

Kyamuhangire W, Lubowa A, Kaaya A, Kikafunda J, Harvey P, Rambeloson Z, Dary O, Dror D, Allen L. **The importance of using food and nutrient intake data to identify appropriate vehicles and estimate potential benefits of food fortification in Uganda.** Food Nutr Bull 2013; 34: 131 – 141.

Introduction

Micronutrient deficiencies (e.g. iron, vitamin A, zinc, iodine, etc.) are prevalent in sub-Saharan Africa, and contribute to increased morbidity and mortality, and developmental deficits (1). Nutritional strategies to control micronutrient deficiencies include supplementation, fortification and dietary diversification. Fortification is “the practice of deliberately increasing the content of an essential nutrient in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health” (2). For these programs to be effective, appropriate food vehicles and adequate levels of fortification should be determined based on the dietary practices of the target population. The World Health Organization (WHO) recommends that countries collect detailed information on dietary intake and micronutrient status prior to designing and implementing fortification programs, to assess the proportion of the population consuming potentially fortifiable foods, the frequency of consumption and typical quantities consumed, and the prevalence of micronutrient inadequacies in the population (2).

This issue of NNA summarizes an article recently published in the *Food and Nutrition Bulletin*, which reported on the results of a baseline dietary intake survey conducted in Uganda to inform the design and implementation of a national food fortification program. The specific objectives of this survey were to: 1) estimate the prevalence of inadequate intakes of specific micronutrients, and 2) predict the potential contribution of fortification of individual or multiple food vehicles to the adequacy and safety of micronutrient intakes among vulnerable subgroups of the population.

Methods

The study was conducted as a regionally-representative cluster survey in three regions (urban Kampala, and rural Western and Northern Regions) in Uganda (3). Dietary data were collected using a 24-h recall method specifically designed for use in low-income countries in Africa (4). Single day dietary recalls were obtained for 957 non-pregnant, non-lactating women (NPNL) of reproductive age and 510 children 24-59 months of age; a second 24-h recall was collected on a non-consecutive day in 10% of households. Nutrient intakes were calculated using values from the HarvestPlus food composition database for Uganda. Although refined vegetable oil was being fortified with vitamin A at the time of this survey, the researchers opted to use nutrient values for non-fortified vegetable oil to estimate baseline adequacy, and to be able to simulate expected nutrient intakes from all possible combinations of currently approved fortification initiatives.

The distribution of actual nutrient intakes was adjusted to *usual* nutrient intakes by removing within-person variance (5). The prevalence of inadequate and excessive nutrient intakes was calculated based on the percentage of *usual* nutrient intakes below the Estimated Average Requirement (EAR) and above the Tolerable Upper Intake Level (UL), respectively. The authors simulated the impact of fortification on intake adequacy by repeating the aforementioned analyses using levels of added nutrients based on Ugandan food fortification standards, as well as those agreed upon by the East, Central, and Southern Africa (ECSA) Health Community.

Results and Conclusions:

Among NPWL women of reproductive age and young children in Kampala, and the rural Western and Northern regions of Uganda, there was a high prevalence of inadequate dietary intakes for multiple micronutrients. Depending on the region and age group, 30-99% of individuals were estimated to have inadequate dietary intake of vitamin A. Within regions, young children were more likely to have inadequate dietary intake of vitamin A than women; individuals residing in the Northern region were more likely to have inadequate intake compared to those in the Western region or Kampala. The percentage of households that reported consuming potentially fortifiable refined vegetable oil and sugar in the 24-h period preceding data collection ranged from 26-74% and 30-94%, respectively; reported consumption was higher in Kampala than in the rural regions. Universal vitamin A fortification of refined vegetable oil only, or both oil and sugar, would reduce the prevalence of inadequate intakes of vitamin A to 6-56% and 0-43%, respectively. However, if both refined vegetable oil and sugar were fortified with vitamin A at the currently proposed levels, 48% of children 24-59 months of age in Kampala who consumed these foods would be at risk of exceeding the UL of vitamin A intake (If wheat flour were also fortified with vitamin A, this prevalence would increase to 70%).

