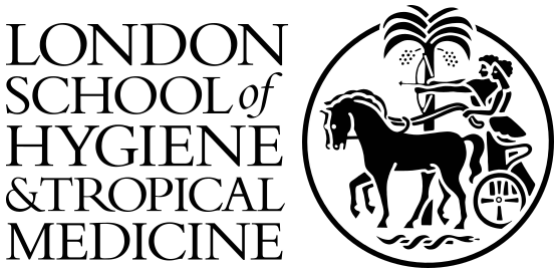

The Derivation of Nutrient Requirements for Disaster Affected Populations: Sphere Project 2011

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Running Head: Nutrient Requirements for Sphere 2011

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AS conducted the review and calculation of the revised nutrient requirements, and produced the first draft of the paper. ST managed and guided the process of revising the nutritional components of the Sphere Handbook. Both authors contributed to the final version of the paper.

Abstract

Background. Nutritional requirements have been calculated for emergency affected populations and are widely used for planning and assessing the nutritional adequacy of humanitarian food assistance. The Sphere Project is an inter-agency collaboration that defines minimum standards and indicators for humanitarian responses, including food and nutrition. It last published population nutritional requirements in 2004 but a revision was required due to the release of new reference nutrient intakes by WHO/FAO.

Objective. To review and revise the list of specified nutrients and recalculate population requirements using reference intakes published by WHO/FAO.

Methods. Review of published normative documents, consultation with experts and participants in the Sphere revision process, construction of a reference demographic profile, and calculation of population nutrient requirements for use in designing emergency general rations.

Results. 21 nutrients and energy were selected for inclusion and a demographic profile constructed to represent a typical beneficiary population. Compared to the previous version of the Sphere Handbook, population requirements for 9 vitamins and minerals were found to have increased as a result of the new WHO/FAO reference nutrient intakes.

Conclusions. The calculated requirements were adopted and published as part of the Sphere 2011 Handbook. The incorporation of these requirements in to planning,

monitoring, and evaluation practices for food assistance will help to ensure that populations receive appropriate nutritional support during crisis.

Introduction

During disasters and emergencies a population may become partially or wholly dependent on external food assistance. Food assistance may take many forms but the provision of a general food ration remains a cornerstone of many responses [1]. The importance of delivering nutritionally adequate assistance has been emphasised over the last few decades by numerous outbreaks of micronutrient deficiencies in refugee and emergency affected populations [2-8]. The increasing availability of epidemiological evidence has been supplemented by analysis of inadequate food aid content and an increasing emphasis on micronutrient malnutrition in the international nutrition community [9].

These factors have, together, contributed to a broad acceptance amongst humanitarian and health actors of the importance of defining and agreeing normative nutrient requirements for emergency affected populations [10-12]. In 2000, WHO first published population safe level of intakes for energy, macronutrients, and a range of vitamin and minerals for emergency affected populations [12]. These values were designed to be used for planning assistance for food aid dependent populations and were based on assumptions about the demographic profile, health, weight, and activity level of the beneficiary population, and the ambient temperature.

The Sphere Project was initiated in 1997 by a group of humanitarian NGOs and the International Red Cross and Red Crescent Movement. Sphere adopted a rights based approach which aimed to improve the quality of disaster response and the accountability of humanitarian actors. The Sphere Handbook defines minimum

standards and indicators for assessing humanitarian responses in key lifesaving areas, including food and nutrition [13]. The first version of the Sphere handbook was published in 1998, with subsequent versions released in 2000 and 2004. The most recent revision of Sphere minimum standards was initiated in 2009-10. The revision process for the Food chapter (Minimum standards for food security and nutrition) involved a wide consultation process with humanitarian actors and those directly affected by disasters. By the end of the consultation more than 350 people from over 20 countries had contributed to the chapter, including representatives of international and local NGOs, community-based organisations, faith-based organisations, national and local government ministries, academic institutions, and UN agencies. The views of beneficiaries were solicited in the process through the participation of local NGOs and community-based organisations, as well as direct consultation with beneficiaries. The current version of the handbook was published in 2011 [14].

