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**Joint FAO/WHO Expert Consultation on Human
Vitamin and Mineral Requirements**

FAO, Bangkok, Thailand

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**PRELIMINARY REPORT ON
RECOMMENDED NUTRIENT INTAKES**

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Introduction

A Joint FAO/WHO Expert Consultation on Human Vitamin and Mineral Requirements was held in the FAO Regional Office for Asia and the Pacific, Bangkok, Thailand, from 21 to 30 September 1998. The purpose of the consultation was to complement the information which had been provided through previous consultations for different nutrients, in order to provide current knowledge on all essential nutrients as the first step towards the production of a new edition of the Manual on Human Nutritional Requirements. The current edition of this publication dates back to 1974, and was therefore in need of re-editing.

The short preliminary report provided here gives only the practical endpoint of the work of the consultation, i.e. the recommended nutrient intakes (RNI) for essential vitamins and some minerals. This information has been put into 2 tables which are attached to this document as **Annexes 1a and 1b**. This information needs to be considered **provisional**, until the full report of the Expert Consultation on the subject has been released. Thus, the RNI information provided in tabular form is given as a preview of information to come with the final report. **This provisional report has been developed to meet the needs of a forthcoming meeting of the Codex Alimentarius Committee on Nutrition and Foods for Special Dietary Use which will meet in Berlin, June 19-23.** The full report of the Expert Consultation is expected to be available soon on the WHO web site with links from the FAO web site, and eventually in hard copy.

Background

For the purpose of preparation of the background papers, the following working definition of a recommended nutrient intake (RNI) was used. The RNI is the intake level sufficient to meet the daily nutrient requirements of most individuals in a specific life-stage and gender group, based on an estimated average nutrient requirement (EAR) plus two standard deviations above the mean: $RNI = EAR + 2SD_{EAR}$.

Written documents providing the criteria that were used in the past to develop the FAO/WHO RNIs were made available to the Experts. These documents included the 1974 *FAO/WHO Handbook on Human Nutritional Requirements*, the 1988 *FAO/WHO Expert Consultation Report on the Requirements for Vitamin A, Iron, folate, and Vitamin B₁₂*, and the 1996 *FAO/WHO /IAEA Report on Trace Elements in Human Nutrition and Health*.

Format and Terms of Reference

The presentations addressed changes in the scientific knowledge base for each essential vitamin and mineral nutrient since the most recent FAO/WHO review of those nutrients was released. The Expert Panel made recommendations for the nutrient requirements, identified key issues for future research, and made preliminary recommendations for the handbook.

The terms of reference for the Expert Panel were the following:

- To review the full scope of vitamin and mineral requirements, including their role in normal human physiology and metabolism and in deficiency disease conditions. To focus on the requirements of the essential vitamins and

minerals, including vitamins A, C, D, E, and K; the B vitamins; calcium; iron; magnesium; zinc; selenium; and iodine.

- To draft and adopt a report which would provide recommended nutrient intakes for vitamins A, C, D, E, and K; the B vitamins; calcium; iron; magnesium; zinc; selenium; and iodine. The report is to provide practical advice and recommendations which will constitute an authoritative source of information to those from member countries who work in the area of nutrition, agriculture, food production and distribution, and health promotion. This report will form, in large part, the basis for a new edition of the FAO/WHO Handbook on Human Nutritional Requirements that was published in 1974 and last re-issued in 1980.
- To identify key issues for future research and make preliminary recommendations for the handbook.

Report of the Consultation

The Consultation was opened by Dr Prem Nath, Assistant Director-General/ Regional Representative for Asia and the Pacific, FAO, who welcomed the participants on behalf of the Director-General of FAO.

In welcoming the participants, Dr Nath recalled previous consultations on nutrients and made reference to the 1974 edition of the Handbook. Consultations such as this are part of a continuing commitment by both FAO and WHO to promote a reliable, nutritious, and safe food supply and to provide scientifically sound nutritional advice to member nations. This commitment was recently reaffirmed at the World Food Summit held in November 1996 in Rome.

Dr Nath spoke of the increasing evidence for the important role which vitamins and minerals play in preventing disease and promoting overall health. Indeed, the understanding of the role of micronutrients in foods and nutrition has significantly increased over the past 24 years. For many years the basic assumption upon which nutritionists make their projections, and which may still be the best assumption, has been that all nutrients can be obtained from a diet containing a variety of foods. There are some challenges to this assumption, however, and they rest in the complexities and diversity of world-wide realities, culture, and tradition. One important influence in this respect is the adoption of sedentary lifestyles and their health consequences.

