The Vitamins & Dietary Supplement Label, Effectiveness, Safety and Risk, Quality

วิตามิน และอาหารเสริมสำหรับ

ป้องกันและรักษาโรคตามหลักฐานวิชาการ

- **The Dietary Supplement Health and Education Act of 1994 (DSHEA):**

a dietary ingredient as a vitamin; mineral; herb or other botanical; amino acid; dietary substance for use by man to supplement the diet by increasing the total dietary intake; or a concentrate, metabolite, constituent, extract, or combination of the preceding substances.

- Dietary supplements are marketed in forms such as tablets, capsules, softgels, gelcaps, powders, and liquids.

supplements should not make claims, such as “reduces pain” or “treats heart disease.” Claims like these can only legitimately be made for drugs, not dietary supplements.

Nutrition

- **Food** "any substance which is eaten and which contains nutrients."
- **Nutrients** "chemical substances which are necessary for the proper functioning of the body"
- **Macronutrients** are proteins carbohydrates and fats, which from the major part of the diet.
- **Micronutrients** are required in much smaller amounts (mg or μg) and are vitamins and mineral elements.
- **Trace elements** "minerals required in extremely small amounts."

- **Nutrition** **"the science which is concerned with food, its acceptance by individuals and the body's uses of chemicals that the food contains."**

- **Diet** "the food and drink consumed each day."

- **Modified or therapeutic diet** (special diet) is the food allowance which has been changed to meet the specific requirements of the individual.

- **Food additive** "substance or mixture of substances, other than a basic food stuff, which is present in food as a result of any aspect of production, processing, storage or packaging."

- **Dietary supplements** "products intended to supplement the diet to enhance health and include vitamins, minerals, amino acids, herbs, and other botanicals."

- **Nutraceutical** " a diet supplement that delivers a concentrated from of a biologically active component of food in a non-food matrix in order to enhance health"

- **Functional foods** "food which deliver an active ingredient within the food matrix"

- **Medical food** "food formulated for the consumption or administration enterally intended for the specific dietary management of diseases or conditions for which distinctive nutritional requirements based on recognized scientific principles are established"
  - Nutritionally complete products
  - Nutritionally incomplete products
  - Formulas for metabolic (genetic) disorders
  - Oral dehydration solutions

DETERMINING NUTRIENT NEEDS

- Recommended Dietary Allowances (RDA)
- Estimated Safe and Adequate Daily Dietary Intake (ESADDI)
- Estimated mininum requirements.
- Food Guide Pyramid
- Thai RDA
- ธงโภชนาการ

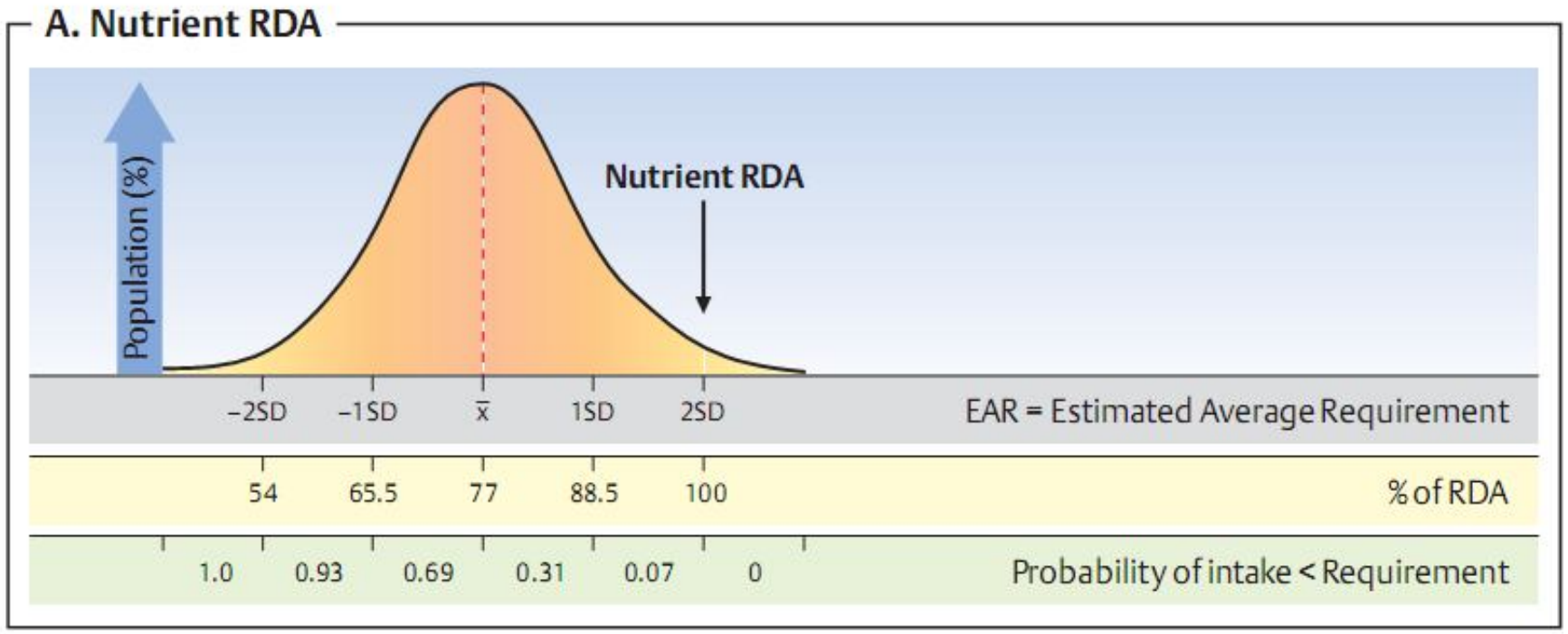
Table 1. Current Terms Used to Describe Dietary Reference Intakes for Oral Requirements[1]

- **Estimated Average Requirement (EAR)**—the average daily intake expected to meet the needs of 50% of the healthy individuals in a particular life stage or gender group based on available scientific literature.
- **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. The RDA is calculated by adding 2 standard deviations to the EAR unless the requirement distribution is skewed, in which case the RDA is set between 97th and 98th percentile. If there is insufficient evidence to establish an EAR, then no RDA can be calculated.

Table 1. Current Terms Used to Describe Dietary Reference Intakes for Oral Requirements[1]

- **Adequate Intake (AI)**—the recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group or groups of apparently healthy individuals that are assumed to be adequate. AI is used when an RDA cannot be determined.
- **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.

