Nutrition Information in Crisis Situations

United Nations System
Standing Committee on Nutrition

# Assessing micronutrient deficiencies in emergencies

## Current practice and future directions

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# Foreword

Micronutrient deficiencies are widespread in developing countries with more than 2 billion people being affected. They have many detrimental effects such as an increase in morbidity and mortality risk as well as impaired growth and mental development. Eradicating micronutrient deficiencies is a fundamental component of public health.

Micronutrient deficiencies occur more frequently in individuals on a monotonous or restricted diet, which is characteristic of most emergency situations. Micronutrient deficiencies have been reported for years in emergency settings and especially in refugee camps, where they were most frequently assessed (table 1).

Although increased attention has been paid to micronutrient deficiencies in recent years, assessments have remained scarce. Less than 10% of the anthropometric nutrition surveys reported in the NICS bulletins in 2005-2006 included assessment of micronutrient deficiencies [UN/SCN, 2005-2006]. Anaemia, measured by blood haemoglobin concentration, and vitamin A deficiency, assessed by clinical signs or symptoms, were the main deficiencies investigated. This phenomenon might be explained by the difficulty in measuring micronutrient deficiencies and challenges to prevent and cure them. Correct diagnosis of clinical signs or symptoms of micronutrient deficiencies requires qualified staff and training may be difficult. Moreover, clinical signs and symptoms are often not specific of a given deficiency. Biochemical measure of micronutrient deficiencies requires collection and conservation of blood or urine samples, as well as biochemical tests that sometimes involve the use of high technology and are expensive. These constraints might be difficult to overcome in emergency settings.

Estimation of the micronutrient content of diets may also give some indication of potential micronutrient deficiencies but is not yet routinely conducted. Although this type of assessment also poses a number of challenges, it may be useful to trigger further investigation.

This document explores options available for investigating micronutrient deficiencies, draws attention to best practices and includes references to practical tools and guidelines.

TABLE 1 MICRONUTRIENT DEFICIENCIES REPORTED IN EMERGENCY SITUATIONS

| Location | Years |
|---|---|
| **VITAMIN C DEFICIENCY** | |
| Somalia* | 1982, 1985 |
| Sudan* | 1984, 1991 |
| Ethiopia* | 1989 |
| Kenya* | 1994, 1996 |
| Afghanistan | 2001, 2002 |
| **VITAMIN A DEFICIENCY** | |
| Sudan* | 1985, 1987 |
| Kenya* | 1998, 2001 |
| Nepal* | 1999 |
| Ethiopia* | 2001 |
| Uganda* | 2001 |
| **NIACIN DEFICIENCY** | |
| Malawi* | 1989, 1990, 1991, 1996 |
| Angola (internally displaced persons) | 1999, 2000 |
| Angola | 2002 |
| **ANAEMIA** | |
| Kenya* | 1998, 2001 |
| Nepal* | 1999 |
| Uganda* | 2001 |
| Ethiopia* | 2001 |
| Algeria* | 2002 |
| Thailand* | 2001-2002 |
| Jordan* | 1990 |
| Lebanon* | 1990 |
| Syria* | 1990 |
| Gaza* | 1990 |
| West Bank* | 1990 |
| **THIAMINE DEFICIENCY** | |
| Thailand* | 1992 |
| Nepal* | 1994-1995 |
| Kenya (internally displaced persons) | 2000 |

*In refugee camps

References: [Tool, 1992; Cheung, 2003; Kemmer, 2003; Weise-Prinzo, 2002; Seal, 2005; Seal, 2007; Hassan, 1997; Baquet, 2000]

# 1. Introduction

As described above, micronutrient deficiencies may affect populations with a high prevalence. For example, iron deficiency has been found at a prevalence of 23-75% in child refugee populations in Africa, and this deficiency contributes substantially to the high prevalence of anaemia found in many scenarios (13-72%) [Kemmer, 2003; Seal, 2005; Hassan, 1997]. Other micronutrient deficiency diseases (MNDD) may be much rarer and, when they do occur, they may be found at a much lower prevalence although the consequences for the individuals affected may be at least as serious.

In describing the seriousness of a MNDD within a population the prevalence is most often used, although for outbreaks, such as seen with niacin deficiency (pellagra), the incidence or attack rate may be quoted. It is difficult to compare the seriousness of different situations when different epidemiological descriptors are used, and this should be borne in mind in any assessment.

