

- 1 **Tables for**
- 2 **RNI_moderate_malnutr_Golden_Tables_67.doc**

1 Table 1: Summary of the nutrient: energy densities from the RNIs for normal children, and those of
 2 F100/RUTF used for treating severely malnourished children (to give comparison boundaries with which to
 3 compare the proposed present recommendations) and the proposals for moderately malnourished individuals
 4 living in contaminated environments. The recommendations for the moderately malnourished are divided into
 5 two components. The first is the amount that should be in the diet when programs are based on a mixture of
 6 local foods (Food) to treat the moderately malnourished without general fortification of the diet; the second are
 7 the suggested nutrient densities that should be achieved in the diet when specially fortified supplementary
 8 foods are used in a program to treat the moderately malnourished or convalescent children.
 9

Nutrient per 1000kcal.		RNI		SAM	Moderate Malnutrition RNI				
		FAO	ALL	F100/RUTF	Food	Supplement		food	Supplement
Nutrient	unit	Gravimetric		Gravimetric	Gravimetric		SI units		
Protein									
Protein	g	22.3		28.4	24	26	-	-	-
Nitrogen	g	3.6		4.6	3.9	4.2	mmol	275	300
Minerals									
Sodium (Na)	mg	-	978	434	550	550	mmol	24	24
Potassium (K)	mg	-	1099	2400	1400	1600	mmol	36	41
Magnesium (Mg)	mg	79	112	175	200	300	mmol	8.3	12.5
Phosphorus (P)	mg	450	634	762	600	900	mmol	19	29
Sulphur (S) †	mg	0	0	0	0	200	mmol	0	5.6
Zinc (Zn)	mg	12.5	16.5	22.3	13	20	µmol	200	310
Calcium (Ca)	mg	595	820	1009	600	840	mmol	15	21
Copper (Cu)	µg	-	892	2749	680	890	µmol	11	14
Iron (Fe)	mg	17.8	17.8	24	9	18	µmol	160	320
Iodine (I)	µg	201	201	190	200	200	µmol	1.6	1.6
Selenium (Se)	µg	17.8	29.7	55	30	55	nanomol	380	700
Manganese (Mn)	mg	-	1.2	0.69	1.2	1.2	µmol	22	22
Chromium (Cr)	µg	-	10.8	0	0	11	nanomol	0	210
Molybdenum (Mo)	µg	-	16.6	0	0	16	nanomol	0	170
Vitamins, water soluble									
Thiamine (B1)	µg	523	523	700	600	1000	mmol	2.0	3.3
Riboflavin (B2)	µg	595	595	2000	800	1800	mmol	2.1	4.8
Pyridoxine (B6)	µg	595	732	700	800	1800	mmol	4.7	10.7
Cobalamine (B12)	ng	966	966	1000	1000	2600	nanomol	745	1930
Folate	µg	167	167	350	220	350	nanomol	500	795
Niacin	mg	6.4	8.4	10	8.5	18	umol	70	145
Ascorbate (Vit C)	mg	45	74	100	75	100	µmol	425	570

Pantothenic acid	mg	2.7	2.7	3	2.7	3	μmol	12.3	13.7
Biotin	μg	9.7	9.7	24	10	13	nanomol	40	53
Vitamins, fat soluble									
Retinol (Vit A)	μg	595	743	1500	960	1900	μmol	3.3	6.6
Cholecalciferol (D)	μg	7.4	10.9	30	7.4	11	nanomol	19	29
tocopherol (E)	mg	8.9	8.9	22	11.5	22	μmol	27	51
Phytomenadione (K)	μg	16.1	16.1	40	20	40	nanomol	44	89
Essential fatty acids									
N-6 fatty acid	g			5	5	5			
N-3 fatty acid	g			0.85	0.85	0.85			
Others									
Choline	mg		223		223	223			
Histidine	mg		430		430	430			
Isoleucine	mg		575		575	575			
Leucine	mg		1245		1245	1245			
Lysine	mg		1190		1190	1190			
Methionine+cystine	mg		575		575	575			
Phenylalanine+tyrosine	mg		1125		1125	1125			
Threonine	mg		655		655	655			
Tryptophan	mg		175		175	175			
Valine	mg		776		776	776			

1 † The sulphur should be in addition to that derived from protein.

1 Table 2: Rates of weight gain required to catch up in weight over 14 to 40 days. The rates of weight gain are
 2 expressed in g/Kg/d, using the mean body weight as the denominator. The values are the means for children
 3 from 60cm to 85cm in height; within this height range the maximum and minimum divergence of values ranged
 4 from 0.7% to 2.5% of the quoted value respectively. (All calculations based on WHO₂₀₀₅ standards)
 5

Category change		-3 to 0 Z	-3 to -1 Z	-3 to -2 Z	-2 to 0 Z	-2 to -1 Z	-1 to 0 Z
14 days	male	16.9	11.1	5.5	11.4	5.7	5.8
	Female	18.3	12.0	5.9	12.4	6.1	6.3
20days	male	11.8	7.8	3.8	8.0	4.0	4.1
	female	12.8	8.4	4.2	8.7	4.3	4.4
30 days	male	7.9	5.2	2.6	5.3	2.6	2.7
	female	8.5	5.6	2.8	5.8	2.9	3.0
40 days	male	5.9	3.9	1.9	4.0	2.0	2.0
	female	6.4	4.2	2.1	4.4	2.1	2.2

