Improving the efficiency of micronutrient intervention planning: a case study of vitamin A intervention programs in Cameroon. Stephen A. Vosti and Kenneth H. Brown, eds. Food and Nutrition Bulletin, 2015; 36 (Suppl 3)

Introduction

The global health and development communities have been devoting greater attention to nutrition in the past decade, as evidenced by initiatives such as the Scaling Up Nutrition (SUN) movement, in which countries commit to increased investments and action in nutrition. However, with a variety of programmatic options available to address micronutrient deficiencies, it may not be feasible or appropriate for countries to implement multiple programs in all regions, indefinitely. Ideally programs should only reach individuals or sub-populations who are at nutritional risk or who have proven nutritional deficiencies (rather than aiming to cover the entire population), because delivering additional nutrition to individuals with adequate nutritional status wastes precious resources and, potentially, contributes to risk of excessive intakes. However, targeting specific sub-populations using some micronutrient delivery platforms may not be effective or cost-effective. Few tools are available for policymakers to craft coherent national strategies that will-effectively address MN deficiencies of at-risk populations.

This issue of NNA describes a series of papers that were published as a Supplement to the Food and Nutrition Bulletin in September, 2015. The papers describe the first set of results of a project which aims to develop and apply a "bio-economic" optimization model to improve the cost-effectiveness (efficiency) of micronutrient intervention programs. In the first paper, Brown et al. (1) present the rationale for applying an optimization model to micronutrient program planning and provide context for the selection of vitamin A (VA) programs in Cameroon as a case study. The subsequent papers include detailed descriptions of the methods used for estimating the nutritional benefits (2) and the costs (3) of micronutrient interventions. Finally, Vosti et al. (4) present the methods for developing the optimization model and describe the costs and benefits of "business as usual" and "optimized" micronutrient program scenarios for VA programs for children in Cameroon.

Methods

The six VA interventions considered in the modeling process were: biannual distribution during Child Health Days (CHD) of high-potency vitamin A supplements (VAS), deworming tablets (considered to increase VA absorption), and a 60 day supply of VA-containing micronutrient powders, industrial fortification of refined cooking oil and bouillon cubes, and bio-fortification of maize.

The nutritional benefits of VA interventions were estimated by modeling of dietary intake data from 24-hour dietary recalls conducted in a nationally representative sample of children in Cameroon (2). The authors considered several definitions of nutritional benefits: 1) reach (proportion of the population who receive one or more interventions), 2) coverage (proportion of the population who are deficient and receive one or more interventions), and 3) effective coverage (proportion of the population who have inadequate intake, but achieve adequate intake due to one or more interventions). Benefits were estimated separately for each of 3 macro-regions: North (3 northern regions of Cameroon), South (remaining 7 regions of Cameroon), and Cities (Yaoundé and Douala, the two major urban areas of Cameroon). Population micronutrient status in the survey was also measured using biomarkers, but the modeling focused on dietary intake (which was correlated with biomarkers for vitamin A).

Information on the costs and activities of programs already in place in Cameroon (VAS, deworming, and oil fortification) were obtained from budgets and expert guidance from implementing organizations, including Helen Keller International and UNICEF. Costs of candidate interventions not yet implemented in Cameroon were estimated by gathering information on program costs from Cameroon and other countries and through expert interviews and modified budgets.

The benefits (number of children effectively covered) and costs of all possible combinations of interventions, in the three macro-regions over 10 years, were introduced into the economic optimization model, a mathematical (mixed-integer linear programming) tool which selects the most cost-effective combination of interventions for each macro-region and by year, using a 10-year planning horizon.

The authors first defined a reference "business-as-usual" (BAU) scenario as implementation of biannual VAS and deworming, and large-scale refined oil fortification in all three regions of Cameroon (the current mix of intervention programs) over 10 years. The optimization model, with its 6 candidate interventions, was then used to find the lowest-cost combination of interventions that generated the same number of effectively covered children (at national level) as the BAU case.

Results and Conclusions:

For most single interventions and in most regions, estimated program reach was greater than 50%, but estimates of coverage and, in particular, effective coverage were substantially lower (maximum of 40%). Regional variation was observed in the prevalence of inadequate intakes, effective coverage of various VA interventions and combinations of interventions, and intervention costs. Additionally, costs of several programs varied over time; in particular, fortification and biofortification programs require large initial investments, but face lower operational costs later on.

The BAU scenario (VAS, deworming, fortified oil) was estimated to effectively cover ~12.9 million child-years over 10 years at a total cost of ~US$37 million, or a cost per child-year effectively-covered of US$2.93. The optimized program scenario included the following interventions: fortification of cooking oil and bouillon cube at the national level for all 10 years (including 3 years to start up the bouillon cube program), distribution of VAS and deworming tablets in all 3 regions for Year 1, and distribution of VAS and deworming tablets only in the North region (where VA intakes were low and the cost per child for VAS distribution was relatively low) for Years 2-10. Micronutrient powder distribution through CHD and bio-fortified maize were not selected by the model as part of the optimized program scenario. The optimized scenario reduced the costs of effectively covering the same number of children as the BAU scenario by ~43%. In particular, at a total costs of ~US$21 million, ~12.9 million child-years could be effectively covered by the optimized mix of interventions. This is equivalent to US$1.63 per child-year of effective coverage.

