Iodine in Health and Civil Defense

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Division of Cardiothoracic Surgery
University of Washington School of Medicine
Iodine in Heart Surgery
Elements that Compose the Human Body

Periodic Table of Elements

Iodine atom
Napoleon

Nuclear Weapons
Iodine in Thyroid Hormones

3', 5', 3, 5-tetraiodothyronine
thyroxine, T4
Actions of Triiodothyronine ($T_3$)

- **Regulate cellular oxidation**
  - Calorigenesis
  - Thermoregulation
  - Intermediary Metabolism

- **Necessary for protein synthesis**

- **Promotes**
  - Nitrogen retention
  - Glycogenolysis
  - Intestinal absorption of glucose and galactose
  - Lipolysis
  - Uptake of glucose by adipocytes
Iodine Deficiency Disorders: Goiter
Iodine Deficiency Disorder Iceberg

- Goiter
- Cretinism (1-10%)
- Mental Retardation (5-30%)
- Loss of Energy due to Hypothyroidism (30-70%)
Hypothyroidism

- **Symptoms**
  - Fatigue (sluggishness)
  - Mental impairment with decreased concentration and memory
  - Depression
  - Muscle aches – fibromyalgia
  - Joint pains
  - Constipation
  - Decreased sexual energy
  - Cold intolerance

- **Signs**
  - Weight Gain
  - Dry, cold (and thick) skin
  - Fluid retention, myxedema
  - Hair loss with dry hair
  - Slow reflexes
  - Hypothermia
  - Manifestations of congestive heart failure
Iodine Deficiency Disorders: Mental Retardation
Iodine Deficiency Disorders: Cretinism
Worldwide Iodine Nutrition

Median urinary iodine concentration of 100-199 ug/L with corresponding approximate iodine intake 150-299 ug/day

International Council for the Control of Iodine Deficiency Disorders. Current IDD Status Database, 2003
Recommended Dietary Allowance (RDA) for Iodine

According to the AMA, NIH National Research Council, Joint UN FAO/WHO Expert Committee on Food Additives, and the EU IPCS

RDA: 100-150 μg/day
Breast Cancer and Iodine

Startling ground-breaking new research shows how to prevent and how to survive breast cancer

Dr. David M. Derry
MD, PhD
Iodine Intake in Japan

Iodine Intake 1950-1963: 13.8 mg/per capita/day
(average 4.5 gm seaweed a day. Measured Iodine content 0.3mg/gm)

Seaweed consumption in 2001: 14.6 gm (dry weight)

Iodine Intake 2001: 43.8 mg
If Iodine content the same (was not measured)

# Iodine Intake in the United States

## Urinary iodine levels (µg/L) in the United States, age 6-74

<table>
<thead>
<tr>
<th></th>
<th>NHANES I, 1971-74&lt;sup&gt;1&lt;/sup&gt;</th>
<th>NHANES III, 1988-91&lt;sup&gt;1&lt;/sup&gt;</th>
<th>NHANES 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Median</strong></td>
<td>320</td>
<td>145</td>
<td>161</td>
</tr>
<tr>
<td><strong>SE</strong></td>
<td>0.6</td>
<td>0.3</td>
<td>0.7</td>
</tr>
</tbody>
</table>


**Current Average Daily Intake of Iodine:**
- **240 µg (0.24 mg)**

**Iodine Intake in 1970s:**
- **480 µg (0.48 mg)**
## Health Comparisons: United States and Japan

<table>
<thead>
<tr>
<th>Health Indicator</th>
<th>United States</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence of Breast Cancer</td>
<td>Highest in World</td>
<td>Lowest</td>
</tr>
<tr>
<td>Life Expectancy</td>
<td>77.85 years</td>
<td>81.25 years</td>
</tr>
<tr>
<td>(48th/226 countries)</td>
<td>(No. 6)</td>
<td></td>
</tr>
<tr>
<td>Infant Mortality Rate</td>
<td>7.0</td>
<td>3.5</td>
</tr>
<tr>
<td>(deaths under age 1 per 1,000 live births)</td>
<td>(Lowest in World)</td>
<td></td>
</tr>
</tbody>
</table>
Atmospheric and Evolutionary Importance of Iodine
The Role of Iodine in the Formation of the Earth’s Atmosphere

1st Atmosphere, 4.6 Ga: Hydrogen and Helium

From Solar Nebula Stripped Off by Solar Wind
Earth’s 2nd Atmosphere, until 2.2 Ga