The effects of deficiencies may be categorized as clinical or sub-clinical. In clinical deficiency there are signs or symptoms that can be specifically ascribed to the deficiency disease. In sub-clinical deficiency, no specific clinical signs or symptoms can be detected but the nutrient levels are low enough in the individual to result in a biochemical or functional parameter being below the normal reference range. When investigating MNDD, it should be remembered that clinical signs will usually only represent the tip of the iceberg, beneath which a much greater burden of sub-clinical deficiency will almost always be found. Two main approaches may be used to investigate micronutrient deficiencies, that is direct and indirect assessment:

- *Indirect assessment* involves the estimation of nutrient intakes at a population level and extrapolating from this the risk of deficiency and the likely prevalence and public health seriousness of MNDD.

- *Direct assessment* involves the measurement of actual clinical or sub-clinical deficiency in individuals and then using that information to give a population estimate of the prevalence of the MNDD.

The guidance currently provided in standard field nutrition manuals is often sketchy despite a fair amount of experience gained by different research, public health groups, and operational agencies over the last 15 years. The WHO reviews published in 1999 and 2000 on scurvy, beriberi and pellagra provide useful reviews of background information and, very importantly, suggested prevalence criteria for defining public health problems [WHO, 1999; WHO, 1999a; WHO, 2000]. Further information is presented in 'The management of nutrition in major emergencies' [WHO, 2000a]. However, there still remains a lack of practical guidance on how to do assessments of micronutrient deficiencies. This is partly perhaps, because it is anticipated that outside technical inputs would be available, and partly because there is, as yet, a lack of agreed protocols for such assessments. This situation is now starting to change with the production of a field manual from CDC and MI [MI, 2007].

The Sphere Project manual provides guidance on micronutrient deficiency assessment and intervention as outlined in the box below [Sphere, 2004]. More recently, a more proactive intervention approach has been advocated by WHO, WFP and UNICEF as outlined in their 2006 joint statement [WHO/WFP/UNICEF, 2006]. This statement calls for micronutrient supplementation of pregnant and lactating women and children (6-59 months) during all emergencies without the need for an assessment of deficiency.[1] This emergency supplementation would be in addition to any ongoing iron, folate or vitamin A supplementation or food fortification programmes. The operational effectiveness and safety of this approach has been the subject of some research [De Pee, et al., 2007] but experience to date is limited. Moreover, these recommendations must be considered together with the recent WHO statement on iron supplementation of young children in regions where malaria transmission is intense and infectious disease highly prevalent [WHO].

Despite these recent initiatives, many gaps exist in our knowledge of how to assess micronutrient deficiencies and how to react to the information that is collected.

Box 1 Sphere Project Guidance [Sphere 2004]

4. *Micronutrient deficiencies:* if the population is known to have been vitamin A-, iodine- or iron-deficient prior to the disaster, it can be assumed that this will remain a problem during the disaster. When analysis of the health and food security situations suggests a risk of micronutrient deficiency, steps to improve the quantification of specific deficiencies should be taken

5. *Epidemic micronutrient deficiencies:* four micronutrient deficiencies – scurvy (vitamin C), pellagra (niacin), beriberi (thiamine) and riboflavin – have been highlighted, as these are the most commonly observed deficiencies to result from inadequate access to micronutrients in food aid-dependent populations and are usually avoidable in a disaster situation. If individuals with any of these deficiencies present at health centres, for example, it is likely to be as a result of restricted access to certain types of food and probably indicative of a population-wide problem. As such, deficiencies should be tackled by population-wide interventions as well as individual treatment (see Correction of malnutrition standard 3 on page 152). In any context where there is clear evidence that these micronutrient deficiencies are an endemic problem, their levels should be reduced at least to pre-disaster levels.

6. *Endemic micronutrient deficiencies:* tackling micronutrient deficiencies within the initial phase of a disaster is complicated by difficulties in identifying them. The exceptions are xerophthalmia (vitamin A) and goitre (iodine) for which clear ‘field-friendly’ identification criteria are available.

[1] The recommended level of supplementation for pregnant and lactating women is one RNI (Recommended Nutrient Intake) per day for each of 15 micronutrients. For children (6-59 months) it is recommended that the same micronutrients are supplied at 1 RNI per day where foods are not fortified, and 2 RNIs per week where food is fortified.

# 2. Indirect Assessment of micronutrient deficiencies in food aid dependent populations - Monitoring the micronutrient content of the diet

## Defining Adequate Micronutrient Intake - Issues and current recommendations

When using the indirect assessment approach a prerequisite to identifying nutrient deficiency problems is to know what the nutrient requirements of individuals and populations actually are. Nutrient intake values (NIVs) aim to provide guidance, based on the available evidence and statistical probability, about the nutrient intakes that healthy individuals require. However, they come in many varieties and there may be large differences in NIVs presented in different publications. In addition, the basis for the derivation of different NIVs may be different and a number of conceptual distinct measures are used.

Moreover, to obtain population nutrient requirements, assumptions have to be made as to the demographic profile of the population, the bioavailability of nutrients within the diet, the energy requirement of the population, and allowances made for population health status. None of these assumptions are straightforward.

