DHS Survey Design: Micronutrient Status

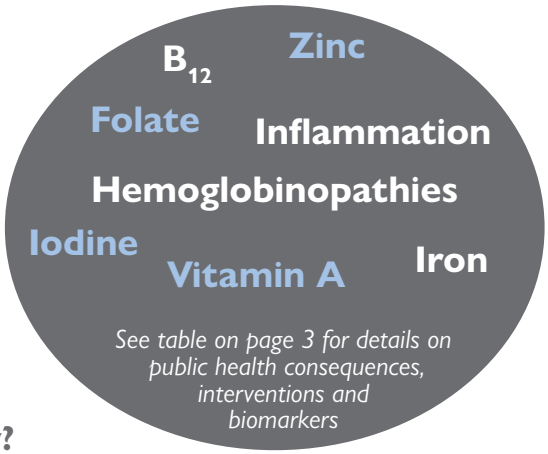
This brief describes considerations for the inclusion of biomarkers to assess micronutrient status in Demographic and Health Surveys (DHS). The information is based on global guidance and The DHS Program's recent experience in the collection of biomarkers to assess micronutrient status and other biomarker data.

Why collect data on micronutrient status?

Micronutrients are vitamins and minerals that are required in small amounts by the body and are essential for human life. Micronutrient deficiencies (and in some cases excesses) result in negative health and economic consequences, including impaired immune response, cognitive and developmental delays, decreased work productivity, blindness, and death.

Data on micronutrient deficiencies and excesses can be used to:

- Identify risk factors for certain health conditions, such as anemia;
- Inform policies, programs, and interventions within food and health systems;
- Develop cost-effective strategies that target the most at-risk populations;
- Improve training for healthcare and other service providers;
- Evaluate the impact of nutrition interventions;
- Track trends in prevalence over time.



Can we collect data on micronutrient status in our survey?

Micronutrient status can be collected in Demographic and Health Surveys in collaboration with a technical partner. The DHS allows for cross-tabulation of data on micronutrient status with other population and health indicators as well as trend analysis. This can provide special insights on the determinants and patterns of micronutrient status.

The suitability of including biomarkers of micronutrient status in DHS surveys needs to be carefully considered. Micronutrient status data collection is expensive and requires a well-developed infrastructure to support its collection and analysis. The time it takes to perform the laboratory testing of specimens can also delay the release of the data on micronutrient status relative to the rest of the survey results. The inclusion of micronutrient biomarkers also has the potential to negatively impact the implementation of other survey components. The increased effort required to collect micronutrient biomarker data may reduce time spent on training, data collection, and monitoring of interviews and other biomarker data. To date, only a few DHS surveys have included a micronutrient biomarkers component and lessons learned from these experiences are still unfolding and being applied to future surveys.

How do we determine an appropriate sample size?

Most DHS surveys are representative at the national level, for urban and rural areas, and at the first administrative level (region/province). Due to the significant cost and complexity of collecting micronutrient biomarkers, micronutrient testing is restricted to a subsample. Sample size is determined on a case-by-case basis but should rarely exceed 2,500 children and 2,500 women. Larger sample sizes may be cost and time prohibitive and can have a significant impact on data quality due to increased burden both in the field and in the laboratory. Therefore, in most cases micronutrient

status estimates are provided at the national level. National estimates of micronutrient status provide valuable information to inform micronutrient-related policies and programs and sub-national estimates may have limited impact on this decision-making process. Sample size determination should consider the micronutrient programs the country would like to assess.

How will the inclusion of micronutrient status assessment impact field work?

In DHS surveys, micronutrient status would typically be collected in the household at the same time as other survey data. Considerations for the impact of this on fieldwork will vary country by country, but overall include:

- Trained and highly skilled field staff are needed to collect and process the samples in the field, and to monitor fieldwork.
- Venous blood draws are required in most cases to have enough blood for all the tests.
- Depending on the biomarkers collected, urine samples need to be collected.
- Specimens need to be processed (centrifuged and aliquoted) in the field.
- An unbroken cold chain is required from the point of collection through transportation to the lab. This requires additional vehicles to maintain the cold chain.
- The length of fieldwork will increase because of call backs and the time required for collecting and processing the specimens for micronutrient testing.

Micronutrient status data have also been collected through a follow-on ("piggybacking") model where households are revisited after the DHS team has completed data collection. This requires substantial planning and coordination efforts, include linkage between the main and follow-on survey teams in order to prevent loss-to-follow-up.

Considerations for Inclusion

Eligible population groups:

Micronutrient status in population-level surveys should be measured in children age 6-59 months and non-pregnant women age 15-49.

