Mandatory fortification: Evaluating Risks and Ethical Considerations

Mark Lawrence
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Introduction

Food fortification:
‘…the addition of one or more essential nutrients to a food whether or not it is normally contained in the food for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients’ [Codex]

Mandatory food fortification:
Governments set food law that obliges food manufacturers to fortify particular foods or categories of foods with specified nutrients
An example from Australia

Standard 2.1.1: Cereals and cereal products
Wheat flour for making bread must contain –
– (a) no less than 2 mg/kg and no more than 3 mg/kg of folic acid; and
– (b) no less than 6.4 mg/kg of thiamin.
[Does not apply to wheat flour for making organic bread.]
– Iodised salt must be used for making bread where salt would otherwise be used
[Does not apply to:
(a) bread which is represented as organic;
(b) the addition of salt (eg rock salt) to the surface of bread; or
(c) the addition of other food containing salt during bread making.]

Standard 2.10.2 sets iodised salt composition. Target is 45 mg I/kg salt.

The contested nature of food fortification:
Public health benefits, risks and ethics?

- Codex
  - “There should be a demonstrated need for increasing the intake of an essential nutrient in one or more population groups.” [Codex principles for the addition of nutrients to foods, 1991]

- FSANZ
  - Protecting public health and safety is the primary objective in setting food standards is the ‘Protection of public health and safety’

How do we specify and measure “demonstrated need”?
What is meant by “protection of public health and safety”?
How balance public health benefits and risks?
How are ethical considerations taken into account?
Case study 1: Universal salt iodization

- The representative case for mandatory food fortification as a policy solution for policy problems that arise when the food supply is unable to provide sufficient nutrients for health

Background

- Iodine and health
  - Most iodine is concentrated in the thyroid gland where it is used in the synthesis of thyroxine and triiodothyronine
  - These thyroid hormones help regulate metabolic processes associated with growth, maturation and thermogenesis

- Iodine RDIs
  - Adults = 150 µg/day
  - Pregnancy = 220 µg/day
  - Lactation = 270 µg/day
  - Iodine UL = 1,100 µg/day (adults)
  - WHO recommends 90 – 250µg/day

- Dietary sources
  - Richest dietary sources are milk, eggs and foods of marine origin
The policy problem

Micronutrient malnutrition
There is a gradient of disease severity in response to levels of iodine deficiency
- The developing foetus, babies and young children are at greatest risk.
- The most damaging effect of iodine deficiency is on the developing brain, especially during pregnancy and in infancy.
- Mild to moderate iodine deficiency can result in learning difficulties and affect development of motor skills and hearing. These adverse effects are irreversible.
- In adults, prolonged iodine deficiency, even mild deficiency, increases risk of thyroid disorders in later life.

Cause of the policy problem

- Iodide is widely distributed in the earth’s soils and oceans.
- However, it is soluble and over time is readily leached from soils
- Food supply unable to provide sufficient nutrients
- LMICs and HICs affected
- Geographical and seasonal variation
### USI: Public health benefits, risks and ethical considerations

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<tr>
<th>Public health benefits</th>
<th>Public health risks</th>
<th>Ethical considerations</th>
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<tr>
<td>Highly effective</td>
<td>Risk of excessive consumption</td>
<td>Necessary</td>
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<tr>
<td>Equitable</td>
<td>Risk of confusion in message about salt consumption</td>
<td>Proportional</td>
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### Case study 2: Mandatory flour fortification with folic acid

- The representative case for mandatory food fortification as a policy solution for policy problems that arise when certain individuals have nutrient requirements higher than reference standards
Background

• Folate and health
  – Folate is a water-soluble B-group vitamin
  – One C substrate in nucleic acid and amino acid metabolism
  – Homocysteine $\rightarrow$ methionine

• Folate RDIs
  – Adults = 400 $\mu$g/day DFEs
  – Pregnancy = 600 $\mu$g/day DFEs
  – Lactation = 500 $\mu$g/day DFEs

• Dietary sources
  – Green leafy vegetables
  – Legumes
  – Citrus fruits and juices