Dr Nath pointed out that for many people with access to an adequate energy intake there is an extensive freedom of choice in the selection of food. However, the existence of widespread poverty in a majority of countries precludes the opportunity to consume adequate energy, let alone a diet balanced in micronutrients. He observed that the increase in the availability of a wide variety of foods and especially “fast foods” in almost every country in the world, coupled with the increasing pace of urban lifestyles across all cultures and countries, does not necessarily result in adequate vitamin and mineral intake.

The existence of the dichotomies in lifespan was also mentioned by Dr Nath. In different parts of the world and in different segments of society within the same countries, there are broad ranges of lifespans in part due to nutritional adequacy. Especially in urban populations, as lifespan increases as a result of nutritional adequacy and despite improved access to health care, an increase has been recorded in all regions

of the globe in obesity, diabetes, some forms of cancer, and cardiovascular disease. Although epidemiological studies do not provide us with cause-and-effect explanations, they do provide impetus for future research into the role of vitamins and minerals in the prevention and management of some non-communicable diseases.

Dr Nath reminded the participants that they had been invited to the Consultation as independent experts and that their participation in the Consultation was to be in their individual capacity and not as a representative of any organisation, affiliation, or government. He underscored the importance of drawing conclusions and making recommendations based on science which is traceable to studies conducted largely in humans. This is necessary for correct food labelling and relevant health claims and for the better use of foods in the dietary management and prevention of non-communicable diseases. These issues have economic implications for agricultural production, the food industry, and public health policy.

Dr Sultana Khanum, Regional Adviser/Nutrition, SEARO (South East Asia Regional Office), WHO, added her welcome on behalf of the Regional Director for South-East Asia Region, Dr. Uton Muchtar Rafel. Dr. Khanum noted the significance of South-East Asia as the site of the Expert Consultation, since some of the most tangible successes and achievements have occurred within this geographical region in the realm of identifying, preventing, reducing, and eliminating many forms of malnutrition.

Dr. Khanum noted that the FAO and WHO have a long history of collaboration at the country, regional and global levels towards combating food and nutritional problems. She underlined the importance of using science as the basis of the standard setting process which took place during the consultation.

Dr Graeme Clugston, Director, WHO Nutrition Programmes, added his welcome to the participants on behalf of the Director-General of WHO, Dr Gro Harlem Brundtland. Dr Clugston pointed out that the formulation and implementation of science-based dietary guidelines has become a central issue for the nutritional sciences as well as a major challenge for governments world wide, especially since the International Conference on Nutrition held in Rome in December 1992.

Dr Clugston expressed confidence that this Expert Consultation would lead to scientifically sound, up-to-date recommendations for vitamin and mineral requirements in human nutrition. FAO and WHO would then ensure that these recommendations would be passed on to all member states, providing them with the best possible guidance for developing their own appropriate dietary guidelines for health promotion, good nutrition and disease prevention.

The Consultation elected Dr Donald McCormick as Chairman and Professor Chen Chunming as Vice-Chair. Dr Glenville Jones and Dr Colin Mills were appointed jointly as Rapporteurs. Dr McCormick in his response indicated the importance of this Consultation and outlined the scope of the issues that would be discussed and on which the two agencies, FAO and WHO, were seeking expert guidance from the Consultation.

Participants and Contributors

The members of the Expert Panel are listed in **Annex 2**, while those who contributed background papers are listed in **Annex 3**. The reviewers for the background papers can be found in **Annex 4**, and the members of the Secretariat are included in **Annex 5**.

Table 1: Recommended Nutrient Intakes – Minerals [PROVISIONAL]

