Cost-Effectiveness of Wheat Flour Fortification with Micronutrients for Reducing Neural Tube Defects and Maternal Anemia in Yaoundé and Douala, Cameroon

Brenda Wu[1], Arram Noshirvan[1], Hanqi Luo[2], Justin Kagin[3], Steve Vosti[3], Reina Engle-Stone[2]

[1]University of California Davis, School of Medicine, [2]University of California Davis, Department of Nutrition, [3]University of California Davis, Agricultural and Resource Economics

Background

- 59% of women of reproductive age (WRA) in Cameroon had inadequate folate intake in 2009[2].
- Folate deficiency increases the risk of neural tube defects (NTD), specifically spina bifida and anencephaly.
- The prevalence of NTD in Cameroon from 1997-2006 was four times that of the US at 1.99/1000 cases per year [1].
- 18% of WRA in Cameroon had iron deficiency anemia (IDA)[2].
- Mandatory wheat flour fortification with micronutrients – including iron and folic acid – was implemented in Cameroon in 2011.
- Food fortification programs are considered cost-effective; most cost-effectiveness estimates rely either on cost-per-individual reached or biological impact.

Figure 1: Cameroon's urban centers, Yaoundé and Douala

Objective

Estimate the cost-effectiveness of wheat flour fortification with iron and folic acid for reducing cases of NTD and maternal anemia in Cameroon.

Methods

- Program costs, pre/post intervention numbers of NTD cases, and prevalence of IDA among WRA were estimated and projected over a 13-year period from 2009-2021.
- IDA prevalence was measured using pre/post intervention micronutrient surveys and projected forward[2].
- Post-fortification NTD cases were estimated using proposed risk and benefit model[4].
- Post-fortification effects on IDA were observed in 2012 and the same magnitude of effect is assumed to have been sustained thereafter.

Methods, cont.

Effects of Fortification Program:

13-year fortification program costs (USD)[5]	$2,439,300
Pre-fortification rate of NTD[1]	1.99/1000 live births
Projected number of NTD cases averted over 13 years[4]	554
Pre-fortification prevalence of IDA[2]	18% WRA*
Post-fortification prevalence of IDA[2]	13% WRA*

Table 1: Costs and impact of wheat flour fortification in Yaoundé and Douala, Cameroon
**WRA=women of reproductive age. Population data from LiST (Lives Saved Tool) used to calculate cases of iron deficiency anemia averted.*

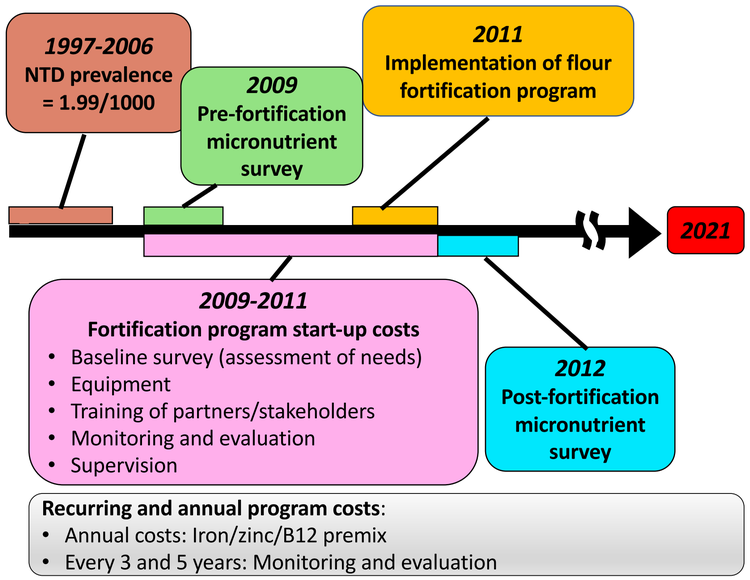

Figure 2: Cameroon food fortification program timeline

Summary Results of 13-Year Program

	Cases averted	Estimated cost per case averted (USD)
NTD	**554**	**$4,400**
Iron Deficiency Anemia in WRA	**688,368** case-years	**$3.54**

Table 2: Cost-effectiveness of reducing NTD and iron deficiency anemia incidence over 13 year period

Conclusions

- Wheat flour fortification programs involving iron and folic acid are effective in reducing NTD and IDA.
- Program cost is significant, ~ $188,000/year for this 13-year program, but the program can be cost-effective:
  - $4,400/case NTD averted
  - $3.54/case iron deficiency anemia averted amongst WRA

Discussion

- Similar analyses estimate the cost/case NTD averted to be $1,200 in Chile ($11,000/infant death averted) using observed changes[6]; and cost/case IDA averted to be $1.33 using projected changes[7].
- Hence, local circumstances (prevalence rates, program effectiveness, etc.) can greatly influence program efficiency.
- The cost of preventing NTD and IDA this way are likely to outweigh social and economic costs of these conditions.
- Calculating quality- and disability-adjusted life years (QALY and DALY) offers an alternative interpretation of fortification cost-effectiveness on reducing disease burden.
- A post-fortification study of NTD prevalence in Cameroon needs to be performed to assess the accuracy of our results.

Contact Information

Brenda Wu, MD Candidate; btwu@ucdavis.edu
Arram Noshirvan, MD Candidate; anoshirvan@ucdavis.edu

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