Recommended Dietary Allowances (RDA)
Estimated Average Requirements (EAR)
Adequate Intake (AI)
Tolerable Upper Intake Levels (UL)



Recommended Dietary Allowances (RDA)
Estimated Average Requirements (EAR)
Adequate Intake (AI)
Tolerable Upper Intake Levels (UL)

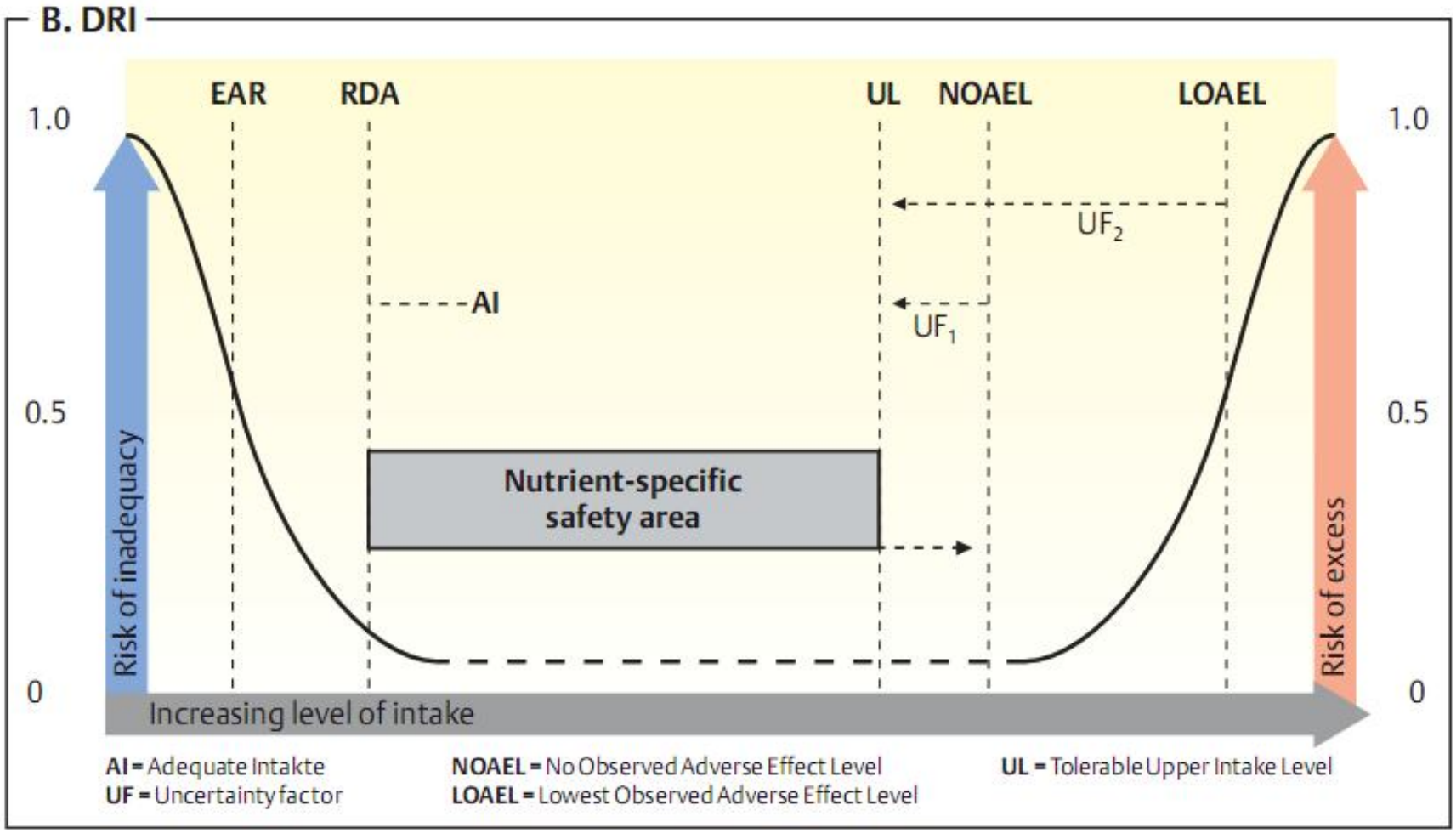
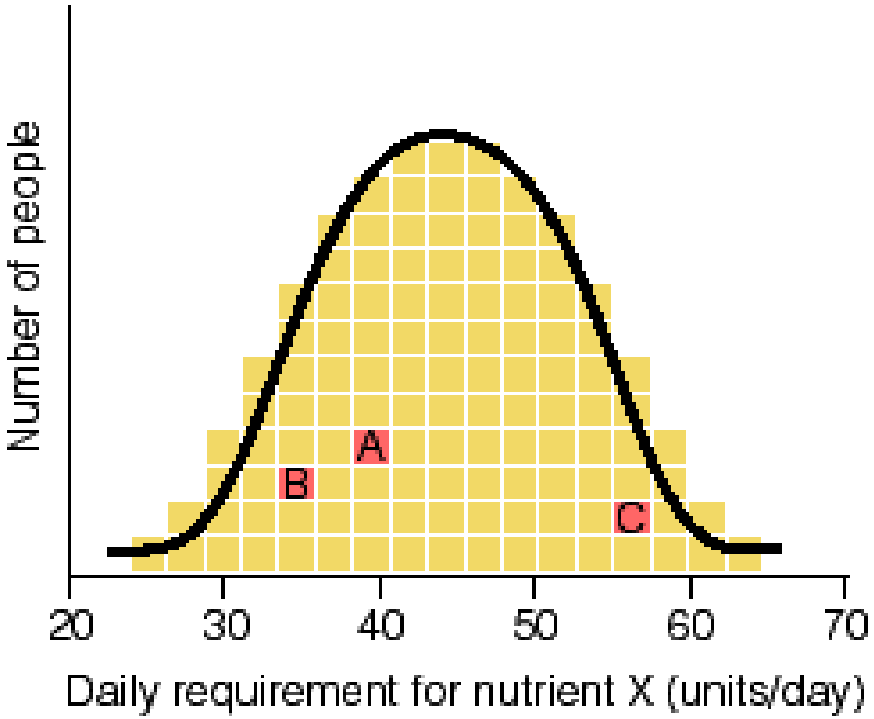
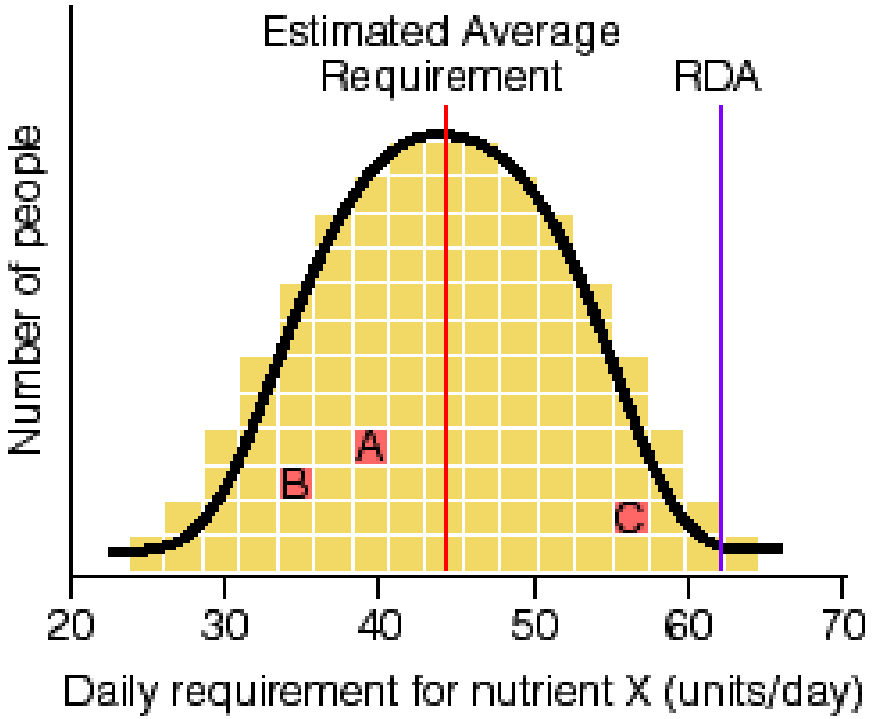