1

2 Table 3 Experimental studies on the energy cost of tissue deposition

3

Author	Kcal/g tissue	subjects	date	Ref	Country	Notes
Recovering SAM children on Milk diet						
Ashworth	5.5	rec SAM	1968	[42]	Jamaica	Milk diet - with K and Mg only
Kerr1	4.61	rec SAM	1973	[43]	Jamaica	Milk diet - with K and Mg only
Kerr 2	6.2	rec SAM	1973	[43]	Jamaica	Milk diet - with K and Mg only
Whitehead	3.5	rec SAM	1973	[44]	Uganda	
Spady	4.4	rec SAM	1976	[45]	Jamaica	Milk diet - with K and Mg only
Jackson	6.1	rec SAM	1977	[46]	Jamaica	Only 5 subjects - but had muscle mass measured.
Golden	4.8	rec SAM	1981	[28]	Jamaica	Milk diet- early in recovery, mixed tissue synthesised
Morris	5.1±0.5	rec SAM	1989	[31]	Jamaica	Standard diet milk based diet added minerals
Morris	4.8±0.5	rec SAM	1989	[31]	Jamaica	F100 diet.
Recovering SAM children on type II deficient diet						
Waterlow	6.56	rec SAM	1961	[47]	Jamaica	original diets - deficient in several nutrients
MacLean.	8.39	rec SAM	1980	[23]	Peru	N2 balance shows only adipose tissue being made
Golden	6.9	rec SAM	1981	[29]	Jamaica	70% fat tissue synthesis – low zinc diet
Golden	8.1	rec SAM	1981	[28]	Jamaica	Milk diet - late in recovery with probable limiting nutrients, fat being synthesized
Recovering SAM children on Soya based diet						
Golden	6.5	rec SAM	1981	[28]	Jamaica	Soy diet – early in recovery
Golden	7.4	rec SAM	1981	[28]	Jamaica	Soy diet – late in recovery
Golden	15.5	rec SAM	1991	[48]	Jamaica	Soya based diet (high phytate/ mineral deficient)
Golden	7.4	rec SAM	1991	[48]	Jamaica	Soya based diet plus zinc
Normal Infants						
Fomon	5.6	normal infants	1971	[49]	USA	
Payne	5	normal infants	1971	[50]	Review	
Reviews						
Butte, Roberts	2.4 to 6	Various	1989	[51] [52]	Review	

4

1 Table 4 RNIs for normal children compared with F100 formula diet.

Nutrient	RNI (FAO)	Other (IOM/UK/WHO)	F100/RUTF	F100 minus FAO	% diff	F100 minus other	% diff
ALL VALUES ARE EXPRESSED PER 1000 Kcal female FAO energy requirement.							
Protein	22.3	21.2	28.4	6.1	29	7.2	34
Prot %kcal	8.9	8.6	11.1	2.2	26	2.5	30
Na mg	(529) UK	978	434	-95	-10	-544	-56
K mg	(1099) UK	2934	2403	1304	44	-531	-18
Cl mg		1467	1831			364	25
Mg mg	79	112	175	96	85	63	56
P mg	450	634	762	312	49	128	20
Ca mg	595	820	1008	413	50	188	23
Zn mg	12.5	16.5	22.3	9.8	60	5.8	35
Cu µg	332	892	2749	2417	271	1857	208
Fe mg	18	16	24	6.2	38	7.6	46
Iod µg	201	193	188	-13.1	-7	-5.1	-3
Se µg	17.8	29.7	54.8	37.0	125	25.1	84
F µg		740	na				
Mn µg		1170	690			-480	-41
Cr µg		10.8	na				
Mo µg		16.6	na				
B1 µg	523	525	700	177	34	175	33
B2 µg	595	628	2000	1405	224	1372	218
B6 µg	595	732	700	105	14	-32	-4
B12 ng	966	864	1000	34	4	136	16
Fol µg	167	147	350	183	124	203	138
Niac µg	6239	8368	10000	3761	45	1632	20
vit C mg	45	74	100	55	75	26	35
Panto mg	2.7	2.7	3	0.3	12	0.3	12
Biot µg	9.7	9.7	10.0	0.3	4	0.3	4
chol mg		223	na				
vit A µg	595	743	1500	905	122	757	102
vit D µg	7.4	10.9	30.0	23	206	19	174
Vit E	9.9	5.2	22.0	12	231	17	321
Vit K µg	16	40	40.0	24	60	0	1

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2 **Table 5** Summary equations used to derive energy and nutrient requirements for catch-up weight gain.
3 The general form of the formula used was:

4
$$\text{Nutrient} = [\text{maintenance} + \text{deficit} + \text{diarrhoea} + \{(\text{C-lean} * \text{P-lean}) + (\text{C-fat} *(1 - \text{P-lean}))\} * \text{RWG}] * \text{efficiency}] / \text{absorption}$$
 the units are energy or nutrient/kg/d,

