Complementary Infant Foods in Developing Countries: Economic Diagnosis and Institutional Remedies for Market Failure

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As you know...

Much of the world’s undernutrition is experienced by infants between 3 and 24 months.

Mean z scores relative to WHO standards across 54 DHS/MCIS studies, by age (1-59 mo.)

What can explain the sudden and severe shortfalls during this period?

Many factors could cause this pattern of onset and duration

• For example:
  – Exposure to water-borne pathogens, air pollution etc.
  – Expression of gestational deficits

• ...and also inadequate total nutrient intake:

<table>
<thead>
<tr>
<th>Mean intake as a percentage of WHO recommended needs, by age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Energy (kcal)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Protein (g)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Calcium (mg)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Iron (mg)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Vitamin A (IU)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Vitamin B1 (mg)</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Vitamin B2 (mg)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Niacin (mg)</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Note: Data shown are mean values for a sample of 400 children in Eastern Ghana.
Why might sufficient nutrient intake be difficult to achieve?

• Total quantity is small and inexpensive relative to family budget
  ...but nutrient density and digestibility must be higher than family diet
• Complementary foods have high-cost ingredients and processing
  – Starchy staple must be fortified with protein, fats and micronutrients
  – Processing at home using traditional methods is labor intensive
  – Availability from artisanal or industrial manufacturers is limited
• Since *Incaparina* in the 1960s, donors have funded startups to produce and sell high-quality complementary foods at lowest possible cost
  – Many different recipes and production methods are possible
  – Locally-adapted products are readily acceptable, have proven efficacy, and cost much less than either home production or imports from industrialized countries
• So what products do we see today in African markets?
Low-income country markets are still dominated by Nestle’s Cerelac

Accra, Ghana (2010)
There are *many* alternatives:

Generics, e.g. “weanimix” in Ghana: Many small-scale local start-ups, e.g. these from around Africa:

Other branded multinationals, typically sold in supermarkets and pharmacies:
Here is the market I studied first:

**All infant foods for sale in Bamako, Mali (1999)**

<table>
<thead>
<tr>
<th>Brand name</th>
<th>Packaging</th>
<th>Retail Prices (FCFA/unit)*</th>
<th>Mkt.</th>
<th>Stores</th>
<th>Pharmacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Céréal (wheat)</td>
<td>400 g. can</td>
<td>1400</td>
<td>1500</td>
<td>1615</td>
<td></td>
</tr>
<tr>
<td>Céréal (wheat)</td>
<td>200 g. box</td>
<td>600</td>
<td>850</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Céréal (rice)</td>
<td>400 g. can</td>
<td>1600</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Céréal (wheat/Banana)</td>
<td>400 g. can</td>
<td>1750</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Céréal (wheat +3 fruits)</td>
<td>400 g. can</td>
<td></td>
<td></td>
<td></td>
<td>2240</td>
</tr>
<tr>
<td>Blédilac** (wheat)</td>
<td>250 g. can</td>
<td>1270</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blédina** lactée fruits</td>
<td>250 g. box</td>
<td></td>
<td></td>
<td></td>
<td>1830</td>
</tr>
<tr>
<td>Farinor** (maize/soy)</td>
<td>400 g. box</td>
<td></td>
<td></td>
<td>1690</td>
<td>1750</td>
</tr>
<tr>
<td>UCODAL (e.g. Sinba)</td>
<td>200 g. bag</td>
<td></td>
<td></td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>MISOLA</td>
<td>500 g. bag</td>
<td></td>
<td></td>
<td></td>
<td>300</td>
</tr>
</tbody>
</table>

All branded imports charged much more than local products, which could be just as nutritious.

...but despite low cost had very few sales, except to institutional buyers.

Of the branded imports, only Céréalac was widely available.

Here is the full range of what I bought from diverse vendors around Accra in 2010
And here’s a shop well-stocked with local complementary foods in Kampala, 2011

But low-income country markets really are still dominated by Nestle’s Cerelac
What might explain the continued dominance of an expensive brand, when cheaper substitutes exist?

- Advertising and consumer misunderstanding
  - Plausible for some times and places, but why so consistent and long-lived?

- Advertising and consumer status
  - Allows richer people to signal wealth, but can’t explain private use by the poor

- Advertising and consumer confidence
  - George Akerlof won Nobel for this: asymmetric information between buyers & sellers
    - Initial example was used cars (“The Market for Lemons”, *Q.J.Econ.* 1971)
    - If buyers’ can’t see qualities that the seller controls, they won’t buy “generics” at any price
    - Buyers will trust only brands supported by relationships, advertising etc., despite high prices
  - Infant food buyers cannot detect nutritional value of even high-quality foods
    - Quality is masked by confounding influences on child appetite, health and growth
    - Taste, etc. are known soon after purchase, but
    - Nutrient density may never become visible to the buyer
  - For such “credence goods”, trusted brands can charge high premiums forever
    - Other examples include specialized legal or medical services, etc.