FIGURE 1-5 Estimated Average Requirements and Recommended Dietary Allowances Compared

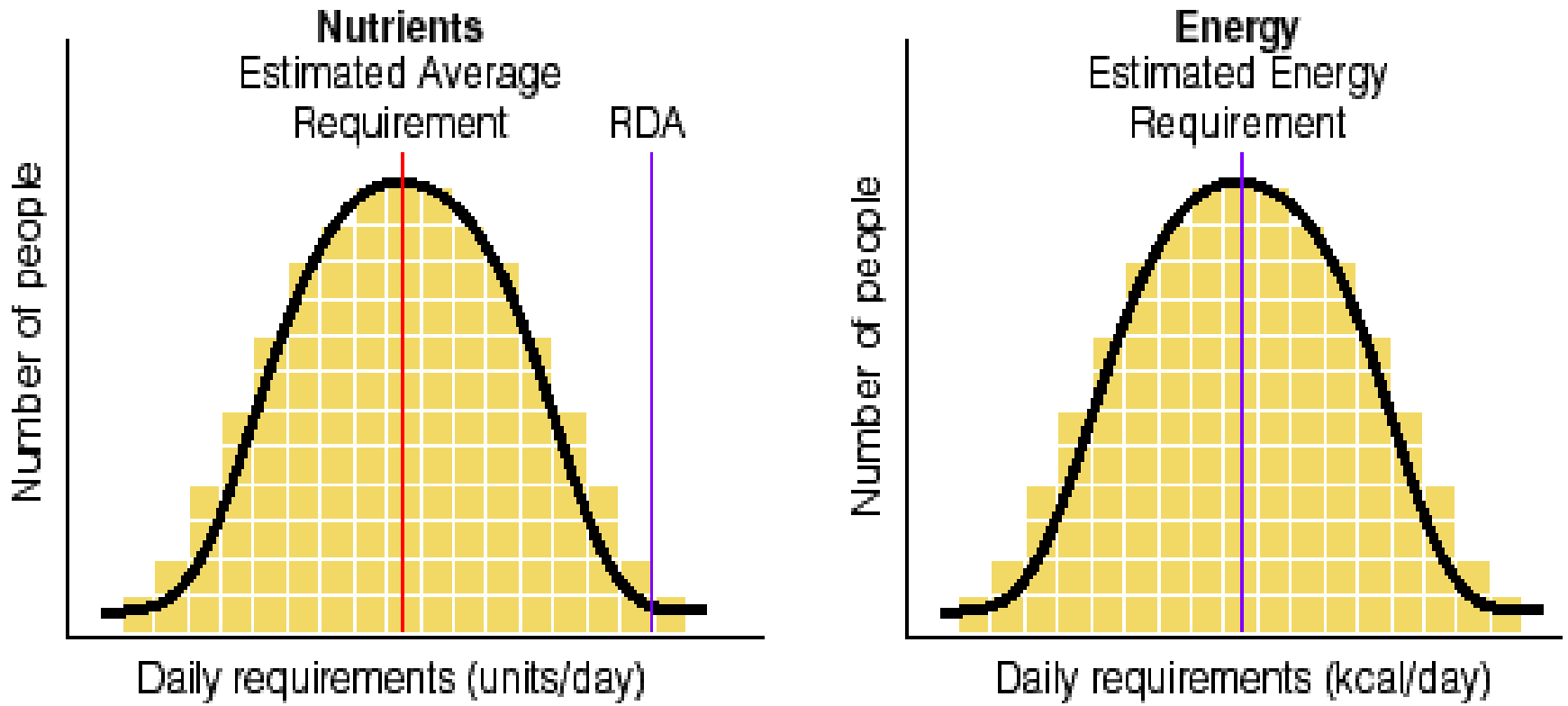


Each square represents a person. Some people require only a small amount of the nutrient, and some require a lot, but most fall somewhere near the middle. The text discusses three of these people: A, B, and C.



The RDA for a nutrient is set well above the Estimated Average Requirement. It covers about 98% of the population.

FIGURE 1-7 Recommended Intakes of Nutrients and Energy Compared



The nutrient intake recommendations are set high enough to cover nearly everyone's requirements (the boxes represent people).

The recommended intake for energy is set at the average that will maintain energy balance in a healthy person of desirable body weight.

Vitamin Supplement

Vitamins and minerals: issues associated with too low and too high population intakes

