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

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Background

- 59% of women of reproductive age (WRA) in Cameroon had inadequate folic acid intake in 2009.
- 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.
- 18% of WRA in Cameroon had iron deficiency anemia (IDA).
- 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.

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.
- Post-fortification NTD cases were estimated using proposed risk and benefit model.
- 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)
  - Pre-fortification rate of NTD = 1.99/1000 live births
  - Projected number of NTD cases averted over 13 years
  - Pre-fortification prevalence of IDA
  - Post-fortification prevalence of IDA

<table>
<thead>
<tr>
<th>Year</th>
<th>NTD prevalence</th>
<th>Fortification survey</th>
<th>Post-fortification survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-2006</td>
<td>1.99/1000</td>
<td>2009 Pre-fortification micronutrient survey</td>
<td>2011 Implementation of flour fortification program</td>
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<tr>
<td>2009-2011</td>
<td></td>
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<tr>
<td>2012</td>
<td>Post-fortification micronutrient survey</td>
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</tbody>
</table>

1997-2006 NTD prevalence = 1.99/1000

Recurring and annual program costs:
- Annual costs: Iron/zinc/B12 premix
- Every 3 and 5 years: Monitoring and evaluation

Summary Results of 13-Year Program

<table>
<thead>
<tr>
<th>Cases averted</th>
<th>Estimated cost per case averted (USD)</th>
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<tbody>
<tr>
<td>NTD</td>
<td>554</td>
</tr>
<tr>
<td>Iron Deficiency Anemia in WRA</td>
<td>688,368</td>
</tr>
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<td></td>
<td>3.54/case iron deficiency anemia averted amongst WRA</td>
</tr>
</tbody>
</table>

Conclusions

- Similar analyses estimate the cost/case NTD averted to be $1,200 in Chile ($11,000/infant death averted) using observed changes; and cost/case IDA averted to be $1.33 using projected changes.
- 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.

Discussion

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References