6 Where: **Maintenance** is the minimum amount of *absorbed* (not ingested) nutrient or energy needed for balance
7 – unit/kg/d. **Deficit** is the tissue deficit that has to be replaced *in the existing tissues of the body*, calculated
8 from the measured reduction in tissue wet-weight concentration (usually from muscle biopsy) of the nutrient
9 per kilo (not adjusted for changes in body composition due to malnutrition), and converted into a daily
10 additional requirement on the basis that the deficit in the child's existing tissue is to be made good in 30 days.
11 That is (normal-concentration * deficit-proportion / 30) ; for example, if normal potassium is 2340mg/kg and
12 there is a 23% deficit then the daily increment added for the deficit is $2340 * 0.23 / 30 = 18 \text{mg/kg/d}$. **Diarrhoea**
13 is the *additional* amount of the nutrient, over and above the maintenance requirement, that is lost when the
14 child has one or two non-dehydrating loose stools per day, converted into a daily loss per kilo body weight. **C-**
15 **Lean** is the concentration of the nutrient or energy in normal lean tissue – nutrient per gram of tissue, **P-lean** is
16 the proportion of new tissue synthesised that is lean tissue. **C-fat** is the concentration of the nutrient or energy
17 in adipose tissue. **(1minus P-lean)** is the proportion new tissue that is adipose tissue. **RWG** is the rate of weight
18 gain in g/kg/d, this has been taken to be 5g/kg/d for most analyses. **Efficiency** is a factor to allow for the
19 efficiency of conversion of the absorbed nutrient into tissue – it is assumed to be 100% for most nutrients that
20 are recycled in the body, this factor is only applied to the nutrient laid down in new tissue; it is assumed that a
21 reduced efficiency is already incorporated into estimates of the maintenance requirement. How the efficiency
22 changes with clinical state or in making good a deficit is unknown and therefore assumed to be 100% - if it is
23 less this would have the effect of increasing the nutrient requirement. **Absorption** is the proportion of the
24 nutrient or energy ingested that is absorbed into the body (availability).

25 At any particular rate of weight gain and tissue composition, the derived value for the nutrient requirement was
26 divided by the derived value for energy requirement (nutrient/kg/d divided by energy/kg/d = nutrient/energy)
27 to obtain the nutrient: energy density; it was expressed as nutrient per 1000kcal required in the diet of
28 moderately malnourished children to promote rapid growth.

29 Most of the values in the table come from single studies in patients with a spectrum ranging from moderate to
30 severe malnutrition. Many of them are old and use relatively inaccurate analytical techniques. The confidence
31 intervals around the values, and hence the derived requirements are correspondingly wide -see text under each
32 nutrient for references.

		Maintenance	Deficit increment	Diarrhoea increment	lean tissue	adipose tissue	efficiency of use	absorption
		/Kg body wt/d	/Kg body wt/d	/Kg body wt/d	Per g tissue	per g tissue	%	%
Energy	kcal	82	0	0	2.8	8	100	90
protein	g	1.2	0	0	0.2	0.02	60	90
Potassium	mg	70	18	47	3.6	0.4	100	90
sodium	mg	10	Minus 17.5	27	1.4	0.7	100	100
magnesium	mg	14.4	4.8	7.2	0.24	0.024	100	30 to 60
phosphorus	mg	34	14.5	68	1.86	0.3	100	60
zinc	µg	33	340, 570	110	81	8.1	100	15,35,56

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2 Table 6 RNI protein requirements expressed as nutrient densities and proportion of energy

	unit	Authority	7-9m	10-12m	1-3y	4-6y
Protein	g/1000kcal	FAO 85	22.3	20.1	15.2	14.6
Protein	g/1000kcal	FAO 2007	15.0	15.6	12.8	13.5
Protein	g/1000kcal	IOM		16.4	12.7	13.7
Protein	g/1000kcal	UK	21.4	21.2	15.2	14.8
Prot %kcal	% energy	FAO	8.9	8.0	6.1	5.8
Prot %kcal	% energy	IOM		6.5	5.1	5.5
Prot %kcal	% energy	UK	8.6	8.5	6.1	5.9

3

1 Table 7 The protein: energy requirement for children gaining tissue with between 30% and 80% lean tissue at
 2 different rates (note that with low rates of weight gain and 30% lean tissue deposition, the requirement
 3 approximates that of the IOM calculations)
 4

% lean	1 g/kg/d	2 g/kg/d	3 g/kg/d	5 g/kg/d	10 g/kg/d	15 g/kg/d
30	15.0	15.2	15.5	15.9	16.6	17.1
35	15.2	15.6	16.1	16.8	18.0	18.7
40	15.4	16.1	16.6	17.6	19.4	20.5
45	15.6	16.5	17.2	18.5	20.8	22.3
50	15.8	16.9	17.8	19.4	22.3	24.2
55	16.0	17.3	18.4	20.3	23.9	26.2
60	16.3	17.7	19.0	21.3	25.5	28.4
65	16.5	18.2	19.7	22.3	27.2	30.6
70	16.7	18.6	20.3	23.3	28.9	32.9
75	16.9	19.0	20.9	24.3	30.8	35.4
80	17.2	19.5	21.6	25.4	32.7	38.0

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1 Table 8 Potassium requirements (AIs) mg/1000kcal

	Unit	Authority	7-9m	10-12m	1-3y	4-6y
K	mg	IOM		1041	2934	2737
K(min)	mg	UK	1099	1001	818	821

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2 Table 9 Basal potassium requirements and effect of stool losses and a tissue deficit.

	mg/kg/d	urine+stool	+deficit
Basal urine	27		
normal stool	43	70	88
1 loose stool	82	110	128
2 loose stool	90	117	135
3 loose stool	98	125	143

3

1 Table 10 potassium requirements of moderately malnourished children (see table 5 for calculations)
2

	no tissue deficit	tissue deficit
	mg/1000kcal	mg/1000kcal
basal, normal stool	770	967
basal 1 loose stool	1203	1400
basal 2 loose stool	1288	1485
basal 3 loose stool	1374	1571

3

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1 Table 11 Magnesium requirements for normal children mg/1000kcal

age			7-9m	10-12m	1-3y	4-6y
Mg	mg	FAO		79	63	59
Mg	mg	IOM		112	78	94
Mg	mg	UK	121	114	89	88