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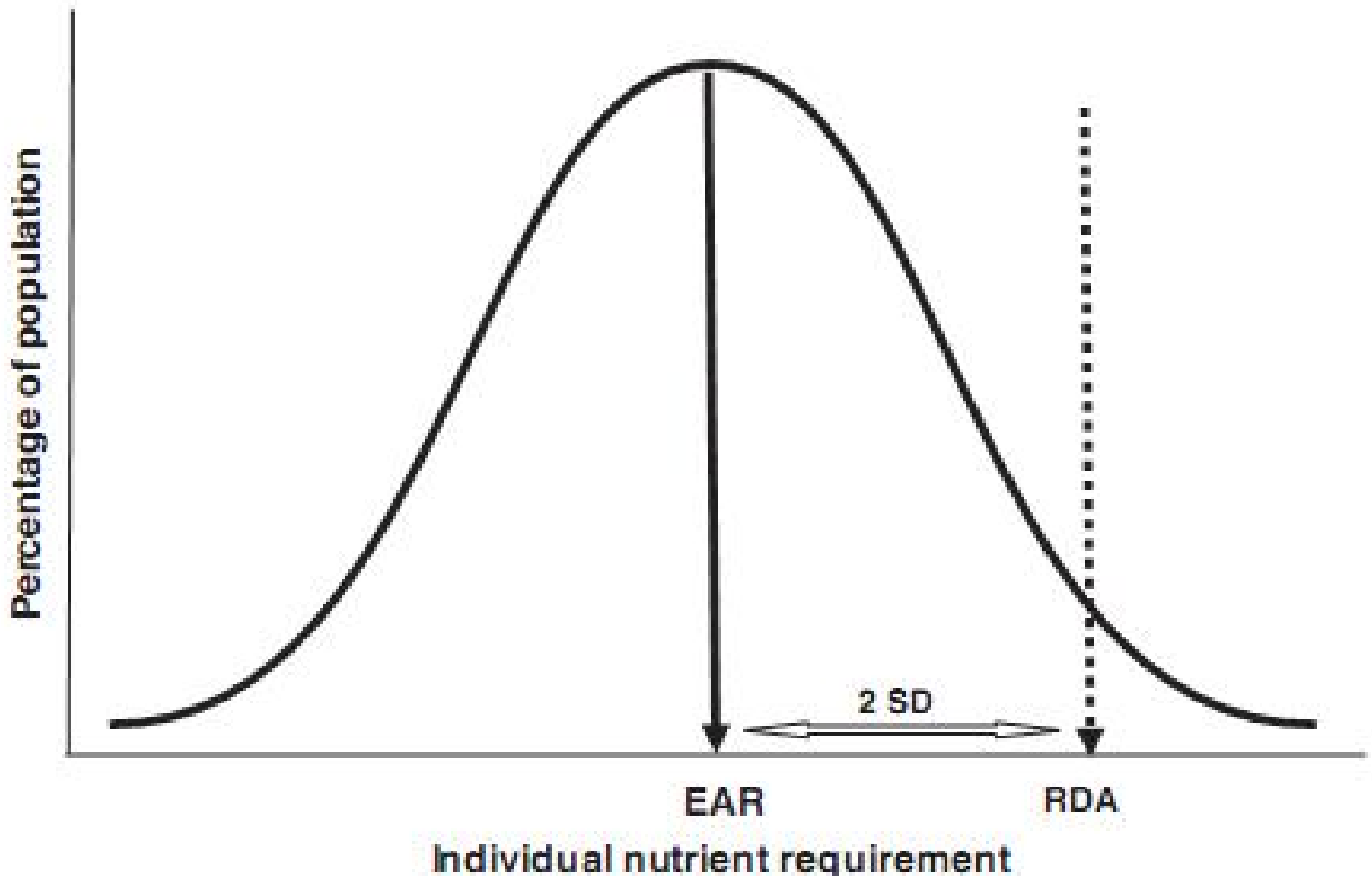

Fig. 1. A normal frequency of distribution of individual requirements for a nutrient. Abbreviations: EAR – estimated average requirements (mean/median requirement of the population); RDA – recommended daily allowance (mean requirement plus 2 SD – the intake that meets the needs of 97%–98% of healthy individuals in a population).

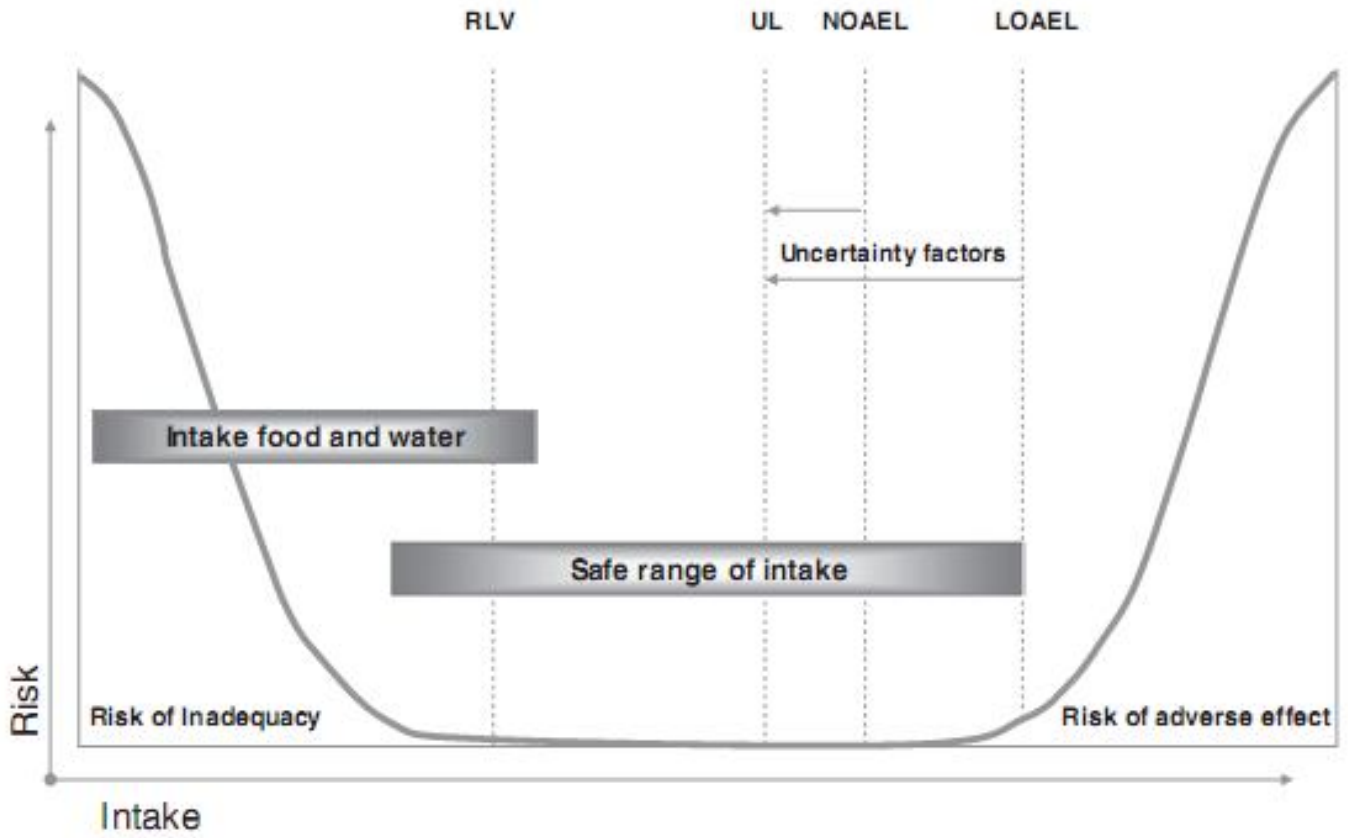

Fig. 2. Theoretical description of adverse health effects of a nutrient as a result of too low or too high intakes. Abbreviations: NOAEL – no observed adverse effect level; LOAEL – lowest observed adverse effect level; UL – tolerable upper intake level; RLV – reference labelling values (RDA – recommended daily allowance for labelling purposes).