Formed from degassing of volcanoes

- $\text{H}_2\text{O}$ (water vapor), 50-60%
  - Oceans Formed from Condensation of Water Vapor
- $\text{CO}_2$ (carbon dioxide), 24%
- $\text{SO}_2$ (sulfur dioxide), 13%

Transformed by bacterial photosynthesis
The Earth’s 3rd Atmosphere, from 2.2 Ga

Oxygen Level in Atmosphere (Percent)

Photosynthesis first done by Cyanobacteria:

\[ 6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \]

Cyanobacteria are also the first life forms to tolerate and use... IODINE
Iodine as an Antioxidant

Reactive Oxygen Species

\[ \text{Iodine as an Antioxidant} \]

\[ \Gamma + \text{H}_2\text{O}_2 \rightarrow \text{HIO} + \text{OH}^- \]

\[ \text{HIO} + \Gamma + \text{H}^+ \rightarrow \text{I}_2 + \text{H}_2\text{O} \]

Cyanobacteria, 2.7 Ga to Present

Stromatolites in Australia Containing Colonies of Cyanobacteria.

Shark Bay, Australia
Cyanobacteria

Under the Microscope
<table>
<thead>
<tr>
<th>The Two Empires of Life</th>
<th>Algae</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eukaryotes</strong></td>
<td></td>
</tr>
<tr>
<td>Plants</td>
<td></td>
</tr>
<tr>
<td>Animals</td>
<td></td>
</tr>
<tr>
<td>Fungi</td>
<td></td>
</tr>
<tr>
<td>Protista (single-cell organisms)</td>
<td>Kelp, Seaweed, etc.</td>
</tr>
<tr>
<td><strong>Prokaryotes</strong></td>
<td></td>
</tr>
<tr>
<td>Bacteria (Eubacteria)</td>
<td></td>
</tr>
<tr>
<td>Cyanobacteria</td>
<td></td>
</tr>
<tr>
<td>Archaea (Archaebacteria)</td>
<td>Blue Green Algae</td>
</tr>
</tbody>
</table>
Iodine in Salamanders

Axolotl

Salamander

Found in lakes near Mexico City. Grow up to 13 inches long.
Iodine in Neanderthals
Bone Morphology Comparisons Between Modern Humans, Neanderthals, and Cretins

Similarities Among Skeletal Morphologies of Neanderthals and Cretins

- Short stature and relatively long torso
- Short Arms and Legs
- Attachments indicating strong musculature
- Heavy, thick-walled bones
- Curved limb bones (especially the femur)
- Large, deformed joints
- Long pelvis, with large exterior diameter
- Large long skull
- Low flat forehead
- Strong prominent bow ridges
- Large, rounded orbits
- Little chin, with wide massive jaw
Function of Iodine in Humans and Other Animals

**Thyroidal -- Organic**
- A Component of Thyroxine and T3

**Extrathyroidal -- Inorganic**
- An Antioxidant
- Triggers Apoptosis

**Other**
- Detoxify chemicals and biological toxins
- Anti-allergic, coat external proteins rendering them non allergic
- Suppress auto-immunity
- Strengthen immune system
- Provide antisepsis in the stomach
Iodine-Induced Apoptosis in Lung Cancer

Effect of Iodine on Tumor Growth in Mice

Genetically Modified Tumor Xenograft Controls

Genetically Modified Tumor Xenograft with Iodine

Organs with Iodine Concentrating Ability
Via the Sodium/Iodine Symporter Pump

- Stomach Mucosa
- Mammary Glands
- Salivary Glands
- Other: Ovaries, Thymus, Epidermis, Choroid Plexus, Articular, Arterial, and Skeletal Systems

$^{125}$I total-body scintiscans

The Reigning Truth on Iodine

1) Iodine is needed only by the thyroid gland for biosynthesis of thyroid hormones. A RDA of 100-150 µg/day for iodine meets this need.

2) Daily intake of more than 1 mg/day of iodine is excessive and potentially harmful.
When you seek a new path to truth, you must expect to find it blocked by expert opinion.

Albert Guérard  *Education of a Humanist*
The Real Truth on Iodine
Its Dose-Related Benefits

<table>
<thead>
<tr>
<th>Amounts</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>In microgram (µg)</td>
<td>For thyroid hormone</td>
</tr>
<tr>
<td>In milligram (mg)</td>
<td>Achieve optimal health, Prevent (and treat) fibrocystic disease of the breast, Prevent (and treat) cancer, Civil Defense</td>
</tr>
<tr>
<td>In gram (g)</td>
<td>Treat multiple diseases: dermatologic, pulmonary, cardiovascular, fungal</td>
</tr>
</tbody>
</table>
Different Kinds of Iodine

- **Inorganic, Nonradioactive** (\(^{127}\)I)
  - KI, SSKI, Lugol’s Solution, Iodoral,
  - Tincture of Iodine, Povidone-Iodine)

- **Organic**
  - **Endogenous**
    - Thyroid hormones
  - **Synthetic**
    - Amiodarone
    - Radiocontrast media
      - Iopanoic acid, Meglumine Iotroxate, Propylidone, etc.