Inadequate dietary intakes of vitamin B12 (32-100%), iron (55-89%), and zinc (18-82%) were also prevalent across regions and age groups. The proposed fortification vehicles for these micronutrients are centrally produced maize and wheat flours. However, the results of this survey indicate that these products were consumed by < 20% of households in the rural Northern and Western regions. In addition, maize flour was produced in dispersed, small scale milling operations, making mass fortification technically challenging. As a result, the public health impacts of mass fortification of wheat and maize flours with multiple micronutrients are likely to be minimal in the rural Northern and Western regions. In Kampala, the fortification of wheat flour would substantially reduce the prevalence of inadequate intakes of B vitamins and zinc, but not iron (using either Ugandan or ECSA food fortification standards).

The authors concluded that mass fortification of potentially fortifiable foods would significantly reduce the prevalence of inadequate micronutrient intakes among young children and women of reproductive age, based on the current coverage and consumption patterns. However, complementary interventions (e.g. dietary diversity, iron supplementation, targeted fortification of maize flour, home-fortification with multiple micronutrient powders) may be necessary to meet nutrient requirements in some regions, age groups, or socio-demographic sub-populations – in addition to dietary diversification and appropriate infant and young child feeding practices. The proposed food vehicles and fortification levels for vitamin A should be revisited owing to the risk of excess intake in some populations.

Policy Implications

The National Working Group for Food Fortification in Uganda has approved fortification standards for refined vegetable oil, sugar, wheat flour and maize flour; and efforts are underway to expand the current fortification initiatives of refined vegetable oil, and to implement fortification of additional foods. This study was therefore critical for policy makers to understand the current prevalence of inadequate nutrient intakes and how different fortification strategies would impact nutrient intakes and prevalence of inadequate intake. Results from this study will allow policy makers to modify currently proposed multiple micronutrient fortification formulas, and to refine decisions about which foods should be fortified. Although mass fortification will likely have a large impact on the prevalence of inadequate micronutrient intakes in this

population, the study showed that supplementation and targeted fortification programs may need to be considered for the most vulnerable population groups.

NNA Editor's Comments *

Uganda is a good example of a country which has assessed dietary intake in a baseline survey to guide the development of a large-scale food fortification program. The availability of information on dietary practices and quantitative food and nutrient intakes, allows planners to identify food vehicles and design effective fortification programs. Moreover, these simulations of micronutrient intake indicate where dietary shortfall may still exist and multiple food vehicles could be deployed. Because these are simulations of the potential impact of specific fortification scenarios in selected regions, the projections should be interpreted with caution. The measurement of micronutrient status and the micronutrient content of fortified foods will be needed to monitor actual program impact. Nevertheless, these dietary simulations provide an important tool for policy makers to consider a combination of programs that are likely to have the desired impact on nutritional status. Additional considerations for any fortification program include whether the food vehicle is centrally processed, technological feasibility and organoleptic effect of fortification and cost.

Although the use of 24-h dietary recall in a representative sample is ideal to assess the prevalence of nutrient inadequacy and establish baseline information, not all countries have adequate resources available to conduct such a survey. Several countries in sub-Saharan Africa have successfully used the Fortification Rapid Assessment Tool (FRAT) (6) to identify suitable food vehicles. FRAT uses a combination of 24-h recall and food frequency for a limited number of food items of interest and is therefore a less costly and time consuming method for assessing consumption of currently or potentially fortified foods, although the tool does not allow calculation of total nutrient intakes. Coates *et al.* (7) have recently reviewed potential survey methods and concluded that Food Frequency Questionnaires (FFQ) and FRAT might be useful to track population coverage of the intervention and Household Consumption and Expenditures Surveys (HCES) are useful to identify potential food vehicles and to estimate coverage and the potential impact of a mass fortification program. Each of these methods has strengths and weaknesses which depend on the context and objective of the survey. Thus, the method selection must be based on available resources and the data needed for the program.

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