SURE Rapid Response

Is mandatory food fortification an efficient strategy for the alleviation of micronutrient deficiency?

May 2011

This rapid response was prepared by the Uganda country node of the Regional East African Community Health (REACH) Policy Initiative.

Key messages

- Micronutrient deficiency is a major cause of morbidity and mortality worldwide. In Uganda it contributes to an estimated loss of about US$ 310 million in lost productivity which represents 4.1% reduction in GDP.

- Food fortification is a proven and preferred strategy in the prevention and management of micronutrient deficiencies. It is effective, cost effective, has the potential to achieve high coverage and has been tested in many rigorous research studies.

Who requested this rapid response?

This document was prepared in response to a specific question from a policy maker in Uganda.

This rapid response includes:

- Key findings from research
- Considerations about the relevance of this research for health system decisions in Uganda

Not included:

- Policy or practice related recommendations
- Detailed descriptions

What is SURE Rapid Response Service?

SURE Rapid Responses address the needs of policymakers and managers for research evidence that has been appraised and contextualised in a matter of hours or days, if it is going to be of value to them. The Responses address questions about arrangements for organising, financing and governing health systems, and strategies for implementing changes.

What is SURE?

SURE – Supporting the Use of Research Evidence (SURE) for policy in African health systems - is a collaborative project that builds on and supports the Evidence-Informed Policy Network (EVIPNet) in Africa and the Regional East African Community Health (REACH) Policy Initiative (see back page). SURE is funded by the European Commission's 7th Framework Programme. www.evipnet.org/sure

Glossary

of terms used in this report: www.evipnet.org/sure/rr/glossary

Background

Micronutrient deficiencies are a recognized worldwide clinical and public health problem causing increased morbidity and mortality from infectious diseases, and of disabilities such as mental and visual impairment (1). ‘Micronutrients’ refers to essential vitamins and minerals vital for the body’s growth and function. While deficiencies in any of the essential micronutrients can result in health problems, there are a few that are particularly important, for example, iron deficiency which causes anemia; iodine deficiency which causes goiter and in pregnancy has long been linked to cretinism and possible fetal wastage; vitamin A deficiency which not only causes visual impairment but also leads to increased childhood and maternal mortality from increased susceptibility to diarrhea, malaria and measles; improvement in zinc deficiencies through zinc supplementation results in improved growth in children, lower rates of diarrhea, malaria, and pneumonia, and reduced child mortality (1). About 800 000 deaths in children and women of reproductive age are attributable to vitamin A deficiency which, along with the direct effects on eye disease, account for 1.8% of global DALYs while another about 800 000 deaths and 2.4% of global DALYs have been attributed to iron deficiency; another 800 000 child deaths per year are attributable to zinc deficiency resulting from increased rates of infectious diseases which is about 1.9% of global DALYs being attributed to zinc deficiency (2, 3).

Putting these disease burden estimates in perspective, the World Health Organization (WHO) estimates that there are 10.8 million child deaths globally annually of which the number attributed to zinc, vitamin A, and iron deficiencies is 2,082,000, or 19% of the total. When this is compared to for example, malaria, the extent of damage is even clearer; malaria causes less than one million child deaths a year globally (1, 2). Furthermore malaria causes 2.7% of global DALYs while iron, vitamin A and zinc deficiencies together cause about 6% of global DALYs (2, 3).

In developing countries about 163 million children have Vitamin A deficiency, and that is a prevalence of 30% of all children (4). Progress in meeting the Millennium Development Goals (MDGs) by halving the prevalence of Vitamin A deficiency is lagging far behind what is needed in most of Africa in comparison to the rest of the world (4). In Uganda, a recent report points out that the most common form of malnutrition in the country is chronic malnutrition and micronutrient deficiencies especially Iron deficiency with about 73% prevalence in under-fives and 49% among women of reproductive age, and Vitamin A deficiency with a prevalence of 20% among under fives (5). Malnutrition in Uganda accounts for about 150 childhood deaths every day and the long term impact of iron and iodine deficiencies coupled with stunting and low birth weight is estimated to cause about US$ 310 million in lost productivity which represents 4.1% reduction in GDP (6).