Age	Calcium	Magnesium	Selenium	Zinc			Iron (h)				Iodine
	<i>mg/day</i>	<i>mg/day</i>	<i>µg/day</i>	High bioavail-ability <i>mg/day</i>	Moderate bioavail-ability <i>mg/day</i>	Low bioavail-ability <i>mg/day</i>	15% bioavailability <i>mg/day</i>	12% bioavailability <i>mg/day</i>	10% bioavailability <i>mg/day</i>	5% bioavailability <i>mg/day</i>	(n) <i>µg/day</i>
Infants											
Premature 0 - 6 months	300 (a) 400 (b)	26 (a) 36 (b)	6	1.1 (d)	2.8 (e)	6.6 (f)	(i)	(i)	(i)	(i)	30 (o) µg/kg/day 15 (o) µg/kg/day
7-12 months	400	54	10	0.8 (d) 2.5 (g)	4.1 (g)	8.4 (g)	[6] (k)	[8] (k)	[9] (k)	[19] (k)	130
Children											
1-3 years	500	60	22	2.9	4.8	9.6	4	5	6	13	75
4-6 years	600	76	22	2.9	4.8	9.6	4	5	6	13	115
7-9 years	700	100	21	3.3	5.6	11.2	6	7	9	18	110
Adolescents											
Males 10 - 18 years	1,300 (c)	230	32	5.1	8.6	17.1	10 (10-14 yrs) 12 (15-18 yrs)	12 (10-14 yrs) 16 (15-18 yrs)	15 (10-14 yrs) 19 (15-18 yrs)	29 (10-14 yrs) 38 (15-18 yrs)	135 (10-11 yrs) 125 (12 + yrs) (p)
Females 10 - 18 years	1,300 (c)	220	26	4.3	7.2	14.4	9 (10-14 yrs) (l) 22 (10-14 yrs) 21 (15-18 yrs)	12 (10-14 yrs) (l) 28 (10-14 yrs) 26 (15-18 yrs)	14 (10-14 yrs) (l) 33 (10-14 yrs) 31 (15-18 yrs)	28 (10-14 yrs) (l) 65 (10-14 yrs) 62 (15-18 yrs)	140 (10-11 yrs) 110 (12 + yrs) (q)
Adults											
Males 19 - 65 years	1,000	260	34	4.2	7.0	14.0	9	11	14	27	130
Females											
19 - 50 years (pre-menopausal)	1,000	220	26	3.0	4.9	9.8	20	24	29	59	110
51 - 65 years (menopausal)	1,300	220	26	3.0	4.9	9.8	8	9	11	23	110
Older adults											
Males 65 + years	1,300	224	33	4.2	7.0	14.0	9	11	14	27	130
Females 65 + years	1,300	190	25	3.0	4.9	9.8	8	9	11	23	110
Pregnancy											
First trimester		220		3.4	5.5	11.0	(m)	(m)	(m)	(m)	200
Second trimester		220	28	4.2	7.0	14.0	(m)	(m)	(m)	(m)	200
Third trimester	1,200	220	30	6.0	10.0	20.0	(m)	(m)	(m)	(m)	200
Lactation											
0-3 months	1,000	270	35	5.8	9.5	19.0	10	12	15	30	200
3-6 months	1,000	270	35	5.3	8.8	17.5	10	12	15	30	200
7-12 months	1,000	270	42	4.3	7.2	14.4	10	12	15	30	200

Notes - Minerals

- (a) Human breast milk.
- (b) Infant formula.

Calcium:

- (c) Particularly during the growth spurt.

Zinc:

- (d) Human-milk fed infants only.
- (e) Formula-fed infants, moderate zinc bioavailability.
- (f) Formula-fed infants, low zinc bioavailability due to infant consumption of phytate rich cereals and vegetable protein based formula.
- (g) Not applicable to infants consuming human milk only.

Iron:

- (h) There is evidence that iron absorption can be significantly enhanced when each meal contains a minimum of 25 mg of Vitamin C, assuming three meals per day. This is especially true if there are iron absorption inhibitors in the diet such as phytate or tannins.
- (i) Neonatal iron stores are sufficient to meet the iron requirement for the first six months in full term infants. Premature infants and low birth weight infants require additional iron.
- (k) Bioavailability of dietary iron during this period varies greatly.
- (l) Non-menstruating adolescents.
- (m) It is recommended that iron supplements in tablet form be given to all pregnant women because of the difficulties in correctly evaluating iron status in pregnancy. In the non-anaemic pregnant woman, daily supplements of 100 mg of iron (e.g., as ferrous sulphate) given during the second half of pregnancy are adequate. In anaemic women higher doses are usually required.

Iodine

- (n) The RNI value has been established from requirements expressed per kg body weight per day. Where appropriate, these values have been used to calculate daily requirements based on standard body weights, and rounded off. The standard body weights have been derived from the 50th percentile of NCHS data until adult weights of 65 kg for male and 55kg for females have been reached. The latter upper limits were selected because they are frequently used as values for “standard” adults. Nevertheless, the need for data expressed on a kg body weight basis exists, and this data is as follows:

<u>premature infants</u> = 30 µg/kg/day	<u>infants 0-12 months</u> = 19 µg/kg/day
<u>children 1 - 6 years</u> = 6 µg/kg/day	<u>children 7 - 11</u> = 4 µg/kg/day
<u>adolescents and adults 12 + years</u> = 2 µg/kg/day	<u>pregnancy and lactation</u> = 3.5 µg/kg/day
- (o) In view of the high variability in body weights at these ages the RNIs are expressed as µg/kg body weight/day.
- (p) The RNI has been calculated on the basis of NCHS data, 50th percentile, for a 16 year old boy.
- (q) The RNI has been calculated on the basis of NCHS data, 50th percentile, for a 15 year old girl.