Currently, WHO recommends Safe Levels of Intake (SLI) for vitamins A, D, B1, B2, B3, B12, C, folic acid, iron, iodine and calcium, for emergency affected populations [WHO, 2000a]. These recommendations are available by age group and for a "typical population", based on calculations including demographic breakdowns. However, these SLI were calculated prior to the adoption of the latest NIVs by WHO and FAO in 2002 [FAO, 2002; WHO, 2004]. They also do not cover the full range of micronutrients considered essential for human health.

In compiling the 2004 version of the Sphere Project, provisional population requirements were added for the additional micronutrients, vitamin E, K, zinc, selenium, biotin, pantothenate and magnesium (table 2) [Sphere, 2004]. These were calculated using the NIVs available from the FAO/WHO 2002 report and population data revised by the UN in 2002 [FAO, 2000; UN, 2003].

However, these recommendations at population level have some limitations:

- They incorporate the requirements of all age groups and both sexes. They should not be used for as requirements for an individual.
- They are based on a particular population profile [UN, 2003]. As the demographic structure of different populations varies, this will affect the nutritional requirements of the population concerned.

TABLE 2 CURRENT STANDARDS FOR POPULATION NUTRITIONAL REQUIREMENTS-TO BE USED IN PLANNING PURPOSES IN THE INITIAL STAGE OF A CRISIS

| Nutrient | Mean population requirements |
|---|---|
| Energy | 2,100 Kcals |
| Protein | 10-12% total energy (52g-63g), but < 15% |
| Fat | 17% of total energy (40g) |
| Vitamin A | 1.666 IU (or 0.5 mg retinol equivalents) |
| Thiamine (B1) | 0.9mg (or 0.4 mg per 1,000 kcal intake) |
| Riboflavin (B2) | 1.4mg (or 0.6mg per 1,000 kcal intake) |
| Folic Acid | 160µg |
| Niacin (B3) | 12.0mg (or 6.6mg per 1,000 kcal intake) |
| Vitamin B12 | 0.9µg |
| Vitamin C | 28.0mg |
| Vitamin D | 3.2-3.8µg calciferol |
| Iron | 22mg (low bio-availability ie 5-9%) |
| Iodine | 150 µg |
| Magnesium* | 201mg |
| Zinc* | 12.3mg |
| Selenium* | 27.6µg |
| Vitamin E* | 8.0mg alpha-TE |
| Vitamin K* | 48.2µg |
| Biotin* | 25.3µg |
| Pantothenate* | 4.6µg |

Values given are Safe Levels of Intake taken from The Management of Nutrition in Major Emergencies [WHO, 2000a] except those marked * which are Provisional Population Requirements from The Sphere Project [Sphere, 2004]

Moreover, debate still continues on whether all of the micronutrients listed in the Sphere Project compilation should in fact be included or, indeed, whether others should be added.

## Food rations

The micronutrient content of general rations distributed in many food aid operations has been the subject of criticism for a number of years [Seal, 2005; Tomkins, 1992]. Recommended rations generally include cereal, pulses, oil, salt and multi-micronutrient fortified blended food, which was added as a component of the ration since the mid-nineties to improve its micronutrient content [WHO, 2000a, UNHCR, 2002]. It is also recommended that salt is fortified with iodine, oil with vitamin A and D and wheat and maize flour with multi-micronutrients [UNHCR, 2002]. However, analysis of the micronutrient content of standard theoretical rations still reveals the presence of numerous deficiencies. For example, two recommended rations are analysed in table 3 and both show severe deficiencies of riboflavin, calcium and the maize based ration is also badly deficient in vitamin C. Moreover, the high anti-nutrient content (especially phytate) of such diets further decreases the absorption of micronutrients.

TABLE 3 - MICRONUTRIENTS ARE DEFICIENT IN STANDARD GENERAL RATIONS

| Daily Ration | | | |
|---|---|---|---|
| Rice based ration g/person/day | | Maize based ration g/person/day | |
| Rice, Polished | 350 | Maize Grain, White | 400 |
| Lentils | 100 | Beans, Dried | 60 |
| Vegetable Oil | 25 | Vegetable Oil | 25 |
| Blended Food | 50 | Blended Food | 50 |
| Sugar | 20 | Sugar | 15 |
| Salt, Iodized | 5 | Salt, Iodized | 5 |

Nutrient Adequacy (%)*

| Ration Type | Planned kcal | Energy | Protein | Fat | Calcium | Iron | Iodine | Vit. A | Vit. B1 | Vit. B2 | Niacin | Vit. C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rice | 2,100 | 100 | 102 | 76 | 29 | 86 | 102 | 95 | 99 | 41 | 207 | 107 |
| Maize | 2,100 | 99 | 116 | 112 | 36 | 90 | 102 | 95 | 212 | 83 | 108 | 86 |

The calculations were performed using NutVal 2004, a WFP/UNHCR spreadsheet for the planning and monitoring of food aid rations. The adequacy is derived from the WHO SLI for an emergency affected population [WHO, 2000a]. It was assumed that commodities were fortified according to WFP specifications [UNHCR, 2002].