Table 1. Health effects and tolerable upper intake levels of vitamins, minerals and trace elements

Vitamin	Inadequacy effects	Excess effects	Tolerable upper intake level[e]		
			EFSA[b]	IOM[c]	UK-EVM[d]
Vitamin A (retinol)	Blindness, night blindness, impaired immune status, impaired resistance to disease	Liver damage, foetal abnormalities, increased risk of hip fracture, increased cranial pressure (baby's)[a]	3000 μg (excluding postmenopausal women)	3000 μg	1500 μg (GL)
Vitamin D (calciferol)	Rickets, osteomalacia	Hypercalcaemia, weakness	50 μg	50 μg	25 μg (GL)
Vitamin E (tocopherol)	Neurological problems	Decreased blood coagulation in persons on anticoagulation drugs	300 mg	1000 mg	800 mg (IU, UL)
Pyridoxine (vitamin B_6)	Seborrheic dermatitis-like eruption, anaemia, reduced resistance to disease, neuropathy	Neurotoxicity	25 mg	100 mg	10 mg (UL)

Table 1. Health effects and tolerable upper intake levels of vitamins, minerals and trace elements

Vitamin	Inadequacy effects	Excess effects	Tolerable upper intake level[e]		
			EFSA[b]	IOM[c]	UK-EVM[d]
Zinc	Among others: growth retardation, diarrhoea, increased susceptibility to infections	Impaired copper absorption	25 mg	40 mg	25 mg (UL)
Selenium	Keshan disease (and possibly also Kashin-Beck disease)	Selenosis (gastrointestinal disorders, hair loss, sloughing of nails, fatigue, neurological damage)	300 μg	400 μg	450 μg (UL)
Iodine	Iodine deficiency disorders (among others: goitre, suboptimal brain functioning, impaired learning ability, growth retardation, cretinism)	Thyroid hyperactivity	600 μg	1100 μg	500 μg (GL)

[a]Some 'provitamin A carotenoids' have vitamin A activity: e.g. beta-carotene, alpha-carotene, and beta-cryptoxanthin. Therefore the food content for vitamin A is expressed in retinol-activity equivalents. Whereas provitamin A carotenoids do have vitamin A activity, they do not have vitamin A toxicity, albeit that they can have toxic potential by themselves (e.g. beta-carotene for smokers).
[b]Evaluation by the EU Scientific Committee on Food/European Food Safety Authority (18).
[c]Evaluation by the USA Institute of Medicine – Food and Nutrition Board (9).
[d]Evaluation by the UK Expert Group on Vitamins and Minerals (21). UL =upper level, GL =guidance level (when the database is insufficient to establish a UL or when no adverse effect has been identified).

Safe addition of vitamins and minerals to foods and supplements

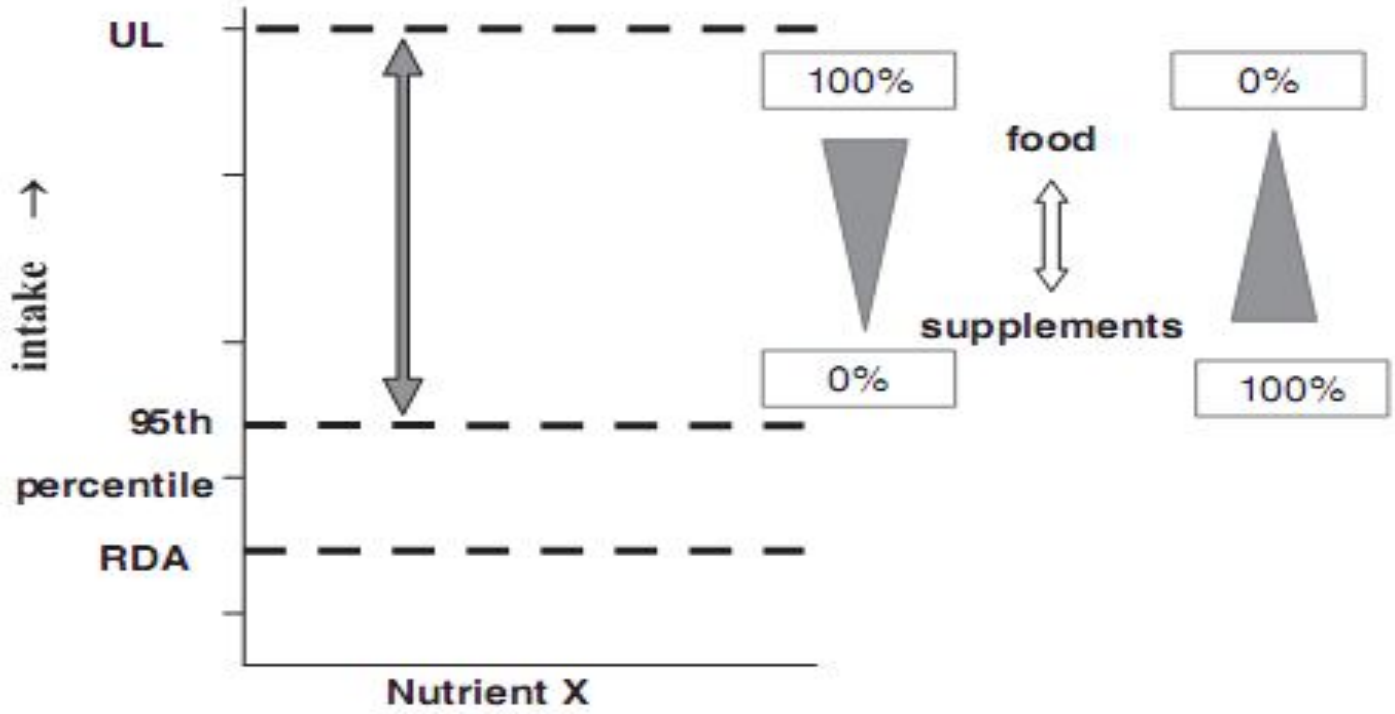

Fig. 3. Free space for the addition of vitamins and minerals to foods and supplements. Abbreviations: UL – tolerable upper intake level; RDA – recommended daily allowance.

