

Sudan Micronutrient Survey Indicators Definition

Mark Myatt and Ernest Guevarra

13 May 2020

1 Background

To aid the analysis of the Sudan Micronutrient Survey 2017-2018 data, appropriate indicators needed to be defined. The only documentation of indicators to be assessed from the survey was the last version of the S3M-II indicators list dated 16 November 2018. However, this document does not clearly define the indicators with no cut-off values provided. As such, indicator definitions were made based on a rapid literature review including micronutrient survey reports done elsewhere and reflected upon based actual available data from the survey itself to update the indicator definitions. This document presents these definitions.

2 Haemoglobin

2.1 Indicators definition used in the main S3M-II survey

In the main S3M-II survey, we defined multiple indicators based on Hb data. These indicators represented the different severities of anaemia by different respondent groupings. Classification into these severity categories was based on Hb level cut-offs defined by WHO [[World Health Organization and Centers for Disease Control and Prevention, 2007](#), [World Health Organization, 2011](#)] as follows:

Table 1: Hb levels to diagnose anaemia at sea level in grams per litre (g/l)

Population	Mild	Moderate	Severe
Children 6-59 months of age	100 - 109	70 - 99	< 70
Children 5-11 years of age	110 - 114	80 - 109	< 80
Children 12-14 years of age	110 - 119	80 - 109	< 80
Non-pregnant women (15 years and above)	110 - 119	80 - 109	< 80
Pregnant women	100 - 109	70 - 99	< 70
Men (15 years and above)	110 - 129	80 - 109	< 80

For the Sudan S3M-II main survey, no data was collected for children 5-17 years of age and for adult men 15 years of age and above so the indicator for this age group was not calculated and reported.

When categorising respondents based on the above cut-offs in the main S3M-II survey, no adjustments of Hb were done based on altitude and for smoking history as recommended by WHO [[World Health Organization and Centers for Disease Control and Prevention, 2007](#), [World Health Organization, 2011](#)].

2.2 Proposed indicators definition

We propose to analyse the Sudan Micronutrient Survey data using the same indicator definitions used in the Sudan S3M-II main survey.

3 Serum ferritin

Since no indicator definition has been made for the Sudan Micronutrient Survey based on serum ferritin values, we propose the following based on current practice described in several literature [[World Health Organization and Centers for Disease Control and Prevention, 2007](#), [Gorstein et al., 2007](#), [Wegmüller et al., 2020](#), [Thurnham et al., 2010](#)]

Serum ferritin will be used to assess iron deficiency for children less than 5 and for any other individual above 5 years old. For children less than 5 years old, a cut-off for serum ferritin value of $< 12 \mu/L$ indicates iron deficiency while for those older than 5 years old, a cut-off of $< 15 \mu/L$ is used.

However, it has been recommended that serum ferritin values be adjusted based on inflammation status ideally using both of the acute phase proteins - C-reactive protein (CRP) and α_1 -acid glycoprotein (AGP) to yield the most unbiased estimates of iron deficiency. However, the Sudan Micronutrient Survey only assessed CRP in the samples. The recommended adjustments when only one of the active phase proteins is available is to use an appropriate multiplier to the serum ferritin value depending on inflammation status of the respondent as described below:

Table 2: Cut-offs to determine inflammation

Active Phase Protein	Cut-off
CRP	$>5 \text{ mg/L}$
AGP	$>1 \text{ g/L}$

If a respondent is classified as being in an active inflammation process, then serum ferritin is adjusted accordingly. If inflammation is assessed using CRP, the serum ferritin is adjusted by 0.65 [[Thurnham et al., 2010](#)].

4 Calcium

Calcium is rarely assessed in population surveys. The most recent population survey that included assessment of calcium was for a national micronutrient survey in Bangladesh [[icddr et al., 2013](#)]. However, these biomarkers were not reported in the survey report. Instead, a paper was published in Public Health Nutrition using the same dataset and reported only

mean values of serum calcium concentrations were reported for the respondent groups of interest [Bromage et al., 2016].

We propose to follow Bromage et al’s reporting approach to calcium and will calculate mean serum calcium concentrations for each of the respondent groups of interest.

5 Iodine

We will assess iodine deficiency in the adult women respondent group using urinary iodine value cut-offs [Gorstein et al., 2007, Wegmüller et al., 2020] below:

Table 3: Cut-offs to determine iodine deficiency

Classification	Cut-off
Mild	50-99 μ /l
Moderate	20-49 μ /l
Severe	< 20 μ /l

6 Summary

Given these indicator definition, we propose the following list of indicators to be analysed and reported for the Sudan Micronutrient Survey.

Table 4: List of proposed indicators for Sudan Micronutrient Survey

Category	Indicators	Type
Anaemia	Mean haemoglobin in children 6-59 months old	Mean
	Mild anaemia in children 6-59 months old	Proportion
	Moderate anaemia in children 6-59 months old	Proportion
	Severe anaemia in children 6-59 months old	Proportion
	Mean haemoglobin in non-pregnant women of reproductive age	Mean
	Mild anaemia in non-pregnant women of reproductive age	Proportion
	Moderate anaemia in non-pregnant women of reproductive age	Proportion
	Severe anaemia in non-pregnant women of reproductive age	Proportion
	Mean haemoglobin in pregnant women	Mean
	Mild anaemia in pregnant women	Proportion
	Moderate anaemia in pregnant women	Proportion
	Severe anaemia in pregnant women	Proportion
Iron deficiency	Mean serum ferritin in children 6-59 months old	Mean
	Mean serum ferritin in non-pregnant women of reproductive age	Mean
	Mean serum ferritin in pregnant women	Mean
	Iron-deficient children 6-59 months old	Proportion
	Iron-deficient non-pregnant women of reproductive age	Proportion
Inflammation	Iron-deficient pregnant women	Proportion
	Mean serum c-reactive protein in children 6-59 months old	Mean
	Mean serum c-reactive protein in non-pregnant women of reproductive age	Mean
	Mean serum c-reactive protein in pregnant women	Mean
	Active inflammation in children 6-59 months old	Proportion
	Active inflammation in non-pregnant women of reproductive age	Proportion
Iodine deficiency	Active inflammation in pregnant women	Proportion
	Mean serum calcium in children 6-59 months old	Mean
	Mean serum calcium in non-pregnant women of reproductive age	Mean
	Mean serum calcium in pregnant women	Mean
	Mean urinary iodine in children 6-59 months old	Mean
Calcium levels	Mean urinary iodine in non-pregnant women of reproductive age	Proportion
	Mean urinary iodine in pregnant women	Proportion
	Mild iodine deficiency in children 6-59 months old	Proportion
	Mild iodine deficiency in non-pregnant women of reproductive age	Mean
	Mild iodine deficiency in pregnant women	Proportion
	Moderate iodine deficiency in children 6-59 months old	Proportion
	Moderate iodine deficiency in non-pregnant women of reproductive age	Proportion
	Moderate iodine deficiency in pregnant women	Mean
	Severe iodine deficiency in children 6-59 months old	Proportion
	Severe iodine deficiency in non-pregnant women of reproductive age	Proportion
	Severe iodine deficiency in pregnant women	Proportion

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