There has been more and more recognition of the importance of improving the micronutrient content of the ration. The WFP has recently taken steps to advance the role of micronutrient nutrition in their policy and practice. At a meeting of the Executive Board in 2004, new policy papers on emergency food aid, mainstreaming nutrition and fortification were passed [WFP, 2004]. These emphasized the importance of the micronutrient content of rations and nutrition as an outcome. "The importance of micronutrients in achieving the goals of emergency operations is increasingly well-understood and there is evidence of the need for greater use of fortified foods than in the past."

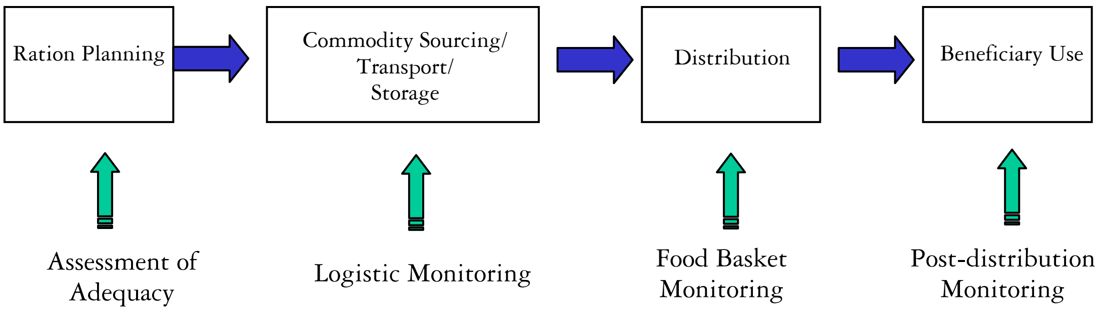
## Monitoring ration contents and dietary intakes

The theoretical ration (what should be distributed according to population needs) for a general food distribution might not correspond to what is consumed by the population for several reasons:

- The planned ration actually distributed on a particular distribution cycle might differ from the theoretical one for logistic reasons; for example some items might be missing and be replaced (or not) by others
- At the distribution point, problems in distribution procedures might mean that people do not receive the quantities of intended planned ration
- Food rations are often not entirely used for consumption but may be sold or exchanged for different purposes such as milling cereals, buying fresh foods and condiments to diversify the diet, buying essential non food items.
- The population might consume other foods in addition to the general ration
- The size and structure of the beneficiary population may change due to in or out migration, births and mortality, making the population planning figure obsolete.

Good data on the functioning of a food aid system is essential for monitoring the risk of MNDD (figure 1). Assuming that the ration has been planned and assessed to be adequate,

Figure 1 – Monitoring Points on a Food Aid System




the three components of a good food aid monitoring system will usually include (1) monitoring of the food aid logistics chain and distribution process, (2) food basket monitoring (FBM), also sometimes called onsite distribution monitoring, and (3) post-distribution monitoring (PDM) at the household and market level.

The aim of FBM is to compare the food actually received by families to the planned ration and to follow-up on any shortfall reported. Protocols for FBM are laid out in MSF and UNHCR Guidelines [MSF, 1995; UNHCR, 1997]. It is good practice for the agency doing the FBM to be organisationally separate from that involved in food distribution to avoid any conflict of interest that might arise. Criteria for the interpretation of FBM data have been laid down by UNHCR [UNHCR, 1997]. According to the UNHCR guidelines the cut-offs for acceptable distributions are $< 90\%$ or $>110\%$ of the planned kcal/person/day. While this is a useful criterion it takes no account of other commodities. While determining what these foods are may be relatively straightforward, gaining an accurate assessment of the quantities available and consumed often proves extremely difficult. The various food security methods that exist are very valuable for gaining in depth insight into household economies but are somewhat cumbersome to use to try and quantify the risk of micronutrient deficiencies. The accurate measurement of dietary nutrient intake using weighed intakes, portion sizes or other methods is a challenging undertaking in any setting. Such approaches are usually inappropriate in refugee or emergency assessments although they have been used in research studies [Banjong, 2003]. The measurement of a Diet Diversity or Food Variety Score using food frequency questionnaires is, in contrast, a much simpler and robust technique and the resulting scores have been shown to correlate with anthropometric status and haemoglobin concentration [Savy, 2005; Torheim, 2003; Swindale, 2005]. In these methods the survey subjects are asked whether they have