer Prevention Study, 29,133 male smokers took 50 mg/day alpha-tocopherol, 20 mg/day beta-carotene, 50 mg/day alpha-tocopherol and 20 mg/day beta-carotene, or placebo for 5–8 years [27]. In the beta-carotene component of the Physicians' Health Study, 22,071 male physicians took 325 mg aspirin plus 50 mg beta-carotene, 50 mg beta-carotene plus aspirin placebo, 325 mg aspirin plus beta-carotene placebo, or both placebos every other day for 12 years [28]. In all three of these studies, taking very high doses of beta-carotene, with or without 7,500 mcg RAE (25,000 IU) retinyl palmitate or 325 mg aspirin, did not prevent lung cancer. In fact, both the CARET and ATBC studies showed a significant increase in lung cancer risk among study participants taking beta-carotene supplements or beta-carotene and retinyl palmitate supplements. The Physicians' Health Study did not find an increased lung cancer risk in participants taking beta-carotene supplements, possibly because only 11% of physicians in the study were current or former smokers.

The evidence on the relationship between beta-carotene and prostate cancer is mixed. CARET study participants who took daily supplements of beta-carotene and retinyl palmitate had a 35% lower risk of nonaggressive prostate cancer than men not taking the supplements [29]. However, the ATBC study found that baseline serum beta-carotene and retinol levels and supplemental beta-carotene had no effect on survival [30]. Moreover, men in the highest quintile of baseline serum retinol levels were 20% more likely to develop prostate cancer than men in the lowest quintile [31].

The ATBC and CARET study results suggest that large supplemental doses of beta-carotene with or without retinyl palmitate have detrimental effects in current or former smokers and workers exposed to asbestos. The

relevance of these results to people who have never smoked or to the effects of beta-carotene or retinol from food or multivitamins (which typically have modest amounts of beta-carotene) is not known. More research is needed to determine the effects of vitamin A on prostate, lung, and other types of cancer.

Age-Related Macular Degeneration

Age-related macular degeneration (AMD) is a major cause of significant vision loss in older people. AMD's etiology is usually unknown, but the cumulative effect of oxidative stress is postulated to play a role. If so, supplements containing carotenoids with antioxidant functions, such as beta-carotene, lutein, and zeaxanthin, might be useful for preventing or treating this condition. Lutein and zeaxanthin, in particular, accumulate in the retina, the tissue in the eye that is damaged by AMD.

The Age-Related Eye Disease Study (AREDS), a large randomized clinical trial, found that participants at high risk of developing advanced AMD (i.e., those with intermediate AMD or those with advanced AMD in one eye) reduced their risk of developing advanced AMD by 25% by taking a daily supplement containing beta-carotene (15 mg), vitamin E (180 mg [400 IU] dl-alpha-tocopheryl acetate), vitamin C (500 mg), zinc (80 mg), and copper (2 mg) for 5 years compared to participants taking a placebo [32].

A follow-up AREDS2 study confirmed the value of this supplement in reducing the progression of AMD over a median follow-up period of 5 years but found that adding lutein (10 mg) and zeaxanthin (2 mg) or omega-3 fatty acids to the formulation did not confer any additional benefits [33]. Importantly, the study revealed that beta-carotene was not a required ingredient; the original AREDS formulation without beta-carotene provided the same protective effect against developing advanced AMD. In a more detailed analysis of results, supplementation with lutein and zeaxanthin reduced the risk of advanced AMD by 26% in participants with the lowest dietary intakes of these two carotenoids who took a supplement containing them compared to those who did not take a supplement with these carotenoids [33]. The risk of advanced AMD was also 18% lower in participants who took the modified AREDS supplement containing lutein and zeaxanthin but not beta-carotene than in participants who took the formulation with beta-carotene but not lutein or zeaxanthin.

Individuals who have or are developing AMD should talk to their healthcare provider about taking one of the supplement formulations used in AREDS.

Measles

Measles is a major cause of morbidity and mortality in children in developing countries. About half of all measles deaths happen in Africa, but the disease is not limited to low-income countries. Vitamin A deficiency is a known risk factor for severe measles. The World Health Organization recommends high oral doses (60,000 mcg RAE [200,000 IU]) of vitamin A for two days for children over age 1 with measles who live in areas with a high prevalence of vitamin A deficiency [34].