The policy problem

Compelling epidemiological evidence that a raised folic acid intake during the periconceptional period reduces the risk of a neural tube defect (NTD)-affected pregnancy

NTD Severity
  – Significant emotional, social, financial cost

NTD Prevalence
  – Varies across the world (0.5-6/1000 births)

Folic acid reference values
  – WHO guidelines on levels of folic acid fortification for wheat and maize flour = 1.0 - 5.0 ppm
  – All adults = UL of 1000$\mu$g folic acid/day
Cause of the policy problem

- Precise cause(s) remains unknown, certain individuals have nutrient requirements higher than reference standards
- Multifactorial and presumed to involve genetic polymorphisms affecting nutrient metabolism in certain at-risk individuals
- Women who are homozygous for the T allele of the C677T polymorphism of the gene encoding the folate dependent enzyme 5,10 methylene-tetrahydrofolate reductase have a raised requirement for folate and are at increased risk of experiencing an NTD-affected pregnancy

Uncertainties and complicating factors

- Folic acid’s protective mechanism is unknown
- Optimal folic acid dosage not known
- Neural tube closed by ~28th day post-conception
- Small window of opportunity to reduce risk, ie the periconceptional period (1m pre- to 3 m post-conception)
- Can’t identify at-risk women (unless have previously experienced a NTD-affected pregnancy)
- Many women may not be aware that they are pregnant during this period
Mandatory folic acid fortification

Large number of potential risks and benefits because of folate’s role in critical metabolic pathways, eg DNA synthesis and repair

“But folate being involved in so many of life’s fundamental processes not only leads to its possibilities as a panacea but also to the prospect that ‘messing around with folate’ could do extensive harm” (Smith, 2004)

A selection of benefits and risks of raised folic acid status throughout the lifecycle

- **Pregnancy:** ↓ NTDs; ↑ multiple births (Haggarty et al, 2006).
- **Newborns:** ↑ atopic dermatitis (Kiefte-de Jong et al, 2012)
- **Childhood:** ↑ asthma (Whitrow et al, 2009)
- **Mid-life:** Lingering concerns about promoting the progression of colorectal cancer (Mason, 2011).
- **Older adults:** ↓ cognitive decline (Walker et al, 2012); ↑ cognitive decline (Morrris et al, 2007)
- **Older adults:** Masking the clinical symptoms of vitamin B12 deficiency and subsequent risk of irreversible nerve damage (Israels and Wilkinson, 1949)
- **Lifespan:** Long term consequences of raised levels of unmetabolised serum folic acid?

In those countries with population-wide folate deficiency it will increase folic acid intake to protect public health
Ethical considerations

“Adding a biologically active ingredient to the food supply of 300 million people is a very weighty issue. You can’t experiment on the American people”

[Personal communication, 26 July 2012, Professor David Kessler, former Commissioner of the US Food and Drug Administration].

Almost 1 million Australians would be exposed to extra folic acid for each NTD case prevented (9% of 2-3yo >UL)

“Even applying the lower cost estimate, mandatory fortification appears less cost effective than other options (combination of promotion and voluntary fortification)”

[Segal et al, 2007]

Voluntary folic acid fortification

Risks
- In Ireland voluntary folic acid fortification may be resulting in excessive exposure in certain population groups (Boilson, 2012)
- The food industry is responsible for implementation so it is difficult to control the timing, level and extent of fortification

Benefits
- Expanding the regulatory provisions to enable a greater number of food products to be fortified with folic acid

Ethical considerations
- Increased freedom of choice
Folic acid supplementation

Risks
• Variable effectiveness
  – Lack of sustained investment in promotion activities
  – Dependent on behaviour change and ongoing compliance

Benefits and ethics
• Advantage of delivering directly to target group
• Can deliver a precise minimum dose

Nutrition education

Risks
• Requires a significant change in current dietary behaviours to achieve folic acid intake recommendations
• Low effectiveness
• Low equity

Benefits
• Secondary benefits in promoting a healthy diet

Ethical considerations
• Maintains individuals’ free choice
• Necessary in that it complements alternative policy options
Case study 3: Mandatory milk fortification with vitamin D