=> The only remedy is 3rd party quality testing and certification
How do we know why consumers choose Cerelac?
Evidence from a market test in Bamako*

The question is,

Why would women buy this?
*Cerelac (400 g. cans)
1617 FCFA = $2.49

Instead of this?
*Sinba (2 x 200 g. bags)
2 x 200 FCFA = $0.61

Or just raw ingredients
to mix at home...

How do we know why consumers choose Cerelac?
Evidence from a market test in Bamako

A “framed field experiment”
with 240 low-income mothers in peri-urban markets

We gave participants a can of Cerelac, then offered to swap for increasing quantities of other infant foods.
The experiment allowed people to reveal their preferences one step at a time

*We asked them to compare:

- The well-known brand *(Cerelac, in 400 g. metal canister)*
- A sealed, “certified” mix *(Certilac, in 400 g. plastic bag)*
- An open, unidentified mix *(Anonymous, in open bags)*
- Raw materials in fixed proportions *(Ingredients, in open bags)*

*the only difference is:*

- **brand & packaging**
- **certification**
- **processing**
These were real choices; they took home one of their actual choices.
On average, the mothers in our experiment cared about product certification almost as much as processing.

**Mean willingness to pay for product:**

- Certilac: 1160 FCFA
- Generic: 705 FCFA
- Ingredients: 120 FCFA

**Implied willingness to pay for the difference:**

- 455 FCFA for certification ($0.70 per 400 g. bag)
- 585 FCFA for processing ($0.90 per 400 g. bag)
We also estimated the cost of certification

- We found that:
  - introducing certification would be worth at least $20 per year per child needing infant foods (between 6 mo. and 2 yrs. of age)
  - this amounts to a value of about $1 million per year for the city of Bamako as a whole

- This is money that they’re still not getting
  - since they don’t yet have a certification system
Many years later in 2010, DFID funded a scoping study to revive the question for Ghana...

• This time, we could address two other questions:
  – Are the locally produced infant foods actually available?
  – Are the locally produced infant foods actually high quality?

• Our economic theory has clear predictions:
  – After start-up the products will be rarely available, because buyers will be skeptical about quality
  – and skepticism will be justified, because quality will be low and variable since the sellers lack motivation to keep it high
Question #1: Are local infant foods as available as Cerelac?

• This is a difficult question...
• To answer in terms of Greater Accra as a whole, we divided the city into quadrants defined like this:
  http://maps.google.com/maps?
  &ll=5.558740,-.253961
  &spn=0.0025,0.0025
  &pw=2

• Then randomly generated latitude and longitude locations and visited each one until we found over 200 shops to judge...
Are local infant foods as available as Cerelac?

Question #2: Are local infant foods as good as Cerelac?

- To answer, we took 14 samples and sent them without labels to a commercial lab in Omaha.
- We did proximate analysis for macronutrients, plus iron & zinc, and also phosphate as an indicator of phytic acid.
Are local infant foods as good as Cerelac?

## Nutrient Density of Sampled Foods in Ghana (% of Cerelac)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Calories (kCal/100g)</th>
<th>Macronutrients (g/100 g)</th>
<th>Minerals (mg/100g)</th>
<th>Ash (g/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Protein</td>
<td>Fat</td>
<td>Carb.</td>
</tr>
<tr>
<td>5</td>
<td>101%</td>
<td>119%</td>
<td>105%</td>
<td>95%</td>
</tr>
<tr>
<td>8</td>
<td>100%</td>
<td>129%</td>
<td>103%</td>
<td>93%</td>
</tr>
<tr>
<td>Cerelac</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>7</td>
<td>99%</td>
<td>163%</td>
<td>97%</td>
<td>86%</td>
</tr>
<tr>
<td>2</td>
<td>97%</td>
<td>108%</td>
<td>77%</td>
<td>104%</td>
</tr>
<tr>
<td>9</td>
<td>97%</td>
<td>81%</td>
<td>78%</td>
<td>109%</td>
</tr>
<tr>
<td>6</td>
<td>97%</td>
<td>109%</td>
<td>77%</td>
<td>104%</td>
</tr>
<tr>
<td>12</td>
<td>97%</td>
<td>76%</td>
<td>76%</td>
<td>110%</td>
</tr>
<tr>
<td>1</td>
<td>97%</td>
<td>110%</td>
<td>75%</td>
<td>103%</td>
</tr>
<tr>
<td>14</td>
<td>95%</td>
<td>186%</td>
<td>81%</td>
<td>82%</td>
</tr>
<tr>
<td>3</td>
<td>94%</td>
<td>48%</td>
<td>53%</td>
<td>122%</td>
</tr>
<tr>
<td>4</td>
<td>94%</td>
<td>131%</td>
<td>59%</td>
<td>101%</td>
</tr>
<tr>
<td>10</td>
<td>93%</td>
<td>92%</td>
<td>48%</td>
<td>113%</td>
</tr>
<tr>
<td>13</td>
<td>92%</td>
<td>77%</td>
<td>38%</td>
<td>119%</td>
</tr>
</tbody>
</table>

We had visited several of these manufacturers, and were surprised:

This producer’s mix had similar nutrient density to Cerelac

This product had a much lower fat content
Products of very different density were sold to us by the same vendor, anonymously.