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Micronutrient supplementation: when is best and why?*

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Nutrient risk assessment process

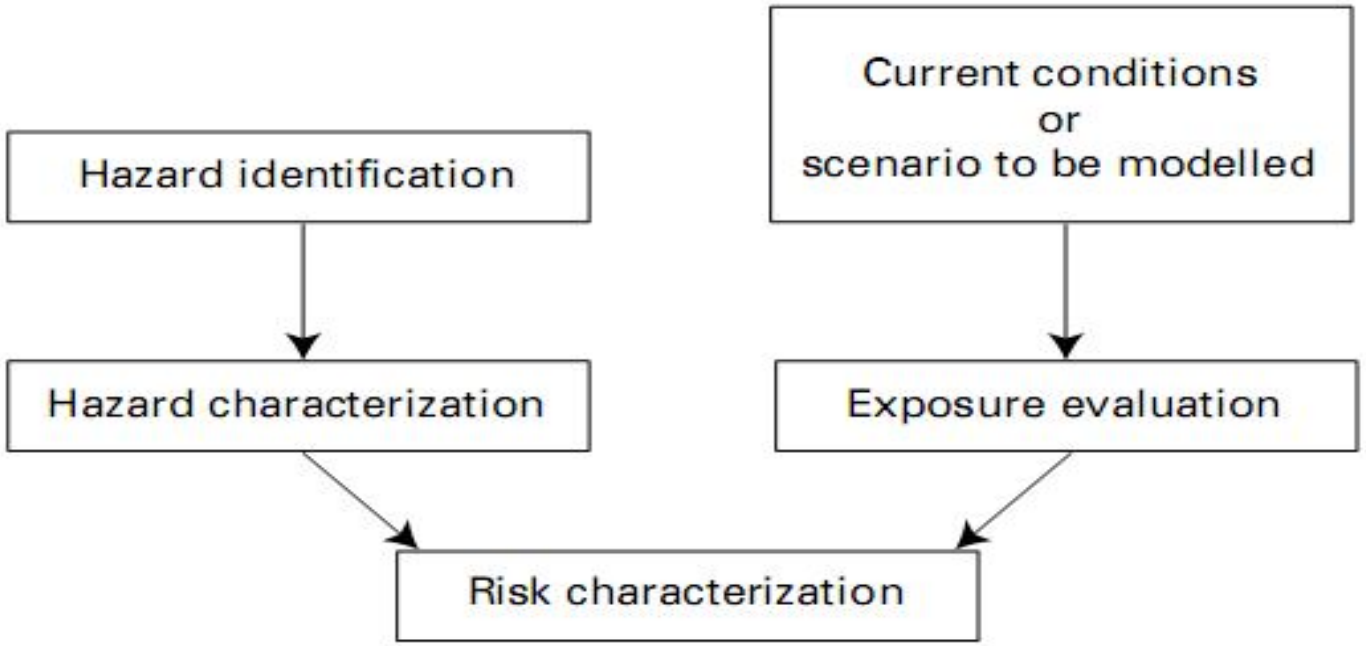

Fig. 1. Outline of the nutrient risk assessment model. The outcome

Table 1. Upper (safe) levels for nutrients that have been established by various government agencies

Agency	Year	Upper (safe) levels for nutrients
EU, Scientific Committee for Food	1993	Maximum safe intake level
France, CSHPF	1996	Safety limits for seven vitamins, three minerals
US National Academy of Sciences (USA and Canada)	1997; reviews ongoing	Tolerable upper intake level, one of the dietary reference intake values established for nutrients
Canada	1997	Nutrient risk assessment methodology; Ca risk assessment parts I and II
EU, Scientific Committee for Food	2000; reviews ongoing	Development of tolerable upper intake levels for a variety of nutrients
Nordic countries	2001	Safe range of intake
WHO	2002	Acceptable range of oral intake
UK Food Standards Agency	2002	Safe upper levels

CSHPF, conseil supérieur d'hygiène publique de France.

National Institutes of Health State-of-the-Science Conference Statement: Multivitamin/Mineral Supplements and Chronic Disease Prevention[1–3]

NIH State-of-the Science Panel

Am J Clin Nutr 2007;85(suppl):257S–64S.

What Is the Efficacy of MVM in Chronic Disease Prevention in the General Population of Adults?

What Is the Efficacy of MVM in Chronic Disease Prevention in the General Population of Adults?

CVD

None of the reviewed studies showed any benefits or harm related to CVD resulting from MVM use in the studied populations.

Cataract

Mixed results emerged from studies in which cataract progression was the targeted outcome. Only modest and inconsistent effects were found in the 2 studies that reported any benefit (25, 26).

Age-Related Macular Degeneration

One study showed less progression of intermediate-stage age-related macular degeneration in persons receiving vitamins C and E, β-carotene, and zinc (26).

ผลิตภัณฑ์เสริมอาหาร

- จัดเป็นอาหารตามพรบ. อาหาร พศ. 2522
- เป็นผลิตภัณฑ์คาบเกี่ยวระหว่างยาและอาหาร
- เดิมไม่มีข้อกำหนดมาตรฐานการผลิตและการควบคุมคุณภาพผลิตภัณฑ์อย่างชัดเจน

ผลิตภัณฑ์เสริมอาหาร

- ผลิตภัณฑ์เสริมอาหาร เป็นอาหารที่กำหนดคุณภาพ หรือมาตรฐาน และฉลากต้องได้รับอนุญาตก่อนนำไปใช้
- เป็นไปตามประกาศกระทรวงสาธารณสุข ฉบับที่ 293 พ.ศ. 2548 ประกาศ ณ วันที่ 15 ธันวาคม 2548 มีผลบังคับใช้ในวันที่ 29 มีนาคม 2549

ผลิตภัณฑ์เสริมอาหารคืออะไร

- อย. ได้ให้คำจำกัดความของผลิตภัณฑ์เสริมอาหาร (Dietary Supplement) ว่าเป็นผลิตภัณฑ์ที่ใช้รับประทาน นอกเหนือจากการรับประทานอาหารตามปกติ ซึ่งมีสารอาหารหรือสารอื่นเป็นองค์ประกอบ อยู่ในรูปเม็ด แคปซูล ผง เกล็ด ของเหลว หรือลักษณะอื่น ซึ่งมิใช่รูปแบบอาหารตามปกติ(conventional food) สำหรับผู้บริโภคที่คาดหวังประโยชน์ด้านส่งเสริมสุขภาพ

ประกาศกระทรวงสาธารณสุข ฉบับที่ 293 พศ. 2548

สารอาหารหรือสารอื่นหมายถึง

1) วิตามิน กรดอะมิโน กรดไขมัน แร่ธาตุ และผลิตผลจากพืช หรือสัตว์
2) สารเข้มข้น สารเมตาบอไลท์ ส่วนประกอบ หรือสารสกัดของสารใน (1)
3) สารสังเคราะห์เลียนแบบสารตาม (1) หรือ (2)
4) ส่วนผสมอย่างใดอย่างหนึ่ง หรือหลายอย่างของสารใน(1) (2) หรือ (3)
5) สารหรือสิ่งอื่นตามที่ อย. กำหนด

ผลิตภัณฑ์เสริมอาหารต้องมีมาตรฐานดังนี้

- มีคุณลักษณะเฉพาะตามชนิดของผลิตภัณฑ์นั้นๆ
- ตรวจพบจุลินทรีย์ที่ทำให้เกิดโรคได้*E. coli* สารพิษ และสารปนเปื้อนไม่เกินปริมาณที่กำหนด
- มีวิตามินและแร่ธาตุต่างๆไม่น้อยกว่า 15 % และไม่เกินปริมาณสูงสุดในสารอาหารที่แนะนำให้บริโภคประจำวัน(RDA) สำหรับคนไทย
- การแสดงฉลากเป็นไปตามประกาศกระทรวงสาธารณสุขเรื่องฉลาก