Program and Policy Implications:

The results of the optimization modeling suggest that reallocating programs by geographical area can increase the efficiency of micronutrient interventions (cost per child effectively covered). In particular, in this example of Cameroon, focusing CHDs on the North region only and adding bouillon cubes as a second fortified vehicle allows for significant cost savings while maintaining the number of children effectively covered at the same level.

The large differences between reach, coverage, and effective coverage suggest that many nutrition programs are delivered to individuals who are not deficient (resulting in waste of resources) and/or do not deliver sufficient VA to allow the individual to achieve dietary adequacy (suggesting that the program would not achieve the intended health benefit).

The authors of a related commentary piece (5) praise the utility and timeliness of the approach, but note that the work should be expanded to include other micronutrients and nutrition issues. Moreover, in practice decisions may be made based on a number of competing priorities, including political considerations, equity concerns (eg, by investing highly in one region), and institutional relationships. So optimization results are just one of several factors to be considered in formulating policy decisions.

The costs of the data collection (~US$900,000) were minor in comparison to the total saved over 10 years (~US$16.5 million) through a more efficient combination of VA programs. Thus, although quality data collection requires a large initial investment, the investment may "pay for itself" in the form of cost savings (or greater effective coverage of interventions) generated by implementing programs more efficiently.

NNA Editor's Comments*:

The present NNA summarizes five articles presenting the rationale, methods and results of a bio-economic model aiming to improve the efficiency and cost-effectiveness of VA intervention programs targeting young children in Cameroon. First, the authors challenge the common approach of monitoring and evaluation of intervention programs, which typically tends to assess the reach of one or more interventions. Instead they introduce the concept of *coverage* (proportion of the population who are deficient and receive one or more interventions), and more importantly *effective coverage* (proportion of the population who have inadequate intake but achieve adequate intake due to one or more interventions).

The authors used VA status and dietary VA intake data obtained during a well-designed national nutrition survey (6,7) and cost estimates derived from program implementation cost data (when available) and stakeholder interviews (for programs not currently implemented in Cameroon). The findings of the bio-economic model identify the least-costly combination of interventions over space and time that achieve the same results in terms of effective coverage as the BAU programs, but at much lower cost. This modeling approach, which explores new combinations of candidate interventions, may help focus limited program resources. Besides applying the model to other micronutrients and other nutrition and health interventions, it will be important to verify its predictions in regard to effective coverage, nutritional benefits and costs.

Among the VA interventions considered in the bio-economic model, changes to biannual VAS intervention programs require particularly careful consideration because high-dose VAS is a child survival intervention that provides a 6 month protective effect against under five mortality. High-dose VAS does not necessarily result in improved vitamin A status, and vitamin A deficiency may remain high even, in settings with good VAS coverage. Therefore, it is recommended to consider suspending biannual VAS distribution only after intake of micronutrient rich foods (e.g. vitamin A rich foods or vitamin A fortified foods) is consistently and sustainably improved, with demonstrated improvements in population micronutrient status. Any changes to VA intervention programs that may be considered in Cameroon or other countries have to be accompanied by thorough monitoring and evaluation using indicators of vitamin A status and child health and wellbeing.

*These comments have been added by the editorial team and are not part of the cited publication.

References:

1. Brown KH, Engle-Stone R, Kagin J, Rettig E, Vosti SA. Use of optimization modeling for selecting national micronutrient intervention strategies: an example based on programs potentially available for control of vitamin A deficiency in Cameroon. Food Nutr Bull. 2015; 36 (3S): S141-S148.
2. Engle-Stone R, Nankap M, Ndjebayi AO, Vosti SA, Brown KH. Estimating the effects of different intervention strategies on the adequacy of vitamin A intake of women and young children in Cameroon. Food Nutr Bull. 2015; 36 (3S): S149-S171.
3. Kagin J, Vosti S, Engle-Stone R, Rettig E, Brown KH, Nankap M, Ndjebayi AO. Measuring the costs of vitamin A interventions: Institutional, spatial, and temporal issues in the context of Cameroon. Food Nutr Bull. 2015; 36 (3S): S172-S193.
4. Vosti SA, Kagin J, Engle-Stone R, Brown KH. An economic optimization model for improving the efficiency of micronutrient interventions: addressing vitamin A deficiencies among young children in Cameroon. Food Nutr Bull. 2015; 36 (3S): S193-S207.
5. Baker SK, Fracassi P, Kupka R, Neufeld L, Shekar M. Know your deficiencies, know your response, know your costs: A commentary on micronutrient program optimization modeling. Food Nutr Bull. 2015; 36 (3S): S208-S210.
6. Helen Keller International Cameroun, Ministe`re de la Sante Publique du Cameroun, UNICEF. National survey of micronutrient status and consumption of fortifiable foods. Yaounde´ (Cameroon): Helen Keller International Cameroon; 2011.
7. Engle-Stone R, Ndjebayi AO, Nankap M, Brown KH. Consumption of potentially fortifiable foods by women and young children varies by ecological zone and socio-economic status in Cameroon. J Nutr. 2012;142:555–65.

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