2

1

2 Table 12 Parameters used in assessing magnesium requirements in moderate malnutrition
Absorption 30 to 60% mg mmol

normal Muscle mg/kg	240	10
normal fat mg/kg	24	1
Malnourished children's muscle mg/kg	96	4
recovered children's muscle mg/kg	132	5.5
deficit corrected over 30 days mg/kg/d	4.8	0.2
urine losses mg/kg/d	2.4	0.1
faecal losses mg/kg/d	7.2	0.3
faecal losses, mild loose stools mg/kg/d	14.4	0.6
Faecal losses, diarrhoea mg/kg/d	28.8	1.2

3

1 Table 13 Potential magnesium requirements mg/1000kcal (see table 5 for calculations)

Percent absorption	30%	40%	50%	60%
No tissue deficit	246	224	211	202
With tissue deficit	342	277	237	211
With some loose stools	421	356	316	290
With several loose stools	580	514	474	448

2

1 Table 14 Phosphorus content of tissues
units mg/kg

Whole body	infant	5,600
Whole body	adult	12,000
muscle	infant	2,010
muscle	adult	1,820
liver	infant	2,560
liver	adult	2,670
kidney	adult	1,780
spleen	adult	2,200
lung	infant	1,360
lung	adult	1,610
brain	infant	1,670
brain	adult	3,380
skin	infant	1,080
skin	adult	430
Tissue mean	all	1,880

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2 Table 15 Phosphorus RNIS mg/1000kcal

		Age	7-9m	10-12m/ 7-12m	1-3y	4-6y
Phosphorus	mg	IOM		409	450	360
Phosphorus	mg	UK	634	578	285	263

3

1	Table 16 Parameters used to assess P requirements		
	availability	%	60%
	balance	mg/kg/d	34
	tissue	mg/kg	1860
	diarrhoea	mg/kg/d	68
	deficit	mg/kg	434
	Replace in 30 days	mg/kg/d	14.5

2

1 Table 17 Phosphorus balance in Malnutrition, Linder 1963 [175]

		Adm	d10-20	d30-50
mg/kg/d	Intake	162.0	161.0	153.0
Malnourished children	urine	9.7	25.7	35.7
	faeces	104.0	67.0	56.0
	balance	48.2	68.8	61.4

3

1 Table 18 Phosphorus requirements for moderately malnourished children (mg/1000kcal). See table 5 for calculations.

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% lean tissue	Rate of weight gain		
	2g/kg/d	5g/kg/d	10g/kg/d
malnourished without deficit or diarrhoea			
50	354	339	323
60	364	360	356
70	375	383	393
with a deficit of 21% soft tissue Phosphorus			
50	585	534	476
60	599	560	517
70	612	589	561
with a deficit of 21% and loose stools			
50	918	814	698
60	936	849	749
70	954	886	804

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1 Table 19 Zinc RNI, mg/1000kcal

	7-9m	10-12m/6-12m	1-3y	4-6y
FAO high		3.7	2.5	2.5
FAO mod		6.1	4.3	4.1
FAO low		12.5	10.8	9.1
IOM		4.5	2.9	3.6
UK	7.7	7.0	5.1	4.9
WHO-High		4.9	3.5	3.1
WHO-Mod		8.3	5.8	5.2
WHO-Low		16.5	11.5	10.4

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2 Table 20 Assessment of zinc requirements with various availabilities and rates of weight gain.
 3 See table 5 for calculations.

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availability	deficit	RWG g/kg/d	Zn mg/1000kcal	mg/kg/d
high 56%	none	0	0.6	0.06
high	none	2	1.9	0.19
high	none	5	3.4	0.40
high	none	10	5.2	0.74
moderate 35%	none	0	1.0	0.09
moderate	none	2	3.1	0.31
moderate	none	5	5.4	0.64
moderate	none	10	8.3	1.18
Low 15%	none	0	2.4	0.22
Low	none	2	7.2	0.73
Low	none	5	12.7	1.49
Low	none	10	19.3	2.75
high	8mg/kg	0	6.2	0.56
high	8mg/kg	2	6.9	0.70
high	8mg/kg	5	7.7	0.90
high	8mg/kg	10	8.7	1.24
moderate	8mg/kg	0	9.9	0.90
moderate	8mg/kg	2	11.0	1.12
moderate	8mg/kg	5	12.4	1.45
moderate	8mg/kg	10	13.9	1.99
Low	8mg/kg	0	23.1	2.11
Low	8mg/kg	2	25.8	2.61
Low	8mg/kg	5	28.8	3.37
Low	8mg/kg	10	32.5	4.64
high	17mg/kg	0	11.8	1.07
high	17mg/kg	2	11.9	1.21
high	17mg/kg	5	12.1	1.41

high	17mg/kg	10	12.2	1.75
moderate	17mg/kg	0	18.8	1.71
moderate	17mg/kg	2	19.0	1.93
moderate	17mg/kg	5	19.3	2.26
moderate	17mg/kg	10	19.6	2.80
Low	17mg/kg	0	43.9	4.00
Low	17mg/kg	2	44.4	4.51
Low	17mg/kg	5	45.0	5.27
Low	17mg/kg	10	45.7	6.53

1 Table 21 Sodium Adequate intakes. mg/1000kcal

			7-9m	10-12m	1-3y	4-6y
Na mg	mg	IOM		550	978	864
Na mg (min)	mg	UK	503	491	529	518

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1 Table 22 Sodium content of muscle biopsies of malnourished and recovered or normal children.
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Normal/recovered	SAM	increase	Ref
mg/kg wet wt	mg/kg wet wt	%	
1408	1693	20	[237] Nichols, 1972
1349	1654	23	[238] Vis, 1965
945	1267	34	[239] Metcoff, 1966
1010	1357	34	[240] Frenk, 1957