There is a commitment to bring this situation to an end. In December 1992, 159 countries convened at the International Conference on Nutrition (ICN), which had been jointly organized by the Food and

Agriculture Organization (FAO) and the World Health Organization (WHO) (7). They all endorsed the World Declaration on Nutrition, which pledged "to make all efforts to eliminate before the end of the decade... iodine and vitamin A deficiencies" and "to reduce substantially... other important micronutrient deficiencies, including iron." In the past few decades, efforts worldwide have concentrated on providing vitamin and mineral supplements to vulnerable populations and in some cases fortifying foods through post production processing. The outcome of these interventions has been mixed, successful in some programs and less than successful in others. For example improvement is quite clear in the iodine programs but less in iron supplementary programs (See tables and graphs below). Table 1 shows obvious improvement in the trends of goiter which is attributed to iodine fortification in the countries, whose coverage trends can be seen in table 2; the success here is quite evident.

Table 1

Total goitre prevalence: results from repeated national surveys (with latest result in 1995 or later)

Subregion	Country	Year survey conducted	Total goitre prevalence (%)	Recent trend
East Africa	Kenya	1984	20.0	
		1994	16.3	
		2004	6.2	Improvement
	Rwanda	1990	49.6	
		1996	17.8	
		1997	25.9	Improvement
	United Republic of Tanzania	1983	42.5	
		1985	37.0	
		1999	23.0	
		2001	17.0	
		2004	6.9	Improvement
	Zimbabwe	1989	42.3	
		1999	14.8	Improvement

Tables 1 and 2, and graphs 1 and 2 are adapted from* ***United Nations System. 6th Report on the World Nutrition Status* *(4)*

Table 2

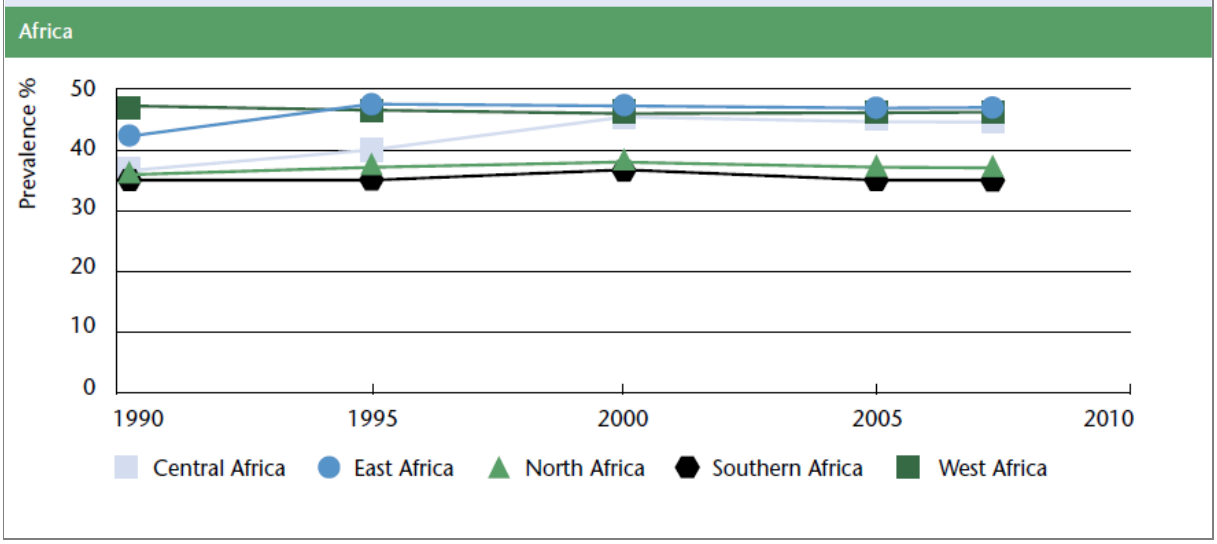
Table . Total goitre prevalence, by country category of endemic (before iodization) goitre prevalence (rows) and iodized salt coverage (columns), within time periods: estimates from available national surveys (number of surveys in brackets) within the corresponding time periods

