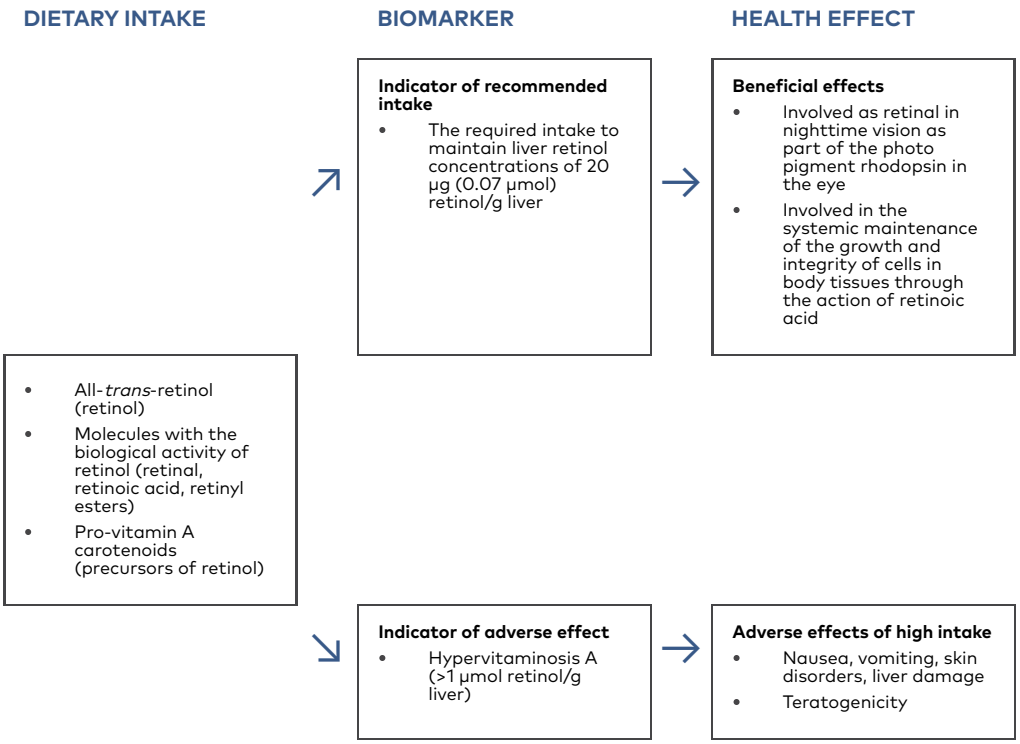
Vitamin A



	Females	Males
AR (RE/d)	540	630
RI (RE/d)	700	800

For more information about the health effects, please refer to the background paper by Thomas Olsen and Ulf H. Lerner (Olsen & Lerner, 2023)

Dietary sources and intake. Vitamin A is an essential fat-soluble vitamin that refers to several precursor and bioactive molecules. Precursors include all-*trans* retinol and pro-vitamin A carotenoids such as β-carotene. Vitamin A can be obtained from both animal and plant sources in the diet. In animal tissues, vitamin A exists predominantly as retinyl palmitate (a retinyl ester) whereas in plants only in the form of precursor compounds such as β-carotene (Olsen & Lerner, 2023). We convert all sources of vitamin A into a single unit with the term 'retinol equivalents' (RE). 1 RE is equal to: 1 µg of dietary or supplemental preformed vitamin A (retinol), 2 µg of supplemental β-carotene, 6 µg of dietary

β-carotene, 12 µg of other dietary provitamin A carotenoids (e.g., α-carotene and β-cryptoxanthin) (Olsen & Lerner, 2023). Foods rich in retinol include offal, meat, dairy products and eggs. Foods rich in β-carotene include vegetables and fruits, such as carrots, dark green leafy vegetables, red peppers, and melons (EFSA, 2015a). The average vitamin A intake ranges from 600 to 1500 RE/d (Lemming & Pitsi, 2022).

Main functions. Vitamin A acts through nuclear receptors in target cells. Activation of nuclear receptors requires that vitamin A is converted to all-*trans*-retinoic acid (ATRA). Vitamin A is involved in the visual cycle in the retina as part of the photopigment rhodopsin in the eye, where 11-cis retinal is the major bioactive component crucial for rhodopsin formation, and in the systemic maintenance of growth and integrity of cells in body tissues (EFSA, 2015a; Olsen & Lerner, 2023).

Indicator for recommended intake. The required intake to maintain liver retinol concentrations of 20 µg (0.07 µmol) retinol/g liver (EFSA, 2015a; Olsen & Lerner, 2023).

Main data gaps. There is a lack of simple screening tests to measure sub-clinical deficiency as plasma retinol is kept under tight homeostatic control. There is uncertainty in the variation of average requirements across populations. Little data are available on excessive intakes among children and adolescents. There is lack of consensus regarding the role that vitamin A may have on the skeleton. Harmonization in estimating the conversion rates of β-carotene to retinol is missing (Olsen & Lerner, 2023).

Deficiency and risk groups. Definitions of deficiency vary. Vitamin A deficiency is defined as liver stores of <0.07 or <0.10 µmol retinol/g liver depending on the publication, or alternatively serum/plasma retinol of <0.7 µmol/L. Clinical vitamin A deficiency is characterized by several ocular features (xerophthalmia) and a generalized impaired resistance to infection and increased infectious disease mortality (Olsen & Lerner, 2023).

Dietary reference values. Requirements and reference values for vitamin A are based on the required intake to maintain liver retinol concentrations of 20 µg retinol/g liver. The recommendations in NNR2012 were based on the factorial methods of IOM 2001 (IOM, 2001). EFSA also used the factorial method, but with more recent data on body/liver stores of vitamin A (EFSA, 2015a; Olsen & Lerner, 2023), and NNR2023 have updated this with Nordic body weights for setting recommendations. The following factors are multiplied to arrive at average requirements in adults that are in turn multiplied by a coefficient of variation (15 %) to yield final recommendations: target liver concentration (20 µg retinol/g), body/liver retinol stores ratio of 1.25, liver/body weight ratio of

2.4%, fractional catabolic rate of 0.7%, 1/efficiency of body storage, and reference body weight (see Appdenix 5). The RIs were set to 700 RE/day (females) and 800 RE/day (males). AR: 540 RE/day (females) and 630 RE/day (males). The UL of vitamin A is 3,000 RE/day.