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2 Table 23 Sodium requirements in relation to stool losses, rate of weight gain and nutritional status

3 See table 5 for calculations

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State	stool losses	Weight gain	mg/1000kcal
Normal	Normal	0	227
	Normal	2	221
	Normal	5	213
	Mild loose(27mg)	0	530
	Mild loose	2	493
	Mild loose	5	449
	Moderate loose (62mg)	0	909
	Moderate loose	2	833
	Moderate loose	5	744
malnourished	Normal	0	0
	Normal	2	17
	Normal	5	36
	Normal	10	59
	Mild loose	0	303
	Mild loose	2	289
	Mild loose	5	272
	Mild loose	10	252
	Moderate loose	0	682
	Moderate loose	2	629
	moderate loose	5	567
	moderate loose	10	493
RDA US			978
UKDRV			529
Breast milk			257
F100			434

5

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2 Table 24 Calcium RNIs for normal children mg/1000kcal

			7-9m	10-12m	1-3y	4-6y
Ca	Mg	FAO		595	523	483
Ca	Mg	IOM		401	489	576
Ca	Mg	UK	820	747	369	340

3

1 Table 25 Iron RNIs at various levels of availability mg/1000kcal

			7-9m	10-12m	1-3y	4-6y
Fe15%	mg	FAO		5.9	4.2	4.8
FE 12%	mg	FAO		7.4	5.2	5.6
Fe10%	mg	FAO		8.9	6.3	7.2
Fe5%	mg	FAO		17.8	13.6	14.5
Fe mg	mg	IOM		16.4	6.8	7.2
Fe mg	mg	UK	12.2	11.1	7.0	4.6

2

1 Table 26 Copper RNIs mg/1000kcal

			7-9m	10-12m	1-3y	4-6y
Cu µg	micro g	IOM		327	332	317
Cu µg	micro g	UK	496	452	399	429
Cu µg	micro g	WHO		892	586	459

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2 Table 27 Selenium Adequate intakes. micrograms/1000kcal

			7-9m	10-12m	1-3y	4-6y
Se µg	micro g	FAO		14.9	17.8	16.9
Se µg	micro g	IOM		29.7	19.6	21.6
Se µg	micro g	UK	15.6	14.2	15.7	15.0
Se µg	micro g	WHO		17.8	20.9	19.3

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1 Table 28 Iodine RNIs microgram/1000kcal

			7-9m	10-12m	1-3y	4-6y
Iod µg	micro g	FAO		201	78	89
Iod µg	micro g	IOM		193	88	65
Iod µg	micro g	UK	94	85	73	75
Iod µg	micro g	WHO		74	94	72

2

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2 Table 29 Thiamine RNIs, microgram/1000kcal

			7-9m	10-12m	1-3y	4-6y
B1 µg	micro g	FAO		446	523	483
B1 µg	micro g	IOM		446	489	432
B1 µg	micro g	UK	312	427	523	525

3

1 Table 30 RNI for Riboflavin, micrograms/1000kcal

		7-9m	10-12m	1-3y	4-6y
B2 µg	FAO		595	523	483
B2 µg	IOM		595	489	432
B2 µg	UK	625	569	628	600

2

1 Table 31 Niacin RNIs, microgram/1000kcal

		7-9m	10-12m	1-3y	4-6y
Niac μ g	FAO		5947	6276	6439
Niac μ g	IOM		5947	5867	5763
Niac μ g	UK	6245	7112	8368	8252

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2 Table 32 Pyridoxine RNIs, microgram/1000kcal

		7-9m	10-12m	1-3y	4-6y
B6 µg	FAO		595	523	483
B6 µg	IOM		446	489	432
B6 µg	UK	468	569	732	675

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2 Table 33 Cobalamine (vitamin B12) RNIs nanogram/1000kcal†

			7-9m	10-12m	1-3y	4-6y
B12 ng	nano g	FAO		743	941	966
B12 ng	nano g	IOM		743	880	864
B12 ng	nano g	UK	625	569	523	600

3 † It is currently thought that the vitamin B12 RNIs may have to be revised upwards (personal communication –
4 L.H. Allen)

5

1 Table 34 Folate RNIs, microgram/1000kcal

	unit	Authority	7-9m	10-12m	1-3y	4-6y
Fol µg	micro g	FAO		119	167	161
Fol µg	micro g	IOM		119	147	144
Fol µg	micro g	UK	78	71	73	75

2

1 Table 35 Ascorbic acid (vitamin C) RNIs, mg/1000kcal

	unit	Authority	7-9m	10-12m	1-3y	4-6y
vit C	mg	FAO		44.6	31.4	24.1
vit C	mg	IOM		74.3	14.7	18.0
vit C	mg	UK	39.0	35.6	31.4	22.5

2

1 Table 36, Vitamin E RNIs, mg/1000kcal

	unit	Authority	7-9m	10-12m	1-3y	4-6y
Vit E	mg	FAO		8.92	5.87	5.04
Vit E	mg	IOM		4.01	5.23	4.02

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Table 37 Vitamin A RNIs microgram/1000kcal

	unit	Authority	7-9m	10-12m	1-3y	4-6y
vit A	micro g	FAO		595	418	362
vit A	micro g	IOM		743	293	288
vit A	micro g	UK	546	498	418	375

3

1 Table 38 Vitamin A Teratogenicity recalculated from Rothman et al [372] to express the intake in terms of a
 2 nutrient density

Intake μg/d	intake μg/1000kcal	Pregnancies	Neural tube defects	%	All congenital defects	%
0-1500	>625	6410	33	0.51	86	1.34
1500-3000	625-1250	12688	59	0.47	196	1.54
3000-4500	1250-1875	3150	20	0.63	42	1.33
>4500	>1875	500	9	1.80	15	3.00