Previous versions of the Sphere handbook contained lists of nutrient requirements to use to assess the adequacy of general food aid rations, a key indicator of many food assistance responses. These lists incorporated the nutrients specified by WHO in 2000, along with some additional nutrients. However, there was a consensus amongst many of the Sphere process participants that, due to advancement in nutritional knowledge and awareness of micronutrient malnutrition, the list should be reviewed and additional nutrients considered for inclusion in the 2011 edition. In addition, the publication of the FAO/WHO 2004 RNIs in 2004 necessitated a review of population requirements, as previous Sphere values had been based largely on the WHO safe levels of intake [12;15].

Preparation of a revised list of nutrient requirements for the Sphere 2011 Handbook involved a review of previous recommendations; a consultation on which nutrients should be included; selection of the nutrient list; and the calculation of new population requirements based on revised WHO/FAO reference nutrient intakes (RNI). In this paper we describe the process and justification for the selection of nutrients for inclusion and the methods used to calculate the population nutritional requirements for use in planning and monitoring general rations for humanitarian response.

Methods

Selection of nutrients for inclusion

A review was undertaken of nutrient requirement references and norms for emergency affected populations that had been published since 2000. This was supplemented by an online consultation process that targeted key informants from the following agencies or groups: WHO; UNICEF; WFP; UNHCR; MSF-B; CDC, Atlanta; and independent consultants.

Consultation of key informants was attempted by e-mailing them directly and a more generally targeted consultation was initiated by starting an online discussion on the en-net forum[1] (email and postings sent on 29th September 2009). In addition, documentation from Sphere project consultations was reviewed and a proposed list of vitamins and minerals was discussed at a Sphere Project consultation meeting in London on 22nd-23rd October 2009.

[1] http://www.en-net.org.uk/question/142.aspx

Selection of nutrient requirement data

Previous versions of Sphere have mainly utilised requirements for emergency affected populations that were also developed by WHO but expressed as 'safe levels of intake' [12]. Since the compilation of the Sphere 2004 manual new normative values have been published by WHO and FAO for vitamin and mineral requirements in human nutrition [15]. Requirements in the latest WHO/FAO report are expressed as reference nutrient intakes (RNI) for all nutrients except Vitamin A, which are given as a 'recommended safe intakes'. Requirements for copper were not specified by WHO/FAO in 2004 and were therefore taken from WHO, 1996 [16].

Population demographic data

Population data was required to determine the typical demographic profile for a beneficiary population and allow calculation of mean requirement figures. For this purpose data was obtained from the UN Population Division (UNPD), Population Estimates and Projections Section, in New York [17]. Regional data from the 2002 tables for less developed regions was used to calculate the proportion in each age and gender category using the medium variant projection statistic.

Calculation method

Population data was copied to an Excel 2003 spreadsheet and the proportions of the different age and gender groups that constitute the reference population was calculated. Groups were defined so as to correspond with the groups used by WHO/FAO to define nutrient requirements [15]. The requirement figures for each age and gender group were then multiplied by the proportion of the reference population in that group and the individual group requirements summed to give the

population mean. A number of challenges were encountered with the calculations for particular nutrients or population groups. The methods used for resolution of these are described below.

Interpolation of population proportions for infants

As the demographic data supplied by UNPD was only available in whole years, advice was sought from the UNPD on how to interpolate figures within whole years. No specific advice was forthcoming, so to generate the proportions in the 0-6 and 7-11 month categories the 1-year population was simply divided into 12 and allocated accordingly. It was surprising that for the expression of requirements FAO/WHO use 0-6 and 7-11 months categories, rather than 0-5 and 6-11 [15]. However, as the nutrient requirement data was available in these categories they were used here for calculation.