Endemic (pre-iodization) total goitre rate	Coverage of iodized salt (% of households)															
	<1990				1990-1994				1995-2000				>2000			
	Before iodization or <25%	25-50%	50-75%	>75%	Before iodization or <25%	25-50%	50-75%	>75%	Before iodization or <25%	25-50%	50-75%	>75%	Before iodization or <25%	25-50%	50-75%	>75%
<20%	15.8 (5)	17.9 (3)	–	–	25.7 (7)	12.9 (3)	4.3 (1)	17.6 (2)	16.3 (2)	27.1 (1)	9.8 (1)	20.6 (3)	–	–	11.0 (1)	6.3 (2)
20-40%	27.5 (38)	15.6 (4)	12.9 (3)	8.0 (1)	31.7 (14)	15.5 (6)	18.6 (4)	12.5 (10)	36.5 (4)	18.6 (2)	21.5 (7)	6.9 (10)	–	17.1 (1)	2.2 (1)	11.7 (11)
>40%	46.2 (9)	40.9 (3)	–	–	53.3 (7)	–	–	20.5 (3)	63.0 (1)	20.4 (1)	40.0 (1)	18.1 (4)	24.8 (2)	–	5.5 (1)	5.7 (1)
Total	29.6 (52)	23.9 (10)	12.9 (3)	8.0 (1)	35.6 (28)	14.6 (9)	15.2 (5)	14.8 (15)	34.5 (7)	21.2 (4)	22.2 (9)	12.0 (17)	24.8 (2)	17.1 (1)	6.2 (3)	10.5 (14)

Trends in anemia are clearly less successful despite the different programs over the last two decades. Graph 1 below shows almost no difference and in sometimes worsening trends the different regions for example the East African region.

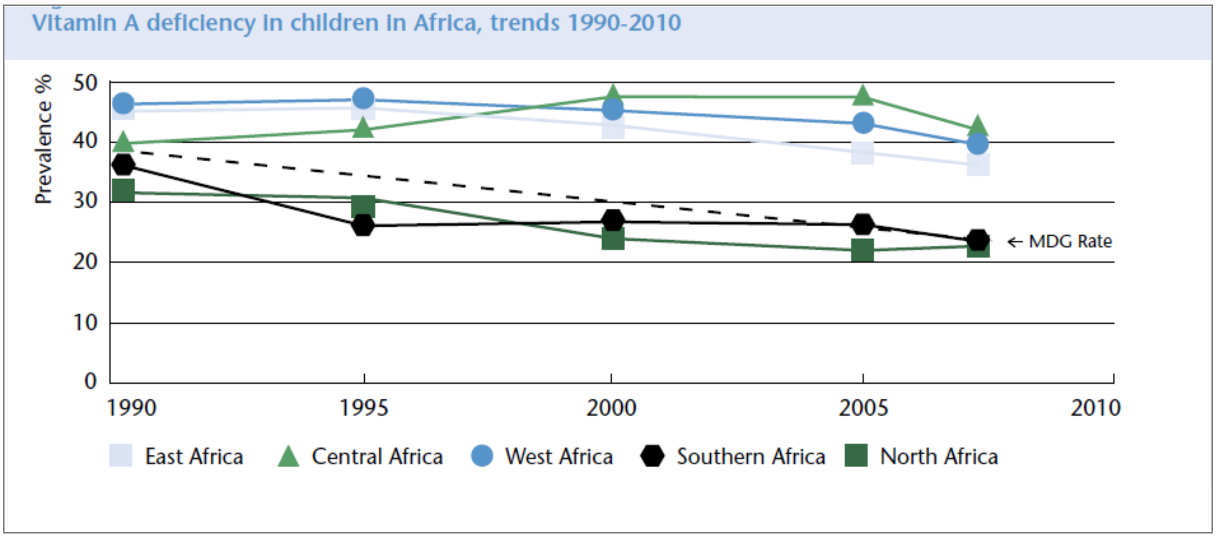
Graph 1

Trends in anaemia in non-pregnant women, by region



The rates in Vitamin a deficiency as seen in graph 2 below are improving albeit very slowly when compared to the changes in the iodine situation.