Note: per unit energy computed on an intake of 2400kcal/day for an early pregnancy in an older woman

3

1 Table 39 Vitamin D RNIs, microgram/1000kcal

	unit	Authority	7-9m	10-12m	1-3y	4-6y
vit D	micro g	FAO		7.43	5.23	4.02
vit D	micro g	IOM		7.43	4.89	3.60
vit D	micro g	UK	10.93	9.96	7.32	0.00

2

1 Table 40 Vitamin K RNI. Microgram/1000kcal

	Unit	Authority	7-9m	10-12m	1-3y	4-6y
Vit K	micro g	FAO		14.87	15.69	16.10
Vit K	micro g	IOM		3.72	29.34	39.62

2

1 Table 41 Biotin Adequate Intakes microgram/1000kcal

	unit	Authority	7-9m	10-12m	1-3y	4-6y
Biotin	micro g	FAO		8.92	8.37	9.66
Biotin	micro g	IOM		8.92	8.37	9.66

2

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2 Table 42 Pantothenic acid adequate intakes, mg/1000kcal

	unit	Authority	7-9m	10-12m	1-3y	4-6y
Pantothenic	mg	FAO		2.68	2.09	2.41
Acid	mg	IOM		2.68	1.96	2.16

3

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2 Table 43 The Adequate intakes of F, Mn, Cr and Mo, expressed per 1000kcal.

	unit	Authority	7-9m	10-12m	1-3y	4-6y
Fluorine	mg	IOM			0.74	0.68 0.72
Manganese	mg	IOM		0.89	1.17	1.08
Chromium	micro g	IOM		8.18	10.76	10.80
Molybdenum.	micro g	IOM		4.46	16.62	15.85

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Table 44 Tolerable upper limits of nutrients in absolute amounts and amounts per 1000kcal, in relation to the recommendations for the moderately malnourished child.

Nutrient		IOM Tolerable upper limits			MAM - food based			MAM - complement based			IOM tolerable upper limits				MAM - food based		MAM - complement based	
		Absolute amounts										nutrient per 1000kcal						
Age range		7-12m	1-3y	4-8y	7-12m	1-2y	3-5y	7-12m	1-2y	3-5y	7-12m	1-3y	4-8y	LOWEST	All	All		
Protein	g	nd	nd	nd	16	23	30	17	25	32	nd	nd	nd	nd	24	26		
Minerals																		
Sodium (Na)	mg	nd	1500	1900	370	530	680	370	530	680		1470	1370	1370	550	550		
Potassium (K)	mg	nd	nd	nd	950	1350	1750	1050	1550	2000	nd	nd	nd	nd	1400	1600		
Magnesium (Mg)	mg	nd	65†	110†	135	190	250	200	290	370	nd	65†	80†	65†	200	300		
Phosphorus (P)	mg	nd	nd	3000	400	570	750	600	860	1120	nd	nd	2160	2160	600	900		
Sulphur (S)	mg	nd	nd	nd	0	0	0	135	190	250	nd	nd	nd	nd	0	200		
Zinc (Zn)	mg	5	7	12	9	12	16	13	19	25	7	7	9	7	13	20		
Calcium (Ca)	mg	nd	2500	2500	400	570	740	560	800	1050	nd	2445	1800	1800	600	840		
Copper (Cu)	µg	nd	1000	3000	450	650	850	600	850	1100	nd	980	2160	980	680	890		
Iron (Fe)	mg	40	40	40	6	9	11	12	17	22	60	40	30	30	9	18		
Iodine (I)	µg	nd	200	300	135	190	250	135	190	250	nd	200	215	200	200	200		
Selenium (Se)	µg	60	90	150	20	30	35	35	55	70	90	90	110	90	30	55		
Manganese (Mn)	mg	nd	nd	2	0.8	1.1	1.5	0.8	1.1	1.5	nd	nd	1.4	1.4	1.2	1.2		
Chromium (Cr)	µg	nd	nd	nd	7	11	14	7	11	14	nd	nd	nd	nd	11	11		
Molybdenum (Mo)	µg	nd	nd	300	10	15	20	10	15	20	nd	nd	215	215	16	16		
Vitamins, water soluble																		
Thiamin (B1)	µg	nd	nd	nd	400	575	750	670	950	1250	nd	nd	nd	nd	600	1000		
Riboflavin (B2)	µg	nd	nd	nd	540	770	990	1200	1700	2250	nd	nd	nd	nd	800	1800		

Pyridoxine (B6)	µg	nd	nd	30000	540	770	990	1200	1700	2250	nd	nd	21000	21000	800	1800
Cobalamine (B12)	ng	nd	nd	nd	675	960	1240	1750	2500	3200	nd	nd	nd	nd	1000	2600
Folate	µg	nd	300	400	150	210	270	240	330	430	nd	nd	290	290	220	350
Niacin	mg	nd	nd	10000	6	8	11	12	17	22	nd	nd	7200	7200	8.5	18
Ascorbate (Vit C)	mg	nd	400	650	50	70	90	60	90	120	nd	390	470	390	75	100
Pantothenic acid	mg	nd	nd	nd	2.0	3.0	3.5	2.0	3.0	3.5	nd	nd	nd	nd	2.7	3
Biotin	µg	nd	nd	nd	6.5	9.5	12.5	8.5	12.5	16.0	nd	nd	nd	nd	10	13
Vitamins, fat soluble																
Retinol (Vit A)	µg	600	600	900	650	920	1190	1280	1820	2360	890	590	650	590	960	1900
Cholecalciferol (D)	µg	25	50	50	5	7	9	7	11	15	nd	50	35	35	7.4	11
tocopherol (E)	mg	nd	200	300	8	11	14	15	20	25	nd	195	215	195	11.5	22
Phytomenadione (K)	µg	nd	nd	nd	13	20	25	25	40	50	nd	nd	nd	nd	20	40

† Magnesium upper limit only applies to “supplemental magnesium” not food Magnesium.

