OPTIMIZING IODINE NUTRITION IN BELGIUM: A SELECTIVE, PROGRESSIVE AND MONITORED APPROACH TO CONTROL IODINE DEFICIENCY

Dr. Stefanie Vandevijvere

Scientific Institute of Public Health, Brussels
Université Libre de Bruxelles, Brussels

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Introduction

<table>
<thead>
<tr>
<th>WHO Indicator</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median UIC general population (µg/L)</td>
<td>100-199</td>
</tr>
<tr>
<td>Proportion of population below 100 µg/L</td>
<td>&lt;50%</td>
</tr>
<tr>
<td>Proportion of population below 50 µg/L</td>
<td>&lt;20%</td>
</tr>
<tr>
<td>Median UIC pregnant women (µg/L)</td>
<td>150-249</td>
</tr>
<tr>
<td>% of households using adequately iodised salt</td>
<td>&gt;90%</td>
</tr>
</tbody>
</table>

TRH: Thyrotropin releasing hormone
TSH: Thyroid stimulating hormone
T3 & T4: Thyroid hormones
UIC: Urinary iodine concentration
Introduction

Assessment of iodine status of the population

- Iodine content in household salt
- Iodine concentration in spot urine samples
- Neonatal thyroid-stimulating hormone concentrations
- Thyroid volume
- Serum thyroglobulin
Introduction

Global iodine status 2011

Still 30% of children iodine deficient

Introduction

First national survey among school-aged children in 1998

Age: 6-12 years
n=2585
Season: autumn
Median UIC: 80 µg/L
<100 µg/L: 66.9%
<50 µg/L: 18.5%
<20 µg/L: 1.4%
Goitre prevalence: 6%

Other non-representative studies:

- **1986-1989**: 3091 subjects 14-77 yrs, median UIC=56 µg/L (Bourdoux P., J Endocrinol Invest 1990)
- **2000**: 90 full term and 65 preterm neonates, median UIC=86 µg/L (Ciardelli R., Eur J Pediatr 2002)
- **2002-2005**: 401 adults 40-60 yrs, multi-ethnic population; median UIC=68 µg/L (Moreno-Reyes R., Eur J Nutr 2011)

Silent iodine prophylaxis
Introduction

SID severe iodine deficiency
MID mild iodine deficiency
UIC urinary iodine concentration

Risk of thyroid disease

Median UIC (µg/L)
Iodine intake (µg/d)

68-80
~80
100
150
199
300
300
600

Brain damage
Endemic goiter

Nodules
Hyperthyroidism
Brain Impairment?

More than adequate
Optimal

Excess

Autoimmune TD
Hypothyroidism

SID severe iodine deficiency
MID mild iodine deficiency
UIC urinary iodine concentration
Objectives

1. To estimate total salt intake in Belgium
2. To develop a salt iodisation program for Belgium
3. To assess iodine status among Belgian school-aged children and their mothers
4. To assess iodine status among Belgian pregnant women
5. To estimate the health care costs due to mild iodine deficiency (MID) in Belgium
6. To evaluate whether small differences in iodine status translate into differences in incidence of thyroid diseases
7. To evaluate the use of neonatal thyroid-stimulating hormone (TSH) concentrations to follow population iodine status in Belgium

To formulate recommendations for policy
1. Estimation of salt intake

- **Study 1**: *Estimation of salt intake using data from the 2004 Belgian adult food consumption survey*
  - Representative sample of the Belgian adult population (*n*=2439); 2 non-consecutive 24-h recalls; sodium concentration from food composition databases
  - Statistical modelling to calculate usual sodium intake

- **Study 2**: *Estimate of salt intake via excretion of sodium in 24-hour urine samples in 2 Belgian regions*
  - Volunteers Ghent (*n*=123)/Liège (*n*=157), 45-65 years old
  - Screening questionnaire, diary, questionnaire on use of salt
  - Exclusion of incomplete urine collections based on creatinine measurement, volume of urine collection and diary
1. Estimation of salt intake

Mean (men) = 3.3 ± 1.2 g/day
Mean (women) = 2.3 ± 0.9 g/day

Bread contributed most to sodium intake in Belgium: 28.4% among men and 25.8% among women.

Only 23% of the population complied with WHO recommendation.

Limitation: consumption of table salt and salt added during recipe preparations greatly underestimated.