A Cochrane review of eight randomized controlled trials of treatment with vitamin A for children with measles found that 60,000 mcg RAE (200,000 IU) of vitamin A on each of two consecutive days reduced mortality from measles in children younger than 2 and mortality due to pneumonia in children [34]. Vitamin A also reduced the incidence of croup but not pneumonia or diarrhea, although the mean duration of fever, pneumonia, and diarrhea was shorter in children who received vitamin A supplements. A meta-analysis of six high-quality randomized controlled trials of measles treatment also found that two doses of 30,000 mcg RAE (100,000 IU) in infants and 60,000 mcg RAE (200,000 IU) in older children significantly reduced measles mortality [35]. The vitamin A doses used in these studies are much higher than the UL. The effectiveness of vitamin A

supplementation to treat measles in countries, such as the United States, where vitamin A intakes are usually adequate is uncertain.

The body needs vitamin A to maintain the corneas and other epithelial surfaces, so the lower serum concentrations of vitamin A associated with measles, especially in people with protein-calorie malnutrition, can lead to blindness. None of the studies evaluated in a Cochrane review evaluated blindness as a primary outcome [36]. However, a careful clinical investigation of 130 African children with measles revealed that half of all corneal ulcers in these children, and nearly all bilateral blindness, occurred in those with vitamin A deficiency [37].

Health Risks from Excessive Vitamin A

Because vitamin A is fat soluble, the body stores excess amounts, primarily in the liver, and these levels can accumulate. Although excess preformed vitamin A can have significant toxicity (known as hypervitaminosis A), large amounts of beta-carotene and other provitamin A carotenoids are not associated with major adverse effects [38]. The manifestations of hypervitaminosis A depend on the size and rapidity of the excess intake. The symptoms of hypervitaminosis A following sudden, massive intakes of vitamin A, as with Arctic explorers who ate polar bear liver, are acute [39]. Chronic intakes of excess vitamin A lead to increased intracranial pressure (pseudotumor cerebri), dizziness, nausea, headaches, skin irritation, pain in joints and bones, coma, and even death [2,4,5]. Although hypervitaminosis A can be due to excessive dietary intakes, the condition is usually a result of consuming too much preformed vitamin A from supplements or therapeutic retinoids [3,5]. When people consume too much vitamin A, their tissue levels take a long time to fall after they discontinue their intake, and the resulting liver damage is not always reversible.

Observational studies have suggested an association between high intakes of preformed vitamin A (more than 1,500 mcg daily—only slightly higher than the RDA), reduced bone mineral density, and increased fracture risk [1,4,40]. However, the results of studies on this risk have been mixed, so the safe retinol intake level for this association is unknown.

Total intakes of preformed vitamin A that exceed the UL and some synthetic retinoids used as topical therapies (such as isotretinoin and etretinate) can cause congenital birth defects [2-4]. These birth defects can include malformations of the eye, skull, lungs, and heart [4]. Women who might be pregnant should not take high doses of vitamin A supplements [2].

Unlike preformed vitamin A, beta-carotene is not known to be teratogenic or lead to reproductive toxicity [1]. And even large supplemental doses (20–30 mg/day) of beta-carotene or diets with high levels of carotenoid-rich food for long periods are not associated with toxicity. The most significant effect of long-term, excess beta-carotene is carotenoderma, a harmless condition in which the skin becomes yellow-orange [1,25]. This condition can be reversed by discontinuing beta-carotene ingestion.

Supplementation with beta-carotene, with or without retinyl palmitate, for 5–8 years has been associated with an increased risk of lung cancer and cardiovascular disease in current and former male and female smokers and in male current and former smokers occupationally exposed to asbestos [27,41]. In the ATBC study, beta-carotene supplements (20 mg daily) were also associated with increased mortality, mainly due to lung cancer and ischemic heart disease [27]. The CARET study ended early, after the investigators found that daily beta-carotene (30 mg) and retinyl palmitate (7,500 mcg RAE [25,000 IU]) supplements increased the risk of lung cancer and cardiovascular disease mortality [41].