Graph 2



Unfortunately the pledge made at the ICN was not met by the end of that decade but the struggle has been carried on in several ways and the commitment still exists. There is a need for stronger approaches in implementing the strategies that have been proven as effective. The Plan of Action for Nutrition which is related to the ICN recommends that governments give priority to food-based strategies to control and prevent micronutrient deficiencies (7). There is need for sustainable approaches as it has been noted that the short-term supplementation programs implemented during the last two decades in many developing countries (in which populations were supplied with vitamin A capsules, iron tablets and iodine injections) have not succeeded in solving the problem of micronutrient malnutrition in a sustainable manner. While short-term interventions have a role in providing specific target groups with vitamin and mineral supplements at certain times, only food-based approaches can prevent micronutrient deficiencies in a sustainable manner for most of the population. In its sixth and most recent report the United Nations System' s Standing Committee on Nutrition noted that there is need for sustainable solutions and lasting changes in the fight against nutrition deficiencies (4). It noted the urgent need for strengthening nutrition governance in countries, regions and globally to create among other things an enabling policy and institutional environment in order to ensure faster progress especially as the world aims to meet the target for the MDGs.

In Uganda there is renewed commitment to fighting micronutrient deficiency. After several decades of low prioritization of these programs, since 2008 there is notable strengthening of governance in the nutrition sector in both the health and agricultural fields leading to the convening of a national nutrition stakeholder forum to map a way forward and running several strategic planning activities. Furthermore the recently developed National Development Plan by the National Planning Authority has incorporated several strategies to help alleviate nutrition problems in the country (8). This has resulted in the currently developing Nutrition Action Plan that will pave the way forward for multisectoral approaches to dealing with nutritional problems.

There are several reasons for the development and existence of micronutrient deficiencies; for example, it has been found that in many countries but especially developing ones, that when incomes rise, people often reduce breastfeeding, stop gathering wild foods and eat fewer green leafy vegetables activities which are considered to have low status yet these are the ones rich in many of the micronutrients. Furthermore some recent market surveys have found that dark green leafy vegetables are the least costly source of vitamin A in many countries but however other sources such as fruit are more expensive especially in the urban areas making them less accessible.

Four main strategies have been identified to prevent and manage micronutrient deficiency, and they include increased production and consumption of micronutrient-rich foods; food fortification; supplementation; and global public health and other disease control measures (7). This paper will look at the evidence suggesting the use of food fortification for the prevention and management of micronutrient deficiencies.

How this Response was prepared

After clarifying the question being asked, we searched for systematic reviews, local or national evidence from Uganda, and other relevant research. The methods used by the SURE Rapid Response Service to find, select and assess research evidence are described here:

www.evipnet.org/sure/rr/methods

What the quality of evidence (GRADE) means

The quality of the evidence is a judgement about the extent to which we can be confident that the findings of the research are correct. These judgements are made using the GRADE framework, and are provided for each outcome. The judgements are based on the type of study design (randomised trials versus observational studies), the risk of bias, the consistency of the results across studies, and the precision of the overall findings across studies. For each outcome, the quality of the evidence is rated as high, moderate, low or very low using the definitions below.

⊕⊕⊕⊕
High: We are confident that the true effect lies close to what was found in the research.

⊕⊕⊕○
Moderate: The true effect is likely to be close to what was found, but there is a possibility that it is substantially different.

⊕⊕○○
Low: The true effect may be substantially different from what was found.

⊕○○○
Very low: We are very uncertain about the effect.