Table 45 Nutrient densities for normal healthy children (RNI and Adequate Intakes) 6 month to 5 years of age by age group, expressed as nutrient per 1000 Kcal, using the FAO mean female energy requirement as the denominator for the particular age range quoted by each authority.

	unit	Authority	age gp 1	age gp 2	age gp 3	age gp 4
Age range		FAO		7-12m	1-2y	3-5y
Age range		IOM		7-12m	1-3y	4-8y
age range		UK	7-9m	10-12m	1-3y	4-6y
age range		WHO/FAO/IAEA		7-12m	1-2y	3-5y
Energy	kcal/d	FAO		673	956	1242
Energy	kcal/d	IOM		673	1023	1388
Energy	kcal/d	UK	641	703	1023	1333
Energy	kcal/d	WHO-TE		673	956	1242
PROTEIN	ALL VALUES ARE EXPRESSED PER 1000 Kcal female energy requirement.					
Protein	g	FAO/WHO 2007		10.1	11.1	14.5
Protein	g	FAO 1985	22.3	20.1	15.2	14.6
Protein	g	IOM		16.4	12.7	13.7
Protein	g	UK	21.4	21.2	15.2	14.8
Prot %kcal	% energy	FAO	8.9	8.0	6.1	5.8
Prot %kcal	% energy	IOM		6.5	5.1	5.5
Prot %kcal	% energy	UK	8.6	8.5	6.1	5.9
MINERAL						
Sodium Na	mg	IOM		550	978	864
Sodium Na (min)	mg	UK	503	491	529	518
Potassium K	mg	IOM		1041	2934	2737
Potassium K(min) mg	mg	UK	1099	1001	818	821
Chlorine Cl	mg	IOM		847	1467	1369
Chlorine Cl(min)	mg	UK	776	757	817	799
Magnesium Mg	mg	FAO		79	63	59
Magnesium Mg	mg	IOM		112	78	94
Magnesium Mg	mg	UK	121	114	89	88
Phosphorus P	mg	IOM		409	450	360

Phosphorus P	mg	UK	634	578	285	263
Calcium Ca	mg	FAO		595	523	483
Calcium Ca	mg	IOM		401	489	576
Calcium Ca	mg	UK	820	747	369	340
Zinc Zn High	mg	FAO-high		3.7	2.5	2.5
Zn moderate	mg	FAO-mod		6.1	4.3	4.1
Zn Low	mg	FAO-low		12.5	10.8	9.1
Zn	mg	IOM		4.5	2.9	3.6
Zn	mg	UK	7.7	7.0	5.1	4.9
Zn high	mg	WHO-High		4.9	3.5	3.1
Zn mod	mg	WHO-Mod		8.3	5.8	5.2
Zn low	mg	WHO-Low		16.5	11.5	10.4
Copper Cu	micro g	IOM		327	332	317
Copper Cu	micro g	UK	496	452	399	429
Copper Cu	micro g	WHO		892	586	459
Iron Fe 15%	mg	FAO		5.9	4.2	4.8
Iron Fe 12%	mg	FAO		7.4	5.2	5.6
Iron Fe 10%	mg	FAO		8.9	6.3	7.2
Iron Fe 5%	mg	FAO		17.8	13.6	14.5
Iron Fe	mg	IOM		16.4	6.8	7.2
Iron Fe	mg	UK	12.2	11.1	7.0	4.6
Iodine I	micro g	FAO		201	78	89
Iodine I	micro g	IOM		193	88	65
Iodine I	micro g	UK	94	85	73	75
Iodine I	micro g	WHO		74	94	72
Selenium Se	micro g	FAO		14.9	17.8	16.9
Selenium Se	micro g	IOM		29.7	19.6	21.6
Selenium Se	micro g	UK	15.6	14.2	15.7	15.0
Selenium Se	micro g	WHO		17.8	20.9	19.3
Fluorine F	mg	IOM		0.74	0.68	0.72
Manganese Mn	mg	IOM		0.89	1.17	1.08
Chromium Cr	micro g	IOM		8.18	10.76	10.80
Molybdenum MO	micro g	IOM		4.46	16.62	15.85

VITAMINS water soluble

Thiamine B1	micro g	FAO		446	523	483
Thiamine B1	micro g	IOM		446	489	432
Thiamine B1	micro g	UK	312	427	523	525
Riboflavin B2	micro g	FAO		595	523	483
Riboflavin B2	micro g	IOM		595	489	432
Riboflavin B2	micro g	UK	625	569	628	600
Pyridoxine B6	micro g	FAO		595	523	483
Pyridoxine B6	micro g	IOM		446	489	432
Pyridoxine B6	micro g	UK	468	569	732	675
Cobalamine B12	nano g	FAO		743	941	966
Cobalamine B12	nano g	IOM		743	880	864
Cobalamine B12	nano g	UK	625	569	523	600
Folic Acid	micro g	FAO		119	167	161
Folic Acid	micro g	IOM		119	147	144
Folic Acid	micro g	UK	78	71	73	75
Niacin	micro g	FAO		5947	6276	6439
Niacin	micro g	IOM		5947	5867	5763
Niacin	micro g	UK	6245	7112	8368	8252
Ascorbate vit C	mg	FAO		44.6	31.4	24.1
Ascorbate vit C	mg	IOM		74.3	14.7	18.0
Ascorbate vit C	mg	UK	39.0	35.6	31.4	22.5
Pantothenic acid	mg	FAO		2.68	2.09	2.41
Pantothenic acid	mg	IOM		2.68	1.96	2.16
Biotin	micro g	FAO		8.92	8.37	9.66
Biotin	micro g	IOM		8.92	8.37	9.66
Choline		IOM		223	196	180