The FNB has established ULs for preformed vitamin A that apply to both food and supplement intakes [5]. The FNB based these ULs on the amounts associated with an increased risk of liver abnormalities in men and women, teratogenic effects, and a range of toxic effects in infants and children. The FNB also considered levels of preformed vitamin A associated with decreased bone mineral density, but did not use these data as the basis for its ULs because the evidence was conflicting. The FNB has not established ULs for beta-carotene and other provitamin A carotenoids [25]. The FNB advises against beta-carotene supplements for the general population, except as a provitamin A source to prevent vitamin A deficiency.

Table 3: Tolerable Upper Intake Levels (ULs) for Preformed Vitamin A [5]*

Age	Male	Female	Pregnancy	Lactation
0–12 months	600 mcg	600 mcg		
1–3 years	600 mcg	600 mcg		
4–8 years	900 mcg	900 mcg		
9–13 years	1,700 mcg	1,700 mcg		
14–18 years	2,800 mcg	2,800 mcg	2,800 mcg	2,800 mcg
19+ years	3,000 mcg	3,000 mcg	3,000 mcg	3,000 mcg

* These ULs only apply to products from animal sources and supplements whose vitamin A comes entirely from retinol or its ester forms, such as retinyl palmitate. However, many dietary supplements (such as multivitamins) do not provide all of their vitamin A as retinol or its ester forms. For example, the vitamin A in some supplements consists partly or entirely of beta-carotene or other provitamin A carotenoids. In such cases, the percentage of retinol or retinyl ester in the supplement should be used to determine whether an individual's vitamin A intake exceeds the UL. For example, a supplement whose label indicates that the product contains 3,000 mcg RAE vitamin A and that 60% of this vitamin A comes from beta-carotene (and therefore 40% comes from retinol or retinyl ester) provides 1,200 mcg RAE of preformed vitamin A. That amount is above the UL for children from birth to 8 years but below the UL for older children and adults.

Interactions with Medications

Vitamin A can interact with certain medications, and some medications can have an adverse effect on vitamin A levels. A few examples are provided below. Individuals taking these and other medications on a regular basis should discuss their vitamin A status with their healthcare providers.

Orlistat

Orlistat (Alli®, Xenical®), a weight-loss treatment, can decrease the absorption of vitamin A, other fat-soluble vitamins, and beta-carotene, causing low plasma levels in some patients [42]. The manufacturers of Alli and Xenical recommend encouraging patients on orlistat to take a multivitamin supplement containing vitamin A and beta-carotene, as well as other fat-soluble vitamins [43,44].

Retinoids

Several synthetic retinoids derived from vitamin A are used orally as prescription medicines. Examples include the psoriasis treatment acitretin (Soriatane®) and bexarotene (Targretin®), used to treat the skin effects of T-cell lymphoma. Retinoids can increase the risk of hypervitaminosis A when taken in combination with vitamin A supplements [42].

Vitamin A and Healthful Diets

The federal government's 2015-2020 *Dietary Guidelines for Americans* notes that "Nutritional needs should be

met primarily from foods. ... Foods in nutrient-dense forms contain essential vitamins and minerals and also dietary fiber and other naturally occurring substances that may have positive health effects. In some cases, fortified foods and dietary supplements may be useful in providing one or more nutrients that otherwise may be consumed in less-than-recommended amounts.”

For more information about building a healthy diet, refer to the [Dietary Guidelines for Americans](http://health.gov/dietaryguidelines/2015/guidelines/) (<http://health.gov/dietaryguidelines/2015/guidelines/>), and the U.S. Department of Agriculture’s [MyPlate](http://www.choosemyplate.gov/) (<http://www.choosemyplate.gov/>).

The *Dietary Guidelines for Americans* describes a healthy eating pattern as one that:

- Includes a variety of vegetables, fruits, whole grains, fat-free or low-fat milk and milk products, and oils.

Many fruits, vegetables, and dairy products are good sources of vitamin A. Some ready-to-eat breakfast cereals are fortified with vitamin A.

- Includes a variety of protein foods, including seafood, lean meats and poultry, eggs, legumes (beans and peas), nuts, seeds, and soy products.

Beef liver contains high amounts of vitamin A. Other sources of the nutrient include some fish, beans, and nuts.

- Limits saturated and *trans* fats, added sugars, and sodium.
- Stays within your daily calorie needs.

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