WHO: World Health Organisation
1. Estimation of salt intake

<table>
<thead>
<tr>
<th>Salt intake (g/day)</th>
<th>Flanders</th>
<th>Walloon region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men (n=60)</td>
<td>Women (n=54)</td>
</tr>
<tr>
<td>Mean (s.d.)</td>
<td>11.8 (4.1)</td>
<td>9.9 (3.2)</td>
</tr>
<tr>
<td>P50</td>
<td>11.1</td>
<td>9.6</td>
</tr>
<tr>
<td>P75</td>
<td>14.8</td>
<td>11.2</td>
</tr>
<tr>
<td>P95</td>
<td>19.6</td>
<td>15.9</td>
</tr>
</tbody>
</table>

s.d. standard deviation
9 persons were excluded because of assumed incomplete urine collection: creatinine excretion below normal values in combination with urine volume of less than 1 litre or reported urine loss in diary

! Limitation! : selection bias, no representative sample of the population
2. Salt iodisation program

Bread with iodised salt

- Visibility of iodised household salt
- Monitoring iodine status: children and pregnant women, TSH in newborns
- Results on iodine status
- ±iodine in salt (10-15 ppm)
- Promotion of iodine for pregnant and lactating women

Monitoring iodine status:
- Children and pregnant women
- TSH in newborns

±iodine in salt (10-15 ppm)

Methods

60 schools visited in autumn:
- 30 in the North
- 30 in the South
Representative nationally and regionally

1. UIC in children and in their mothers
2. Thyroid volume by US in children
3. Household salt samples for iodine determination
4. General questionnaire

UIC: urinary iodine concentration
US: ultrasound

Methods
Results

60 schools selected

50 children per school invited to participate

1541 children participated in the study

1507 children provided a urine sample
1539 children had an US
904 children provided a household salt sample

637 mothers provided a urine sample

37% of households used iodised salt

Overall response rate children: 51.4%

US: ultrasound
### 3. National survey in children 2010

#### UIC (µg/L) in Belgian school-aged children

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Median</th>
<th>95% CI</th>
<th>%&lt;100 µg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All population</strong></td>
<td>1507</td>
<td>113.1</td>
<td>110.4-116.6</td>
<td>39.4</td>
</tr>
<tr>
<td><strong>Boys</strong></td>
<td>785</td>
<td>120.3a</td>
<td>113.9-126.9</td>
<td>35.9</td>
</tr>
<tr>
<td><strong>Girls</strong></td>
<td>722</td>
<td>108.4</td>
<td>104.9-112.8</td>
<td>43.1</td>
</tr>
<tr>
<td><strong>Age 6-8 yrs</strong></td>
<td>650</td>
<td>114.5</td>
<td>111.0-121.0</td>
<td>38.3</td>
</tr>
<tr>
<td><strong>Age 9-10 yrs</strong></td>
<td>547</td>
<td>113.0</td>
<td>107.5-119.2</td>
<td>40.4</td>
</tr>
<tr>
<td><strong>Age 11-12 yrs</strong></td>
<td>284</td>
<td>110.7</td>
<td>105.5-119.2</td>
<td>39.8</td>
</tr>
<tr>
<td><strong>Wallonia</strong></td>
<td>572</td>
<td>107.4b</td>
<td>101.5-112.3</td>
<td>44.1</td>
</tr>
<tr>
<td><strong>Flanders</strong></td>
<td>723</td>
<td>118.5</td>
<td>113.1-124.8</td>
<td>36.4</td>
</tr>
</tbody>
</table>

*aP <0.001 for boys compared to girls

*bP <0.001 for Wallonia compared to Flanders

80 µg/L in 1998

% of bakers using iodised salt: 11% in 2001 and 41% in 2010 (ESCOSALT)

UIC in matched pairs of school-aged children and their mothers

Median UIC (n=624):
- Mothers: 84 µg/L
- Children: 115 µg/L

P<0.001

Prevalence of goitre among Belgian school-aged children

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Boys (%)</th>
<th>Girls (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>4.0</td>
<td>10.3</td>
<td>7.1</td>
</tr>
<tr>
<td>7</td>
<td>12.4</td>
<td>4.3</td>
<td>8.5</td>
</tr>
<tr>
<td>8</td>
<td>7.3</td>
<td>6.1</td>
<td>6.7</td>
</tr>
<tr>
<td>9</td>
<td>9.8</td>
<td>2.5</td>
<td>6.5</td>
</tr>
<tr>
<td>10</td>
<td>7.9</td>
<td>8.3</td>
<td>8.1</td>
</tr>
<tr>
<td>11</td>
<td>5.0</td>
<td>7.0</td>
<td>5.9</td>
</tr>
<tr>
<td>12</td>
<td>12.9</td>
<td>4.6</td>
<td>9.4</td>
</tr>
<tr>
<td>Total</td>
<td>8.0</td>
<td>6.4</td>
<td>7.2</td>
</tr>
</tbody>
</table>

P = 0.002

6% in 1998
4. National survey pregnant women 2010-2011

Methods

- 55 hospitals visited
  Representative nationally and regionally
- 11 1st and 3rd trimester women per hospital

1. Weight and height by gynecologist
2. UIC in pregnant women
3. Questionnaire face-to-face with study nurse
Results

60 hospitals selected

22 women per hospital invited to participate

1311 women participated in the study: 640 in 1st and 666 in 3rd trimester of pregnancy

50% with lower education level and 20% from non-Caucasian descent

2.7% reported suffering from thyroid disease

15% reported smoking and 12% drinking alcohol during pregnancy
Results

- 87.2% of the women did not use iodised household salt
- Use of iodine-containing multivitamins:

<table>
<thead>
<tr>
<th></th>
<th>First trimester women (n=640)</th>
<th>Third trimester women (n=666)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use</td>
<td>51%</td>
<td>70%</td>
</tr>
<tr>
<td>Daily use</td>
<td>49%</td>
<td>66%</td>
</tr>
<tr>
<td>Start before pregnancy</td>
<td>12.6%</td>
<td>11.5%</td>
</tr>
</tbody>
</table>

Limitation: use of iodised salt and supplements was self-reported
4. National survey pregnant women 2010-2011

Results

Overall median UIC:
124.1 µg/L or 122.6 µg/g Cr

* Different from 1st and 3rd trimester women (p<0.001)

** Different from 1st trimester women (p<0.001)

UIC: urinary iodine concentration
6. Costs related to MID in Belgium

- To perform a health economic evaluation of the consequences of MID in Belgium, focusing on undisputed and measurable health outcomes among the adult population.

- Simulation using data from Denmark: 38% reduction in thyroid enlargement after mandatory fortification of bread and HHsalt (13 ppm).

- Total annual costs including costs due to surgery, medicines, I-131 treatment, diagnosis and follow-up amounted to ±37500000 euros.

- Total costs related to fortification program, monitoring and social marketing amounted to 270000 euros over 4-5 year period.

\[\text{Net savings per year, because of optimization of iodine intake in Belgium:}\]
\[\pm 14 \text{ million Euros}\]

! Limitations !:
- Use of prevalence data from another country, many assumptions...
- Exclusion of savings related to improved cognition and productivity, less work disability and absence from work and costs due to possible transient increase in thyroid diseases.
# 7. Iodine intake vs. thyroid diseases

Frequency of therapy (per 100,000 py) and incidence of thyroid diseases

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>Flanders</th>
<th>Wallonia</th>
<th>Adjusted P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Observed</td>
<td>Adjusted</td>
<td>Observed</td>
</tr>
<tr>
<td>Goitre</td>
<td>35.3 [34.8-35.9]</td>
<td>34.6 [34.2-34.9]</td>
<td>79.9 [78.9-81.0]</td>
</tr>
<tr>
<td>MNG</td>
<td>12.1 [11.8-12.4]</td>
<td>11.8 [11.5-12.0]</td>
<td>41.7 [40.9-42.5]</td>
</tr>
<tr>
<td>Thyroidectomy for MNG</td>
<td>11.1 [10.8-11.4]</td>
<td>10.8 [10.6-11.0]</td>
<td>40.6 [39.8-41.4]</td>
</tr>
<tr>
<td>Thyroidectomy for SN</td>
<td>2.5 [2.4-2.7]</td>
<td>2.5 [2.4-2.6]</td>
<td>10.3 [9.9-10.7]</td>
</tr>
<tr>
<td>Graves' disease</td>
<td>6.3 [6.1-6.5]</td>
<td>6.2 [6.0-6.3]</td>
<td>5.9 [5.6-6.2]</td>
</tr>
</tbody>
</table>
8. Neonatal TSH: an indicator of MID?

- Frequency of neonatal TSH levels above 5 mU/L below 3% proposed as threshold indicating iodine sufficiency
- **Ring test** among the different centres and methods organised (n=100) ➔ high variability among the methods
- All new-borns in Belgium 2009-2011 (n=377713) except premature babies and those suffering from congenital hypothyroidism
- Frequency of neonatal TSH above 5 mU/L in Belgium fluctuates between 2.6 and 3.3% in centres using the same TSH assay
- Borderline iodine sufficiency among Belgian neonates ➔ Neonatal TSH values do not detect MID in pregnancy

➔ Re-evaluation of recommended cut-off needed
Recommendations for policy

- **Legal framework: mandatory fortification** of bread and household salt; not iodised products upon request

- **In the mean time:**
  - Regular monitoring program including vulnerable groups and bakers
  - Creation of Belgian *scientific committee* for the control of iodine deficiency
  - Negotiating further agreements with the food industry and the caterers
  - **Awareness** of the public and professionals
  - Specification of strategies for vulnerable groups
  - Optimization of iodine intake versus *salt reduction*
  - Monitoring prevalence of thyroid diseases
Conclusions

- In 1998 MID in Belgium but until 2009 before action was taken
- In 2009: selective, progressive, monitored, voluntary salt iodisation program in Belgium
- In autumn 2010: significant improvement of iodine status among school-aged children in Belgium compared to 1998, at least partly due to increased % of bakers using iodised salt
- Women of child-bearing age are still suffering from MID
- High % of pregnant women taking iodine-containing multivitamins but MID due to suboptimal iodine status among women of child-bearing age

Mandatory fortification of bread and household salt (10-15 ppm)
Rigorous monitoring program
Scientific Committee for the control of iodine deficiency disorders
Thank you for your attention!

Stefanie Vandevijvere
Public health nutrition scientist
Stefanie.vandevijvere@wiv-isp.be