Adjustment of population requirement to allow for pregnancy and breastfeeding

The prevalence figures for pregnancy and lactation were taken from WHO, 2000 [12]. Figures of 2.4% and 2.6 % were used. To avoid double-counting the 5% of women assumed to be pregnant or lactating, the proportion of women in the 19-50 years age group was reduced by 5%. In reality, in most populations some of the pregnant and lactating women will be less than 19 years old but no data was available to quantify this proportion and no reduction was performed in the 10 - 18 years age group.

For accurate estimation, the population requirement requires adjustment to account for the nutrients being delivered to the infants through breastmilk. To achieve this adjustment it was assumed that all requirements for 0-6 months are met through

breastmilk and the requirement for this age group was removed from the calculation of the population nutrient requirement as it was assumed these nutrients will be delivered by the mother and are included in the lactation requirements. To allow calculation in the absence of additional data, it was also assumed that no nutrients are delivered by breastfeeding to older infants.

Vitamins B6 and D requirements for adult males

The nutrient requirement figures for adults are usually expressed by WHO/FAO for the 19-65 year age group [15]. However, for some nutrients this age group is split into two. To calculate the male requirements for vitamin B6 and vitamin D a weighted average of the 19-50 and 50+ age range requirement figures was used.

Vitamin K requirements for adolescents

WHO/FAO express the requirement for vitamin K as a range. A single value had to be selected to facilitate calculation of the population requirement and the mid point of the requirement range was taken for this purpose.

Calcium requirements during pregnancy and infancy

The requirement for infants was based on infants receiving breastmilk from 0-6 months. The requirements in pregnancy were based on 2 trimesters of non-pregnant adult female requirement, and 1 trimester of increased requirement.

Iron requirements

A low bioavailability of 5% was assumed for all the foods available to the beneficiary population. A weighted average was used for the requirements of adolescents and it

was assumed that all girls were menstruating between 15-18 years and none between 10 - 14 years. The requirement for pregnancy was assumed to be the same as for lactation, as no requirement figures for pregnancy are specified by FAO/WHO [15].

Iodine requirements for adolescents

A weighted average was used for the calculation of iodine requirements for adolescents as WHO/FAO express requirements separately for the 6-12 years and 13-18 years age groups.

Selenium requirements during pregnancy and lactation

A simple average of the trimester requirements was used for pregnancy, and a simple average of the first and second 6 months post partum for lactation.

Zinc requirements during pregnancy and lactation

Zinc requirements were calculated using an assumption of low bioavailability. A simple average of the trimester requirements was used for pregnancy and a simple average of the first and second 6 months post partum for lactation.

Results

Selection of nutrients for inclusion in Sphere 2011

In selecting nutrients for inclusion in the 2011 edition of the Sphere handbook the following issues were considered. The Sphere handbook should focus attention on the most important nutritional issues affecting the health of emergency affected populations with the aim of encouraging action where problems are identified. To achieve this focus, the number of nutrients to be included should be constrained to

those for which there is either a strong international consensus for inclusion or strong evidence for malnutrition associated with deficiency or excess.

The Sphere 2011 process therefore selected all those nutrients previously specified by WHO and other UN agencies in 2000 and 2007 for inclusion. In addition, pantothenic acid, vitamin K, and magnesium had been included in the Sphere 2004 handbook and were retained in the 2011 edition. However, it was considered that biotin should be removed as there was a lack of both international consensus and evidence regarding its importance in relevant contexts. This process led to the final selection of protein, fat, and the 19 vitamins and minerals shown in table 1.

As can be seen from table 1, with time there has been a tendency to include an increasing number of nutrients in normative documents. This may reflect a growing awareness of the importance of nutrition, an increasing knowledge base, and the availability of tools or food assistance vehicles by which nutrients can be delivered to populations. The Sphere Project has also tended to specify a larger number of nutrients than WHO or other UN agencies.

The demographic profile shown in table 2 was derived from data from the UNPD [17]. Age categories were constructed to align with those used by WHO/FAO [15]. The categories are, as a result, more detailed than those used in previous Sphere editions.