For more information about GRADE:

www.evipnet.org/sure/rr/grade

Summary of findings

Fortification is actually identified as a more effective intervention to reduce Vitamin A deficiency at an accelerated rate if there is any chance at meeting the MDGs. In fact looking at worldwide trends before 1990 it is easy to see that increased coverage of iodized salt was associated with lower total goiter rates (tables 1 and 2). In its 2008 report, the Copenhagen Consensus (a project that seeks to establish priorities for advancing global welfare addressing some of the biggest challenges facing the world, assessing development opportunities and their costs, and considering possible solutions to a wide range of problems) rated food fortification with micronutrients as the most successful intervention to reduce the prevalence of iron deficiency anemia, and iodine and vitamin A deficiencies and further rated it as the world's best investment at the time (9).

Fortification may be a preferred approach of the four identified strategies for several reasons. Correcting micronutrient deficiencies is difficult because even when micronutrient-rich foods are available, they may not be and are often not consumed in sufficient quantities to prevent or reverse already present deficiencies (10, 11). Diets may therefore need to be enhanced.

Food fortification also has the potential for wide populations coverage and can involve a combination of micronutrients (7). However this has to be done with care as in low- and middle-income settings there are commonly deficiencies of several micronutrients in the same population. It is important to find out whether the effects of iron, vitamin A and zinc deficiencies are largely independent or overlapping. It is also important to understand the interactions of the essential micronutrients because for example, vitamin A may enhance iron nutrition state and zinc may increase vitamin A absorption while on the other hand, iron and zinc may interfere with the absorption of each other (1). Thus, it should not be assumed that providing supplements with multiple micronutrients will have the same benefits as supplements with single micronutrients.

It is not only a simple technology, fortification of foods such as flour, salt and oils is also a cost-effective approach (12). It has been estimated that salt iodization in several countries costs between US$0.02 and US$0.06 per capita per year (7, 13). Fortification of sugar with vitamin A in Guatemala costs US$0.29 per capita and iron fortification of wheat flour costs an estimated US$0.02 per capita (7).

Food fortification or sometimes referred to as enrichment is the process of adding micronutrients (essential trace elements and vitamins) to food; food supplementation or a food supplement is a preparation intended to supplement the diet and provide nutrients, such as vitamins, minerals, fiber, fatty acids, or amino acids, that may be missing or may not be consumed in sufficient quantities in a person's diet. Therefore fortification is a form of supplementation, but supplementation is also seen as a more temporary process in comparison, done using dosaging. Therefore despite the well-recognized benefits of micronutrient supplementations, this supplementation has been hindered by poor adherence to dosing regimens, inadequate supply, low coverage, and potential dose-related side effects and safety concerns {Sazawal S, 2006 #19}.

A systematic review done to evaluate the effectiveness of zinc supplementation in the prevention of pneumonia in children aged 2-59 months found that zinc supplementation in children is associated with a reduction in the incidence and prevalence of pneumonia the leading cause of death in children (14). The studies were mainly clinical trials carried out in Bangladesh, India, Peru and South Africa and the high grade evidence provided from this review was found sufficient to recommend zinc intake in deficient populations through supplementation, dietary improvements, or fortification, for enhancing child survival.

Another systematic review was done to evaluate the effect of vitamin A supplementation (VAS) for preventing morbidity and mortality in children aged 6 to 59 months (15). This included about 43 clinical trials and showed that giving vitamin A capsules to children in this age group can reduce morbidity and mortality significantly; results indicated that vitamin A reduces the overall risk of death by 24%. The authors concluded that VAS is effective in reducing all-cause mortality and did recommend universal supplementation for children under 5 in areas at risk of VAD. The evidence is presented in the table below.

Table 3

Vitamin A supplementation for preventing morbidity and mortality in children from six months to five years of age

Patient or population: Children aged between 6 months and five years
Intervention: Vitamin A supplementation
Comparison: Placebo or usual care