Validity:

Validity depends on the proper collection, processing, and transportation of specimens. Specimens need to be analyzed at experienced laboratories with an external proficiency program, which are often outside of the host-country.

Impact on planning:

Decisions about which biomarkers to include, the identification of laboratories, and the procurement of specialized supplies need to be made early so as not to impact the overall DHS survey timeline.

Impact on cost:

Micronutrient testing substantially increases survey costs as additional training, supplies, staff, collection procedures, transport, storage, and analysis of specimens are needed.

Impact on quality:

Including micronutrient status testing in a DHS increases the complexity of the survey and makes it more challenging to implement which can negatively affect overall quality.

Important associated indicators:

Anemia testing, anthropometry, and malaria testing (in endemic settings) should also be performed in the same individuals selected for micronutrient status testing. Testing of micronutrients in food vehicles should be considered in countries with large-scale fortification programs. This has implications for team composition.

Most commonly assessed micronutrients and conditions associated with micronutrient deficiencies

Micronutrient or associated condition[1]	Public health consequences[2]	Interventions	Biomarkers
B_{12}	• Anemia • Neural tube defect • Cognitive impairment and poor academic performance	• Increase consumption of animal source foods • Fortification • Supplementation	Serum/ plasma vitamin B_{12}
Folate	• Anemia • Neural tube defect, fetal growth retardation, low birth weight, preterm delivery • Cognitive impairment	• Increase consumption of legume seeds, orange juice, and green-leafy vegetables • Fortification • Supplementation	Serum/plasma folate; Red blood cell folate
Iodine	• Goiter (enlarged thyroid) • Stillbirth, spontaneous abortion, and congenital abnormalities • Cognitive impairment	• Increase consumption of foods rich in iodine • Fortification • Supplementation	Urinary iodine
Iron	• Anemia • Motor and cognitive impairment • Slower emotional development • Poor academic performance and loss of productivity later in life	• Increase consumption of fish, poultry, and meat and dietary modification[3] • Fortification and biofortification • Supplementation • Delayed cord clamping	Serum/plasma ferritin
Vitamin A	• Visual impairment and blindness • Weakened immune system • Child mortality	• Increase consumption of vitamin A rich foods and dietary modification • Fortification and biofortification • Supplementation	Serum/plasma retinol
Zinc	• Growth faltering • Increased risk and severity of diarrhea and other infections • Poor birth outcomes, such as preterm birth	• Increase consumption of fish, poultry, and meat and dietary modification • Fortification and biofortification • Supplementation	Serum/plasma zinc
Inflammation (acute-phase proteins)[4]	• Anemia • Non-communicable diseases	• Prevention and treatment of infectious diseases • Prevent and treatment of chronic illnesses and syndromes	Serum/plasma apha-1-acid-glycoprotein and C-reactive protein
Hemoglobin-opathies	• Anemia and a number of other conditions depending on the type of hemoglobinopathy	• Genetic screening, counseling, and management • Transfusions • Iron chelation (beta thalassemia) • Medications to reduce pain and prevent complication (sickle cell)	Depends on type of hemoglobinopathy

1-Depending on the country, tests for other micronutrients may be added, for example vitamin D.
2-Excess micronutrient intake can also have negative health consequences.
3-Dietary modification is when a change is made during food preparation, processing, or consumption to increase bioavailability of food.
4-Iron and vitamin A biomarkers require acute-phase proteins to be measured in conjunction in order to interpret results.

How are laboratories selected and assessed?

An assessment is required to determine a laboratory's capacity to conduct micronutrient testing, store and process the quantity of samples needed for the survey, and capture data results from the tests. Laboratories need to demonstrate adequate analytical performance through participation in an external proficiency program.

Micronutrient biomarker analysis is specialized, and is often not a part of a laboratory's routine work. Surveys that include micronutrient status data usually require participation of international laboratories to test some of the biomarkers. Thus, while an effort is made to analyze specimens locally, it is often necessary to ship specimens out of the country.

Summary

Accurate and timely national estimates of micronutrient status are needed to inform program design and track progress. Including the assessment of micronutrient status in a survey has the potential to fill this gap. However, several challenges do exist, with some of the largest being:

- Significant funding required to collect biomarkers of micronutrient status;
- Additional time required to plan for the inclusion of biomarkers of micronutrient status;
- Added field complexities, such as collecting venous blood and maintaining a cold chain;
- Absence of national laboratories with the demonstrated ability to analyze biomarkers of micronutrient status at scale.

Venous blood collection during a DHS.

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