The calculated population requirements for use in the initial stages of an emergency are presented in table 3 and compared to those used in Sphere 2004. Requirements for

vitamins A, B1, B3, B12, Folate, C, D, and iron have all increased, with B12 and folate increasing by more than 100% of the 2004 values. In contrast, requirements for vitamin B2 and iodine have slightly decreased. Vitamins B6, copper, and calcium are additions that were not included in the 2004 handbook. However, a safe level of intake was given for calcium by WHO in 2000, and the Sphere 2011 requirement is approximately double this value [12].

Discussion

In this paper we have described the approach used in the development of population nutrient requirements for use in the initial stages of emergency response. The values described here were accepted by the group of core technical advisers and incorporated in the 2011 version of the Sphere handbook [14]. Previous failures in delivering nutritionally adequate food assistance, and the resulting health consequences, have reinforced the importance of continued quality improvement in the humanitarian nutrition and food assistance system. The adoption of the Sphere nutrition requirements represents another small step in this process.

The work on developing recommendations for micronutrient requirements for Sphere 2011 occurred in the context of a number of related or complementary initiatives. These included the introduction of nutritional quality reporting within the WFP International Food Aid Information System (INTERFAIS), based on selected micronutrient content [18]. The nutrient recommendations adopted by Sphere 2011 were designed to take into account the need to try and ensure coherence with these different initiatives, whilst maintaining Sphere's role as an independent standards setting initiative.

While the 2011 Sphere revision led to the revision of initial population requirements for 14 vitamins and minerals, the requirement for energy and macronutrients remained unchanged. It should be noted that new requirements had also been recently published for energy and protein [19;20]. However, the need to draw on the most recent scientific knowledge had to be balanced aginst the importance of acheiving an international consensus on requirements and avoiding operational confusion. It is anticipated that future revisons to the Sphere Handbook may involve an additional review of energy and macronutient requirements.

The changes in the calculated population requirements imply some challenges for the design and delivery of food assistance. As described above, the population requirements for 7 vitamins, iron, and calcium have increased significantly in Sphere 2011, due largely to the new RNI values published by WHO/FAO. This will have implications for achieving nutrient targets and further work is required to examine how these revised requirements should be taken into account in the design of food assistance packages, food products, and fortification levels for staples. In this regard it should be noted that WFP has recently specified new fortification levels for blended foods. Proposals for new fortification levels for US PL480 blended foods have also been published [21;22]. The potential role for special nutritional products such as lipid nutrient supplements in achieving nutritional adequacy for sub-groups of general ration recipients has also been attracting increasing attention [23]. The revision process for Sphere 2011 acknowledged this body of ongoing work and future editions should review the evidence base at the time and its implications for programme guidance and indicators.

With the increasing use of fortified commodities and products in food assistance operations there is an increasing risk of excessive consumption of micronutrients above the upper intake levels. It may therefore be prudent for future revisions of the Sphere handbook to include upper limits for population consumption as well as minimum levels of intake.

Finally, certain nutrients were omitted from inclusion in the Sphere 2011 handbook based on current evidence and international precedent. This is of course subject to change as new evidence is generated and the basis for inclusion or exclusion of nutrients should also be reviewed in future revisions to the Sphere Handbook.

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Table 1 Nutrients specified in normative documents for emergency affected populations since 2000