VITAMINS fat soluble

vit A	micro g	FAO		595	418	362
vit A	micro g	IOM		743	293	288
vit A	micro g	UK	546	498	418	375
vit D	micro g	FAO		7.43	5.23	4.02
vit D	micro g	IOM		7.43	4.89	3.60

vit D	micro g	UK	10.93	9.96	7.32	0.00
Vit E	mg	FAO		4.01	5.23	4.02
Vit E	mg	IOM		8.92	5.87	5.04
Vit K	micro g	FAO		14.87	15.69	16.10
Vit K	micro g	IOM		3.72	29.34	39.62

AMINO ACIDS

HIS	mg	IOM		428	267	254
ILE	mg	IOM		575	356	349
LEU	mg	IOM		1244	801	777
LYS	mg	IOM		1191	750	729
MET+CYS	mg	IOM		575	356	349
PHE+TYR	mg	IOM		1124	686	650
THR	mg	IOM		656	407	380
TRY	mg	IOM		174	102	95
VAL	mg	IOM		776	470	444

HIS mg/gPr	mg/g prot	IOM		26	21	19
ILE mg/gPr	mg/g prot	IOM		35	28	25
LEU mg/gPr	mg/g prot	IOM		76	63	57
LYS mg/gPr	mg/g prot	IOM		73	59	53
MET+CYS/gPr	mg/g prot	IOM		35	28	25
PHE+TYR/gPr	mg/g prot	IOM		69	54	47
THR mg/gPr	mg/g prot	IOM		40	32	28
TRY mg/gPr	mg/g prot	IOM		11	8	7
VAL mg/gPr	mg/g prot	IOM		47	37	32

Table 46 Proposed nutrient intakes for moderately malnourished children (MAM) expressed as absolute amounts for comparison with the standard FAO/WHO RNIs and AIs for normal healthy children. The values recommended, expressed in nutrient:energy densities, have been "back-converted" from the recommendations derived to absolute amounts using the average energy requirement for females children within the age range quoted, and rounded.

Nutrient (absolute amounts)		FAO/WHO RNIs			MAM - food based			MAM - fortified complement based		
Age range		7-12m	1-2y	3-5y	7-12m	1-2y	3-5y	7-12m	1-2y	3-5y
Energy used as divisor	Kcal	673	956	1242	673	956	1242	673	956	1242
Protein	g	10.1	11.1	14.5	16	23	30	17	25	32
Nitrogen	g	1.6	1.8	2.3	2.6	3.7	4.8	2.8	4.0	5.2
Minerals										
Sodium	mg	nr	nr	nr	370	530	680	370	530	680
Potassium	mg	nr	nr	nr	950	1350	1750	1050	1550	2000
Magnesium	mg	53	60	73	135	190	250	200	290	370
Phosphorus	mg	300	430	560	400	570	750	600	860	1120
Sulphur	mg	0	0	0	0	0	0	135	190	250
Zinc (high)	mg	2.5	2.4	3.1						
Zinc (mod)	mg	4.1	4.1	5.1						
Zinc (low)	mg	8.3	8.4	10.3	9	12	16	13	19	25
Calcium	mg	400	500	600	400	570	740	560	800	1050
Copper	µg	nr	nr	nr	450	650	850	600	850	1100
Iron (15%)	mg	6	4	4						
Iron (12%)	mg	8	5	5						
Iron (10%)	mg	9	6	6						
Iron (5%)	mg	19	12	13	6	9	11	12	17	22
Iodine	µg	135	75	110	135	190	250	135	190	250
Selenium	µg	10	17	21	20	30	35	35	55	70
Manganese	mg	nr	nr	nr	0.8	1.1	1.5	0.8	1.1	1.5
Chromium	µg	nr	nr	nr	7	11	14	7	11	14
Molybdenum	µg	nr	nr	nr	10	15	20	10	15	20
Vitamins, water soluble										
Thiamin (B1)	µg	300	500	600	400	575	750	670	950	1250
Riboflavin (B2)	µg	400	500	600	540	770	990	1200	1700	2250
Pyridoxine (B6)	µg	300	500	600	540	770	990	1200	1700	2250
Cobalamine (B12)	ng	500	900	1200	675	960	1240	1750	2500	3200

Folate	µg	80	160	200		150	210	270		240	330	430
Niacin	mg	4	6	8		6	8	11		12	17	22
Ascorbate (Vit C)	mg	30	30	30		50	70	90		60	90	120
Pantothenic acid	mg	1.8	2	3		2.0	3.0	3.5		2.0	3.0	3.5
Biotin	µg	6	8	12		6.5	9.5	12.5		8.5	12.5	16.0
Vitamins, fat soluble												
Retinol (Vit A)	µg	400	400	450		650	920	1190		1280	1820	2360
Cholecalciferol (D)	µg	5	5	5		5	7	9		7	11	15
tocopherol (E)	mg	2.7	5	5		8	11	14		15	20	25
Phytomenadione (K)	µg	10	15	20		13	20	25		25	40	50