Outcomes	Comparative absolute risks		No of studies	Quality of evidence (GRADE)
	Control	Vitamin A		
All-cause mortality Follow-up: 12-96 weeks • Low risk population • Medium risk population • High risk population	0 per 1000 11 per 1000 90 per 1000	0 per 1000 8 per 1000 68 per 1000	11 studies	++++ High
Diarrhoea-related mortality Follow-up: 48-104 weeks • Low risk population • Medium risk population • High risk population	3 per 1000 4 per 1000 9 per 1000	2 per 1000 3 per 1000 6 per 1000	7 studies	+++O Moderate
Measles-related mortality Follow-up: 52-104 weeks • Low risk population • Medium risk population • High risk population	2 per 10,000 16 per 10,000 44 per 10,000	2 per 10,000 13 per 10,000 35 per 10,000	5 studies	+++O Moderate
LRTI-related mortality Follow-up: 48-104 weeks • Low risk population • Medium risk population • High risk population	4 per 10,000 11 per 10,000 219 per 10,000	3 per 10,000 9 per 10,000 171 per 10,000	7 studies	++OO Low
Diarrhoea incidence Mean episodes per child per year Follow-up: 24-60 weeks	1.9/child/year in controls.	VAS led to 0.29 episodes fewer per child per year	13 studies	++OO Low
Measles-morbidity	0.028 event	VAS led to	6 studies	++++

incidence Mean episodes of measles per child per year Follow-up: mean 52 weeks	per child per year.	0.015 fewer episodes per child per year		High
LRTI-morbidity incidence Mean episodes per child per year Follow-up: mean 52 weeks	0.7 episodes.	VAS led to 0.1 more episodes/child /year	9 studies	+OOO Very Low
Bitot's spots Follow-up: mean 80.72 weeks • Low risk population • Medium risk population • High risk population	4 per 1000 14 per 1000 203 per 1000	2 per 1000 6 per 1000 91 per 1000	4 studies	+++O Moderate
Night blindness Follow-up: 52 to 68 weeks • Low risk population • High risk population	4 per 1000 7 per 1000	1 per 1000 2 per 1000	2 studies	+++O Moderate
Vitamin A deficiency Follow-up: mean 54.5 weeks • Low risk population • Medium risk population • High risk population	93 per 1000 286 per 1000 588 per 1000	66 per 1000 203 per 1000 417 per 1000	4 studies	++++ High
GRADE: GRADE Working Group grades of evidence (see bar on the right)				

Despite the supportive evidence, it should be clearly pointed out that there is a need for a policy on fortification and active government involvement. A document commissioned by the Asian Development Bank has shown that to be successful, national fortification programs must be sustainable and market driven, and governments must back them up with adequate regulations, standards, and public education (16). Furthermore it notes that international experience shows that government policy, standards, and regulations are critical to establishing an environment that enables the private food sector to invest, produce, and distribute quality, fortified products. Government is key to creating producer awareness, building consumer demand, and shaping the marketplace with clear regulations and transparent regulatory enforcement procedures. In addition, food control and monitoring systems for fortified flour, salt, and other foods require technical and managerial capacity as well as coordination among government agencies charged with regulating domestic and imported food. There is also a need to strengthen food control and monitoring systems for fortified food at the market and household levels.

Conclusion

This paper has shown that micronutrient deficiencies are a recognized worldwide health problem causing increased morbidity and mortality, and causing a loss in productivity and several DALYs. However it is also clear that there is a commitment to alleviate this especially in vulnerable populations. Of the four main proven food based strategies to prevent and manage micronutrient deficiency, food fortification is a good choice because it is effective, cost effective, has a potential to reach high levels of coverage and has been tested in many rigorous studies that have proven its credibility.

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Regional East African Community Health Policy Initiative

The Regional East African Community Health-Policy Initiative (REACH) links health researchers with policy-makers and other vital research-users. It supports, stimulates and harmonizes evidence-informed policymaking processes in East Africa. There are designated Country Nodes within each of the five EAC Partner States.
www.eac.int/health

The Evidence-Informed Policy Network (EVIPNet) promotes the use of health research in policymaking. Focusing on low and middle-income countries, EVIPNet promotes partnerships at the country level between policymakers, researchers and civil society in order to facilitate policy development and implementation through the use of the best scientific evidence available.
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Conflicts of interest
None known.

This Rapid Response should be cited as
Rhona Mijumbi, MPH, MSc. **Is mandatory food fortification an efficient strategy for the alleviation of micronutrient deficiency?** A SURE Rapid Response. March 2011.

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