รายละเอียดในฉลาก

- ชื่ออาหาร โดยมีคำว่าผลิตภัณฑ์เสริมอาหารกำกับไว้
- เลขสารบบอาหาร
- ชื่อที่ตั้งผู้ผลิตผู้นำเข้า
- ปริมาณอาหาร
- ชื่อและปริมาณส่วนประกอบสำคัญ และส่วนประกอบที่มีการกล่าวอ้างสรรพคุณ
- ใช้ข้อความว่า“ใช้วัตถุกันเสีย’ เจือสีธรรมชาติ เจือสีสังเคราะห์ แต่งกลิ่นธรรมชาติ
- ข้อความชัดเจนว่า การได้รับสารอาหารต่างๆนั้น ควรได้จากการบริโภคอาหารหลักที่หลากชนิดครบทั้ง5 หมู่ และเป็นสัดส่วนที่พอเหมาะ

รายละเอียดในฉลาก (2)

- คำแนะนำในการใช้
- คำแนะนำในการเก็บรักษา
- วันเดือนปีที่หมดอายุการบริโภค
- คำเตือน ตามประกาศกระทรวงสาธารณสุข
- การแสดงข้อความกล่าวอ้างทางสุขภาพบนฉลาก ต้องเป็นไปตามประกาศกระทรวงสาธารณสุข

การแสดงฉลากต้องมีข้อความเป็นภาษาไทย จะมีภาษาต่างประเทศด้วยก็ได้

Claims

- Nutrient content claim อ้างว่ามีสารอาหารชนิดใดชนิดหนึ่งในปริมาณสูง หรือเป็นแหล่งของสารอาหารชนิดใดชนิดหนึ่ง
- Nutrient comparative claim กล่าวอ้างในเชิงปริมาณเปรียบเทียบของสารที่มีในผลิตภัณฑ์ว่าต่ำกว่าที่พบในอาหารชนิดเดียวกันในสภาวะปกติ
- Structure-function claim อ้างในเชิงสรรพคุณ ในการปรับเปลี่ยนการทำงานของร่างกายในทางที่ดีขึ้น
- Disease claim อ้างในเชิงคุณภาพของสารที่มีอยู่ในสรรพคุณในการป้องกัน รักษา บรรเทา หรือวินิจฉัยโรค(ซึ่งเป็นการอ้างสรรพคุณของ**ยา** ไม่สามารถทำได้)

The Importance Of Proper Supplementation

Factors affecting dietary requirements

- Metabolic requirement including:
- age, gender, body size;
- lifestyle (smoking, obesity, physical activity, etc.);
- disease, e.g. fever, catabolism;
- trauma;
- growth.
- Bioavailability including:
- altered absorption, e.g. milk Ca is better absorbed than non-milk Ca;
- reduced utilization;

The Importance Of Proper Supplementation

Factors affecting dietary requirements

- increase losses, e.g. diarrhoea, burns, renal disease;
- environment, e.g. heating of nutrients;
- drugs, e.g. diuretics;
- dietary concentration;
- dietary interactions;
- drug–nutrient interactions

Case: vitamin E

What Is Known about the Safety of MVM for the Generally Healthy Population?

Vitamin E

Supplement Forms/Alternate Names

Alpha Tocopherol
D-Tocopherol
DL-Tocopherol
DL-Alpha-Tocopherol
Tocopheryl Succinate
Tocopheryl Acetate
D-Alpha-Tocopherol
D-Delta-Tocopherol
D-Beta-Tocopherol
D-Gamma-Tocopherol
Mixed Tocopherols

Principal Proposed Uses

Prostate Cancer prevention

Other Proposed Uses

Acute Anterior Uveitis (in Combination With Vitamin C)
Alzheimer's Disease
Cancer Treatment Support
Cataracts
Cyclical Mastalgia
Deep Venous Thrombosis (Prevention)
Diabetic Neuropathy and Other Complications of Diabetes
Diabetic Neuropathy
Epilepsy
Immune Support
Macular Degeneration
Male Infertility
Menopausal Symptoms
Menstrual Pain
Premenstrual Syndrome (PMS)
Preeclampsia (Prevention)
Restless Legs Syndrome
Rheumatoid Arthritis
Sports Performance
Tardive Dyskinesia
Vascular Dementia

Probably Not Effective Uses

- Amyotrophic Lateral Sclerosis
- Cancer Prevention (Other Than Prostate Cancer)
- Cataract Prevention
- Congestive Heart Failure
- Diabetes (Prevention)
- Fibrocystic Breast Disease
- Heart Disease (Prevention)
- HIV Support
- Kidney Damage in Diabetes
- Macular Degeneration
- Osteoarthritis
- Parkinson's Disease
- Prevention of Preterm Birth
- Stroke

There are *no* medicinal uses for vitamin E with solid scientific support

Other forms of vitamin E

Occur in food as beta-, delta-, and gamma-tocopherols

gamma-tocopherol may be the most important (or, perhaps, the only) form of vitamin E for preventing prostate cancer

more confusing

- Vitamin E on labels as international units (IU)
- One IU **natural** vitamin E equals 0.67 mg alpha-tocopherol
- One IU **synthetic** vitamin E equals 0.45 mg alpha-tocopherol.
- meet the new dietary recommendations for vitamin E (15 mg per day)
- need to get either 22 IU natural vitamin E (22 IU x 0.67 = 15 mg)
- 33 IU synthetic vitamin E (33 IU x 0.45 = 15 mg)

The official US and Canadian recommendations for daily intake of vitamin E

Infants

0-6 months: 4 mg

7-12 months: 5 mg

Children

1-3 years: 6 mg

4-8 years: 7 mg

9-13 years: 11 mg

Males and Females

14 years and older: 15 mg

Pregnant Women : 15 mg

Nursing Women : 19 mg

Foods that are high in vitamin E:

Food Serving size Vitamin E content (milligrams [mg]) % Daily Value
Wheat germ 1 tablespoon 20.3 100
Sunflower seeds, dry roasted 1 ounce 7.4 37
Almonds, dry roasted 1 ounce 6.8 34
Sunflower oil 1 tablespoon 5.6 28
Safflower oil 1 tablespoon 4.6 25
Hazelnuts, dry roasted 1 ounce 4.3 22
Peanut butter 2 tablespoons 2.9 15
Peanuts, dry roasted 1 ounce 2.2 11
Corn oil 1 tablespoon 1.9 10
Olive oil 1 tablespoon 1.9 10
Spinach, boiled ½ cup 1.9 10
Broccoli, boiled ½ cup 1.2 6
Soybean oil ½ cup 1.1 6
Kiwifruit 1 medium 1.1 6
Mango ½ cup 0.7 4
Tomato, raw 1 medium 0.7 4
Spinach, raw 1 cup 0.6 3

Therapeutic Dosages

- The optimal therapeutic dosage of vitamin E Most studies have used between 50 IU and 800 IU daily
- Higher doses would correspond to 50 mg to 800 mg of synthetic vitamin E (dl-alpha-tocopherol)
- or 25 mg to 400 mg of natural vitamin E (d-alpha- or mixed tocopherols).