- **(Inorganic) Radioactive Isotopes**
Forms of Inorganic, Nonradioactive Iodine

- **KI** (Potassium Iodide)
  - A 130 mg tablet contains 100 mg of iodide

- **SSKI** (Saturated Solution of Potassium Iodide)
  - 38 mg/drop iodide (760 mg/ml)
    - 19 mg/drop in Tahoma Clinic’s SSKI Tri-Quench

- **Lugol’s Solution** — 5% iodine (I₂) and 10% KI
  - 6.5 mg/drop blend of iodine and iodide (130 mg/ml)

- **Iodoral** — 5% iodine and 10% KI
  - One tablet = 12.5 mg blend of iodine and iodide
Iodine Poisoning

Ingested 15 gm of Iodine – 100,000 x the RDA of 0.00015 gm (150 µg)

Serum Iodide level was 2,950 ug/dL (normal is 3.5 µg/dL with daily intake of 150 ug Iodine)

Salivary Iodide Level 60,000 ug/dL (normal 105 µg/dL)
Albert Szent-Györygyi (1893-1986)

In 1937, when awarded the Noble Prize for discovering vitamin C

In 1983, at the Marine Biological Laboratory, Woods Hole, MA
Iodine in Dermatology

Table I. Reported uses for potassium iodide

<table>
<thead>
<tr>
<th>Infectious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutaneous cryptococcosis(^{31})</td>
</tr>
<tr>
<td>Entomophthoramycosis (caused by \textit{Basidiobolus} and \textit{Conidiobolus} fungi)(^{27,28})</td>
</tr>
<tr>
<td>Human pythiosis (caused by \textit{Pythium insidiosum} fungus)(^{29})</td>
</tr>
<tr>
<td>Lymphocutaneous \textit{Nocardia brasiliensis}(^{30})</td>
</tr>
<tr>
<td>Sporotrichosis (fixed cutaneous and lymphocutaneous)(^{5,23,26})</td>
</tr>
<tr>
<td>Neutrophilic dermatoses</td>
</tr>
<tr>
<td>Pyoderma gangrenosum(^{18})</td>
</tr>
<tr>
<td>Sweet’s syndrome(^{1,15,17})</td>
</tr>
<tr>
<td>Panniculitis</td>
</tr>
<tr>
<td>Erythema nodosum(^{1,14,15})</td>
</tr>
<tr>
<td>Nodular vasculitis(^{1,14,15})</td>
</tr>
<tr>
<td>Subacute nodular migratory panniculitis(^{16})</td>
</tr>
<tr>
<td>Miscellaneous</td>
</tr>
<tr>
<td>Behçet’s syndrome(^{1,15})</td>
</tr>
<tr>
<td>Erythema multiforme(^{1,15})</td>
</tr>
<tr>
<td>Wegener’s granulomatosis(^{19})</td>
</tr>
</tbody>
</table>

Fibrocystic Breast Disease

Elemental Iodine, $I_2$, more effective than Iodide, $I^-$

Diatomic Iodine (I₂) Treatment for Fibrocystic Disease

Special Report of Efficacy and Safety Results
(Submitted to FDA 21 March 1995)

Table F. Analysis of Total Breast Examination Score

<table>
<thead>
<tr>
<th>Comparison Groups</th>
<th>Mean Changes from Baseline</th>
<th>p-values*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iodine vs. Placebo</td>
<td>-23.9 vs. -2.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Iodine (C) vs. Placebo (C)</td>
<td>-29.1 vs. -2.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Iodine (C) vs. Iodine (I)</td>
<td>-29.1 vs. -18.7</td>
<td>0.01</td>
</tr>
<tr>
<td>Iodine (I) vs. Placebo (C)</td>
<td>-18.7 vs. -2.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Placebo (C) vs. Placebo (I)</td>
<td>-2.6 vs. -2.7</td>
<td>0.99</td>
</tr>
</tbody>
</table>

*p-value for F test
C: Compliant Patients
I: Patients with Treatment Interruptions