Nutrient	Management of Nutrition in Major Emergencies	Humanitarian Charter and Minimum Standards in Disaster Response[a]	Food and Nutrition Needs in Emergencies	Humanitarian Charter and Minimum Standards in Disaster Response	Preventing and Controlling Micronutrient Deficiencies in Populations Affected by an Emergency	Humanitarian Charter and Minimum Standards in Humanitarian Response
	WHO (2000)	The Sphere Project (2000)	UNHCR/UNICEF/WFP/ WHO (2002)	The Sphere Project (2004)	WHO/WFP/UNICEF (2007)[b]	The Sphere Project (2011)
Protein	Y	Y	Y	Y	NC[c]	Y
Fat	Y	Y	Y	Y	NC	Y
Vitamin A	Y	Y	Y	Y	Y	Y
Vitamin D	Y	Y	Y	Y	Y	Y
Vitamin E	-	-	-	Y	Y	Y
Vitamin K	-	-	-	Y	-	Y
Vitamin B1	Y	Y	Y	Y	Y	Y
Vitamin B2	Y	Y	Y	Y	Y	Y
Vitamin B3	Y	Y	Y	Y	Y	Y
Vitamin B6	-	-	-	-	Y	Y
Vitamin B12	Y	-	Y	Y	Y	Y
Folate	Y	-	Y	Y	Y	Y
Pantothenate	-	-	-	Y	-	Y
Biotin	-	-	-	Y	-	-
Vitamin C	Y	Y	Y	Y	Y	Y
Iron	Y	Y	Y	Y	Y	Y
Iodine	Y	Y	Y	Y	Y	Y
Zinc	-	Y	-	Y	Y	Y
Calcium	Y	Y	-	-	-	Y
Copper	-	Y	-	-	Y	Y
Selenium	-	Y	-	Y	Y	Y
Magnesium	-	Y	-	Y	-	Y
Phosphorus	-	Y	-	-	-	-
Sodium	-	Y	-	-	-	-
Potassium	-	Y	-	-	-	-
Number	***13***	***18***	***12***	***19***	***17***	***21***

[a] The Sphere handbook from 2000 also included 'desirable nutrient densities' for manganese, chromium, molybdenum, and fluorine.
[b] This document focussed on the requirements for women and children rather than the whole population.
c NC, not covered by the scope of the document.

Table 2 Population demographic profile used for calculation of minimum mean population requirements

Age Group	% of total
0-6 months	1.32
7-11 months	0.95
1-3	6.58
4-6	6.41
7-9	6.37
10-18 females	9.01
10-18 males	9.52
19-50 females	17.42
51- 65 females	4.72
19-65 males	27.90
65+ females	2.62
65+ males	2.18
Pregnant	2.40
Lactating	2.60
	100.00

Table 3 Summary of calculated minimum mean population requirements and comparison with Sphere 2004

Nutrient	Unit	2004 Sphere Population Requirements	2011 Sphere Population Requirements	Difference	% Change
Energy	kcal	2,100	2,100	0.0	0.0
Minimum Protein Content	g	52-63	53	0.0	0.0
Minimum Energy from Protein	%	10-12	10	0.0	0.0
Minimum Fat Content	g	40	40	0.0	0.0
Minimum Energy from Fat	%	17	17	0.0	0.0
Vitamin A	µ RAE[a]	500	550	50.0	10.0
Vitamin D	µ	3.5[e]	6.1	2.6	74.3
Vitamin E	mg alpha-TE[b]	8.0	8.0	0.0	0.0
Vitamin K	µ	48.2	48.2	0.0	0.0
Vitamin B1 (Thiamin)	mg	0.9	1.1	0.2	16.7
Vitamin B2 (Riboflavin)	mg	1.4	1.1	-0.3	-22.9
Vitamin B3 (Niacin)	mg NE[c]	12.0	13.8	1.8	15.3
Vitamin B6 (Pyidoxine)	mg	-	1.2	-	-
Vitamin B12 (Cobalamin)	µ	0.9	2.2	1.3	138.9
Folate	µ DFE[d]	160	363	203.4	127.2
Pantothenate	mg	4.6	4.6	0.0	0.0
Vitamin C	mg	28.0	41.6	13.6	48.7
Iron	mg	22.0	32.0	9.9	45.0
Iodine	µ	150	138	-11.6	-7.7
Zinc	mg	12.3	12.4	0.1	0.8
Copper	mg	-	1.1	-	-
Selenium	µ	27.6	27.6	0.0	0.0
Calcium	mg	-	989	-	-
Magnesium	mg	201	201	0.0	0.0

[a] RAE - retinol activity equivalents
[b] alpha-TE - alpha-tocopherol equivalents
[c] NE - niacin equivalents
[d] DFE - dietary folate equivalents
[e] mid point of the specified range