• The representative case for mandatory food fortification as a policy solution for policy problems that arise when there is a reduction in exposure to the primary source of a nutrient

Background

• Vitamin D is associated with a range of physiological systems and may have a role in mediating many health outcomes:
  – Intestine and bone
  – Immune system
  – Pancreas and metabolic homeostasis
  – Heart and cardiovascular
  – Muscle
  – Brain

• Vitamin D AIs
  – Adults = 5-15 µg/day
  – Pregnancy and lactation = 5 µg/day
  – Vitamin D UL = 80 µg/day

• Sources
  – Sunlight exposure
  – ‘Natural’ food sources – foods of animal origin and some fungi
  – Supplements and fortified foods
The policy problem

Estimated that 1 billion people worldwide have vitamin D deficiency or insufficiency

Ricketts is re-emerging

“Vitamin D deficiency is the most common medical condition in the world” [Holick, 2010]

Cause of the policy problem

Primary:
- Inadequate sunlight exposure

Secondary:
- Cultural, religious and social customs that require people to cover their bodies extensively
- Urbanisation, crowded cities, air pollution
- Working indoors, residential care
- Migration patterns
### Public health benefits, risks and ethical considerations

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<td>Moderately effective</td>
<td>Low risk of excessive intake</td>
<td>Necessary? (highly coercive)</td>
</tr>
<tr>
<td>Reduces seasonal variation</td>
<td>Does it deflect from additional benefits of fresh air and sunlight?</td>
<td>Many, many uncertainties</td>
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### Uncertainties

- Dispute over the quality and quantity of evidence for vitamin D – health relationships
- Non-consensus on cut-off levels for serum 25(OH)D concentrations to determine deficiency, insufficiency, optimal and excessive status
- Non-consensus on recommended vit D intake levels
- Difficulty in measuring vit D composition of foods
- Opposing public health message to avoid excessive sunlight exposure to reduce melanoma risk
- Lack of investment in alternative policy options
Concluding comments

• Mandatory food fortification can be a powerful technology for public health, however, not all interventions are the same
• All case studies were associated with convincing evidence of a policy problem
• It was less clear if mandatory food fortification was necessarily always the best policy solution
• Concerns about how public health benefits, risks and ethics are (not) specified and measured in policy-making

Four priority policy suggestions

1. Conceptualise the cause of the policy problem to help match the policy solution to the policy problem
   - The case studies indicate that the strongest predictor of public health benefits, risks, and ethical considerations for a prospective policy solution is the alignment of the particular policy option with the underlying cause of the policy problem.
   - Taking causation into account will result in the evaluative frameworks’ assessment of available policy options being more relevant to the problem at hand.
2. Strengthen the evidence and ethical base for ALL policy options

• Reform evidential and ethical evaluative frameworks
  – Currently the rigid evaluative frameworks privilege a reductionist thinking to policy problems, which in turn generally privileges nutrient-based policy ‘solutions’
• Increase research investment into policy alternatives to food fortification (their relative benefits, risks, ethics, etc)
• Adequate and sustained investment in the implementation of all relevant policy options
  – Too often non-fortification policy options are destined for poor evaluation outcomes because of lack of support
• Frequent lack of attention towards ethical considerations

3. Nutrition education

• A complementary strategy to food fortification interventions

• Ethical importance of informing the population about a food fortification intervention
4. Monitoring and evaluation

Need to establish a nutrition information system:
- Baseline (population intake and status)
- Process (compliance, quality control, etc)
- Dietary intake (natural + fortified + supplements = ?)
  - Sufficient
  - Safe
- Health outcome
  – Promoting health
  – Protecting health (How measure what we don’t know?)
  – How differentiate voluntary and mandatory fortification?

Food Fortification
The evidence, ethics, and politics of adding nutrients to food

• Illustrates competing scientific, ethical and political views that can arise in science policy-making

• An evidence-based review of the practice and policy-making theories behind the inclusion of nutrients in staple foods

• Increases understanding of how and why evidence of food and health relationships is being translated into policies that affect what people consume on a daily basis