The Virginia Mason Randomized Controlled Trial Report sponsored by Mimetix, Inc.
Iodine Prevents Breast Cancer

Animal Studies

- Reduces incidence in rats given carcinogens

Human Studies

- Kills cancer cells grown \textit{in vitro}
- Absorbed by cancer-prone ductal epithelium

Epidemiological Studies

- Increased incidence with goiter
- Lower incidence in people who eat seaweed and fish
The Iodine Project

Hypothesis: Whole body sufficiency of iodine requires mg (12.5 mg), not µg (150 µg) daily amounts

Principle Investigators
Guy Abraham MD, 1997: Optimox Corp., Torrance, CA
Jorge Flechas MD, 2000 (1,000 pts.): Flechas Family Practice, Hendersonville, NC
David Brownstein MD, 2003 (3,000 pts.): Center for Holistic Medicine, West Bloomfield, MI

Iodine Loading Test
Take 50 mg iodine, urine collected for 24 hours
Less than 90 % excretion indicates iodine insufficiency
Amiodarone
## Isotopes of Iodine

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Half Life</th>
<th>How Made</th>
<th>Radioactivity</th>
<th>As Radiotracer</th>
<th>Radiotherapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>123</td>
<td>13 hours</td>
<td>Cyclotron</td>
<td><strong>Gamma rays</strong></td>
<td>SPECT scans for Thyroid</td>
<td>---------</td>
</tr>
<tr>
<td>124</td>
<td>4.2 days</td>
<td>Cyclotron</td>
<td><strong>Beta positrons</strong></td>
<td>PET scans</td>
<td>---------</td>
</tr>
<tr>
<td>125</td>
<td>60 days</td>
<td>Cyclotron</td>
<td><strong>Gamma rays</strong></td>
<td>Immunoassy</td>
<td>Brachytherapy for prostrate cancer</td>
</tr>
<tr>
<td>127</td>
<td>Stable</td>
<td>Naturally Occurring</td>
<td>None</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>131</td>
<td>8 days</td>
<td>Nuclear Fission</td>
<td><strong>Beta electrons</strong></td>
<td>Thyroid scans Other imaging</td>
<td>Hyperthyroidism Thyroid cancer Hodgkin’s lymphoma</td>
</tr>
</tbody>
</table>
Iodine in Civil Defense

Trans-Pacific Radioactive Fallout after a Chinese 300-Kiloton Atmospheric Nuclear Explosion at their Test Site near Lop Nor in 1966

Fig. 1. The Fifth Chinese Nuclear Test was Detonated on Dec. 28, 1966. It “involved thermonuclear material,” and, according to the AEC press release, was a “nuclear test in the atmosphere at their test site near Lop Nor.” As indicated above, by the end of Dec. 31, 1966 the leading edge of its fallout cloud extended as far east as the dotted line shown running from Arizona to the Great Lakes.
KI Blockade of Thyroid Irradiation by $^{131}$I

Zanzonico PB, Becker DV. Effects of Time of Administration and Dietary Iodine Levels on Potassium Iodide (KI) Blockade of Thyroid Irradiation by $^{131}$I from Radioactive Fallout. *Health Physics* 2000;78(6):660-667
Chernobyl  April 26, 1986
Sound Science and Iodine

Then -- 2 centuries ago

1779: The Coventry Remedy: Burnt sponge for goiter
1811: Iodine discovered (Bernard Courtois)
1816: Sea sponge found to contain high quantities of iodine (Andrew Fyfe)
1819: Tincture of Iodine shrinks goiter (Jean Coindet)

Now

Thyroid-centered consensus view on iodine intake, limited to 100-150 ug/day
Endocrinologists decree iodine >1 mg/day is excessive
1993 study showing that iodine in mg doses cures fibrocystic disease of the breast ignored
“Symbollon is enrolling patients in a national multi-center, placebo-controlled, double-blinded, randomized Phase III clinical trial for the treatment of moderate or severe breast pain associated with fibrocystic breast disease. The trial drug, IoGen, may help relieve breast pain. The study has been registered with FDA under the Protocol Registration System at ClinicalTrials.gov.”
Health Benefits of mg-Dose Iodine at 100x the RDA

- Feel Healthier
  - Sense of Well-Being
  - Lifting of Brain Fog
  - Increased Energy - Achieve More in Less Time
- Feel Warmer in Cold Environments
- Need Less Sleep
- Regular Bowel Movements
- Improved Skin Complexion
- Strengthens Immune System
- Prevents Cancer
- Blocks $^{131}$I Absorption from Radioactive Fallout