Purchase natural vitamin E

- look for a label that says "mixed tocopherols.”
- some manufacturers use this term to mean the synthetic dl-alpha-tocopherol
- so you need to read the contents closely
- Natural tocopherols come as d-alpha-, d-gamma-, d-delta-, and d-beta-tocopherol.

Mortality

"meta-analysis," some evidence appears suggesting that long-term usage of vitamin E at high doses might increase overall death rate for reasons that are unclear.

Interactions You Should Know About

Seek medical advice before taking vitamin E if you are taking blood thinning drugs, such as:

Warfarin (Coumadin) , heparin , clopidogrel (Plavix), ticlopidine (Ticlid), pentoxifylline (Trental), or aspirin

Vitamin E may help protect you from lung-related side effects if you are taking amiodarone .

Vitamin E may help reduce side effects if you are takingphenothiazine drugs .

Seek medical advice before taking vitamin E if you are taking chemotherapy drugs.

High-dose vitamin E might cause your blood sugar levels to fall too low, requiring an adjustment in medication dosage, if you are taking oral hypoglycemic medications .

A.S.P.E.N. Position Paper : Recommendations for Changes in Commercially Available Parenteral Multivitamin and Multi –Trace Element Products

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Table 4. Current Recommended Adult Daily Oral and Parenteral Micronutrient Requirements

	Oral[1,a]	Parenteral[23]
Fat-Soluble Vitamins		
Vitamin A	M, 900 mcg or 3000 IU; F, 700 mcg or 2333 IU[b] 770 mcg (preg); 1300 mcg (lact)	990 mcg or 3300 IU[b]
Vitamin D	Age 19–70 y: 15 mcg or 600 IU[c,35] Age >70 y: 20 mcg or 800 IU[35]	5 mcg or 200 IU[c]
Vitamin E	15 mg; 19 mg (lact)	10 mg or 10 IU[d]
Vitamin K	M, 120 mcg; F, 90 mcg (AI)	150 mcg

Table 4. Current Recommended Adult Daily Oral and Parenteral Micronutrient Requirements

	Oral[1,a]	Parenteral[23]
Water-Soluble Vitamins		
Vitamin B_1 (thiamine)	M, 1.2 mg; F, 1.1 mg 1.4 mg (preg/lact)	6 mg
Vitamin B_2 (riboflavin)	M, 1.3 mg; F, 1.1 mg 1.4 mg (preg); 1.6 mg (lact)	3.6 mg
Vitamin B_3 (niacin)	M, 16 mg; F, 14 mg 18 mg (preg); 17 mg (lact)	40 mg
Vitamin B_5 (pantothenic acid)	5 mg; 6 mg (preg); 7 mg (lact) (AI)	15 mg
Vitamin B_6 (pyridoxine)	Age 19–50 y: 1.3 mg Age >51 y: M, 1.7 mg; F, 1.5 mg 1.9 mg (preg); 2.0 mg (lact)	6 mg
Vitamin B_{12} (cyanocobalamin)	2.4 mcg; 2.6 mcg (preg); 2.8 mcg (lact)	5 mcg
Vitamin C (ascorbic acid)	M, 90 mg; F, 75 mg 85 mg (preg); 120 mg (lact)	200 mg
Folate	400 mcg; 600 mcg (preg); 500 mcg (lact)	600 mcg
Biotin	30 mcg; 35 mcg (lact) (AI)	60 mcg

Table 4. Current Recommended Adult Daily Oral and Parenteral Micronutrient Requirements

	Oral[1,a]	Parenteral[23]
Other Nutrients		
Choline	M, 550 mg; F, 425 mg 450 mg (preg); 550 mg (lact) (AI)	Not available for PN use
Trace Elements		
Copper	900 mcg 1000 mcg (preg); 1300 mcg (lact)	0.3–0.5 mg
Chromium	Age 19–50 y: M, 35 mcg; F, 25 mcg Age >51 y: M, 30 mcg; F, 20 mcg 30 mcg (preg); 45 mcg (lact) (AI)	10 – 15 mcg
Fluoride	M, 4 mg; F, 3 mg (AI)	Not routinely added in U.S.[e]
Iodine	150 mcg; 220 mcg (preg); 290 mcg (lact)	Not routinely added in U.S.[e]

Table 4. Current Recommended Adult Daily Oral and Parenteral Micronutrient Requirements

	Oral[1,a]	Parenteral[23]
Iron	Age 19–50 y: M, 8 mg; F, 18 mg Age >50 y: 8 mg 27 mg (preg); 9 mg (lact)	Not routinely added in U.S.[e] (given 25–50 mg/monthly as separate IV infusion when indicated)
Manganese	M, 2.3 mg; F, 1.8 mg 2.0 mg (preg); 2.6 mg (lact) (AI)	0.06–0.1 mg
Molybdenum	45 mcg; 50 mcg (preg/lact)	Not routinely added in U.S.[e]
Selenium	55 mcg; 60 mcg (preg); 70 mcg (lact)	20–60 mcg
Zinc	M, 11 mg; F, 8 mg 11 mg (preg); 12 mg (lact)	2.5–5 mg

Ranges include female (lower amounts) and male (higher amounts). This table does not include nutrient needs for pregnancy or lactation for ages <19 years. AI, Adequate Intake; F, female; IU, International Unit; IV, intravenous; lact, lactation; M, male; PN, parenteral nutrition; preg, pregnancy.

[a]Enteral recommendations are the Recommended Dietary Allowance (RDA) unless one is not established, in which case the AI is listed and so noted in the table.

[b]1 mcg RAE (retinol activity equivalent) = 1 mcg retinol = 12 mcg β-carotene = 24 mcg α-carotene or β-cryptoxanthin.

[c]1 IU of retinol = 0.3 mcg retinol or 0.3 mcg RAE.

[d]To convert IU α-tocopherol to mg: IU × 0.67 mg RRR-α-tocopherol, natural form ("d-α-tocopherol") or IU × 0.45 mg all-rac-α-tocopherol, synthetic form ("dl-α-tocopherol"). dl-α-tocopheryl acetate (1 IU = 1 mg = 1 USP unit) is used in IV multivitamin preparation.[36]

[e]Fluoride (0.57–1.45 mg), iodine (10–130 mcg), iron (1–1.95 mg), molybdenum (10–25 mcg), and cobalt (0–1.47 mcg) are routinely added to PN products in Europe.[37]