More nutrient-dense than Cerelac (sample #5)

Less nutrient-dense than Cerelac (sample #4)
Four of the six had lower fat density than *any* of the 14 Ghana samples.

Nutrient Density of Ugandan Samples and Reference Foods (% of Cerelac)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Calories (kCal/100g)</th>
<th>Macronutrients (g/100 g)</th>
<th>Minerals (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Protein</td>
<td>Fat</td>
</tr>
<tr>
<td>1</td>
<td>87%</td>
<td>107%</td>
<td>39%</td>
</tr>
<tr>
<td>2</td>
<td>85%</td>
<td>79%</td>
<td>25%</td>
</tr>
<tr>
<td>3</td>
<td>88%</td>
<td>92%</td>
<td>56%</td>
</tr>
<tr>
<td>4</td>
<td>83%</td>
<td>94%</td>
<td>25%</td>
</tr>
<tr>
<td>5</td>
<td>87%</td>
<td>103%</td>
<td>28%</td>
</tr>
<tr>
<td>6</td>
<td>88%</td>
<td>80%</td>
<td>26%</td>
</tr>
<tr>
<td>Cerelac</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>CSB13</td>
<td>80%</td>
<td>101%</td>
<td>63%</td>
</tr>
<tr>
<td>CSB++</td>
<td>82%</td>
<td>97%</td>
<td>70%</td>
</tr>
</tbody>
</table>

Note: Reference values are from labels of Cerelac and two CSB food-aid products. Source: W.A. Masters, “Notes on nutrient density of infant foods in Kampala, Uganda.” 18 June 2011.
Actual nutrient densities differed widely from products’ own labels

Nutrient Density of Ugandan Samples (% of labeled values)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Calories (kCal/100g)</th>
<th>Macronutrients (g/100 g)</th>
<th>Minerals (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Protein</td>
<td>Fat</td>
</tr>
<tr>
<td>1</td>
<td>105%</td>
<td>120%</td>
<td>89%</td>
</tr>
<tr>
<td>2</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>3</td>
<td>106%</td>
<td>104%</td>
<td>128%</td>
</tr>
<tr>
<td>4</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>5</td>
<td>100%</td>
<td>67%</td>
<td>95%</td>
</tr>
<tr>
<td>6</td>
<td>97%</td>
<td>116%</td>
<td>na</td>
</tr>
</tbody>
</table>

Note: Nutrients not labeled are marked “na”.
So...
Locally produced foods *could* be widely available at much lower cost and similar nutrient density as Cerelac

- ...and yet they are not.
  - They are rarely available, and when found their quality is variable
  - Certification could help them be more widely sold with higher quality
- There is no demand for quality certification.
  - Better-off buyers can afford enough Cerelac, since quantities are small
  - Potential beneficiaries don’t know it would help them
- So the market is stuck!
  - This is a classic economics problem
  - The remedy is clear but difficult to sell politically
  - Historically, quality assurance has been introduced after scandals to avoid harm, or to introduce new attributes
Our current project: What’s for sale, and is it any good?

- A global catalog of marketed complementary foods:
  - Step 1: A complete global catalog of what’s marketed in 2013
    - All products found by our collaborators around the world
    - Criterion: marketed as complement to breastmilk, for >6 months of age
    - Typical product: a fortified composite flour

  e.g. Mauritania
  [Image of a package labeled "céréAmine"]

  Tanzania
  [Image of a package labeled "misola Happy Mills"]

  Cameroon
  [Image of a package labeled "Tanty Reine"]
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    • All products found by our collaborators around the world
    • Criterion: marketed as complement to breastmilk, for >6 months of age
    • Typical product: a fortified composite flour
  – Step 2: Random sampling to test for nutrient profiles
    • A sample of 20 countries, 5 products from each country
    • Test for protein, fats, calories, iron, zinc, and phosphorus (for phytates)
  – Step 3: Correlate measured quality with potential determinants
    • Country, market and governance factors (income, city size, policies)
    • Manufacturer and retailer influences (foreign/local, formal/informal etc.)
• Results could demonstrate need for new quality assurance systems
  – both plant inspections and product sampling with nutrient testing
  – 3rd-party label, e.g. “INQAP—OK for babies over 6 months”
  – Local advertising about the use and expiration of these labels by color
Eventually, maybe…
An RCT for quality certification

1) Establish an Infant Nutrition Quality Assurance Project (INQAP)
2) Recruit manufacturers to participate, and issue time limited INQAP-OK stickers
3) Roll out billboards and demonstrations at randomly-chosen market locations
4) Use household surveys and growth monitoring to track food purchases & infant bodyweights
5) Use child’s age at the time of market advertisements to identify causal effect of certification on growth
...and some conclusions

• An economics approach can offer:
  – a surprising diagnosis for puzzling behavior
  – a promising remedy to improve outcomes

• This kind of research typically:
  – is based on the biological systems that cause health outcomes
  – uses economics to explain behavior & design the intervention
    • individuals are already doing the best they can;
    • interventions aim to change the equilibrium between people

• Quality assurance for infant foods is just one example
  • many other institutional remedies for market failures can be diagnosed using economics!