(NCHS data source: WHO, Measuring Change in Nutritional Status. Guidelines for Assessing the Nutritional Impact of Supplementary Feeding Programmes for Vulnerable Groups, World Health Organization, 1983)

Table 2: Recommended Nutrient Intakes ^{(g) (h)} – Water and Fat Soluble Vitamins [PROVISIONAL]

Age	----- WATER-SOLUBLE VITAMINS -----									----- FAT-SOLUBLE VITAMINS -----			
	Thiamin <i>mg/day</i>	Riboflavin <i>mg/day</i>	Niacin (a) <i>mg NE/day</i>	Vit. B ₆ <i>mg/day</i>	Panto- thenate <i>mg/day</i>	Biotin <i>µg/day</i>	Folate (c) <i>µg DFE/day</i>	Vit. B ₁₂ <i>µg/day</i>	Vit. C <i>mg/day</i>	Vit. A (f) (g) <i>µg RE/day</i>	Vit. D <i>µg/day</i>	Vit. E (acceptable intakes) (h) <i>mg α-TE/ day</i>	Vit. K (l) <i>µg/day</i>
Infants													
0 - 6 months	0.2	0.3	2 (b)	0.1	1.7	5	80	0.4	25	375	5	2.7 (i)	5 (m)
7-12 months	0.3	0.4	4	0.3	1.8	6	80	0.5	30	400	5	2.7 (i)	10
Children													
1-3 years	0.5	0.5	6	0.5	2	8	160	0.9	30	400	5	5 (k)	15
4-6 years	0.6	0.6	8	0.6	3	12	200	1.2	30	450	5	5 (k)	20
7-9 years	0.9	0.9	12	1.0	4	20	330	1.8	35	500	5	7 (k)	25
10-18 years													
Males	1.2	1.3	16	1.3	5	25	400	2.4	40	600	5	10	35-55
Females	1.1	1.0	16	1.2	5	25	400	2.4	40	600	5	7.5	35-55
Adults													
Males, 19 - 65 years	1.2	1.3	16	1.3 (19-50 yrs) 1.7 (50 + yrs)	5	30	400	2.4	45 (d)	600	5 (19-50 yrs) 10 (50 + yrs)	10	65
Females													
19-50 years (pre- menopausal)	1.1	1.1	14	1.3	5	30	400	2.4	45 (d)	500	5	7.5	55
50 - 65 years (menopausal)	1.1	1.1	14	1.5	5	30	400	2.4	45 (d)	500	10	7.5	55
Older adults, 65 + years													
Males	1.2	1.3	16	1.7	5		400	2.4	45	600	15	10	65
Females	1.1	1.1	14	1.5	5		400	2.4	45	600	15	7.5	55
Pregnancy	1.4	1.4	18	1.9	6	30	600	2.6	55 (d)	800	5	(i)	55
Lactation	1.5	1.6	17	2.0	7	35	500	2.8	70 (e)	850	5	(i)	55

Notes - Vitamins

Niacin

- (a) NE = niacin equivalents, 60-to-1 conversion factor for tryptophan to niacin.
- (b) Preformed niacin.

Folate

- (c) DFE = dietary folate equivalents; μg of DFE provided = [μg of food folate + (1.7 x μg of synthetic folic acid)].

Vitamin C

- (d) An RNI of 45 mg was calculated for adult men and women and 55 mg recommended during pregnancy. It is recognised however that larger amounts would promote greater iron absorption if this can be achieved.
- (e) An additional 25 mg is needed for lactation.

Vitamin A:

- (f) Recommended safe intake μg RE/day, 1 μg retinol=1 RE; 1 μg β -carotene=0.167 μg RE; 1 μg other provitamin A carotenoids=0.084 μg RE.
- (g) Vitamin A values are "recommended safe intakes" instead of RNIs. This level of intake is set to prevent clinical signs of deficiency, allow normal growth, but does not allow for prolonged periods of infections or other stresses.

Vitamin E:

- (h) Data were considered insufficient to formulate recommendations for this vitamin so that "acceptable intakes" are listed instead. This represents the best estimate of requirements, based on the currently acceptable intakes that support the known function of this vitamin.
- (i) Breast milk substitutes should not contain less than 0.3 mg α -tocopherol equivalents (TE)/100 ml of reconstituted product, and not less than 0.4 mg TE/g PUFA. Human breast milk vitamin E is fairly constant at 2.7 mg for 850 ml of milk.
- (k) Values based on a proportion of the adult acceptable intakes.

Vitamin K:

- (l) The RNI for each age group is based on a daily intake of 1 $\mu\text{g}/\text{kg}/\text{day}$ of phyloquinone, the latter being the major dietary source of Vitamin K.
- (m) This intake cannot be met by infants who are exclusively breast-fed. To prevent bleeding due to vitamin K deficiency, all breast fed babies should receive vitamin K supplementation at birth according to nationally approved guidelines.

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