Selenium status in elderly: Relation to cognitive decline

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FCF-USP

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Selenium

**Functional Aspects**

*Essential trace element for humans.*

- Selenoproteins.
- Antioxidant system
- Reduction of Cancer risk
- Imune system enhancement
- Detoxification of heavy metals and xenobiotics

(BOOSALIS, 2008; HUANG et al., 2012; PAPP et al., 2007; VIVANCO et al., 2006)
Se Deficiency

Associated with:

- Muscle pain
- Fatigue
- Muscle weakness
- ↑ Creatine kinase levels in serum

Main causes

- Insufficient intake (poor soils)
- Malabsorption syndromes or enteral and parenteral nutrition without supplementation
- Oxidative stress → chronic conditions

**Selenium**

**Animal Foods**
Main Se sources
More selenocysteine

**Vegetal Foods**
Poor source
Exception
Brazilian Nuts

(BOOSALIS, 2008; COMINETTI et al., 2011; SUZUKI, 2005)
<table>
<thead>
<tr>
<th>Study</th>
<th>Concentration (µg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GONZAGA (2002)</td>
<td>40</td>
</tr>
<tr>
<td>MARTENS and COZZOLINO (2002)</td>
<td>43</td>
</tr>
<tr>
<td>ROCHA (2009)</td>
<td>25</td>
</tr>
<tr>
<td>STOCLER PINTO (2009)</td>
<td>58</td>
</tr>
<tr>
<td>COMINETTI (2010)</td>
<td>58</td>
</tr>
<tr>
<td>PIRES (2012)</td>
<td>115</td>
</tr>
<tr>
<td>CALLOU and CARDOSO (2012)</td>
<td>71</td>
</tr>
<tr>
<td>LABORATORY MINERAL (2011)</td>
<td>85</td>
</tr>
</tbody>
</table>
Phenolic compounds of brazilian nuts

TPC = Total phenolic compounds
The results are expressed in mg/g sample.
Letters differ statistically, p<0.05.

TPC : 398 mg/100g brazilian nuts
1 nut (5g) = 19,9 mg TPC
<table>
<thead>
<tr>
<th>Age</th>
<th>EAR (µg)</th>
<th>RDA (µg)</th>
<th>UL (µg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6 months</td>
<td>15 (AI)</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>7-12 months</td>
<td>20 (AI)</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>1-3 years</td>
<td>17</td>
<td>20</td>
<td>90</td>
</tr>
<tr>
<td>4-8 years</td>
<td>23</td>
<td>30</td>
<td>150</td>
</tr>
<tr>
<td>9-13 years</td>
<td>35</td>
<td>40</td>
<td>280</td>
</tr>
<tr>
<td>14-18 years</td>
<td>45</td>
<td>55</td>
<td>400</td>
</tr>
<tr>
<td>19-50 years</td>
<td>45</td>
<td>55</td>
<td>400</td>
</tr>
<tr>
<td>51-70 or &gt;</td>
<td>45</td>
<td>55</td>
<td>400</td>
</tr>
</tbody>
</table>

(IOM, 2001)
Selenium - Toxicity

➤ Selenosis

➤ Gastrointestinal symptoms, garlic odor, fatigue, irritation and abnormalities of nervous system

Selenium and Brain
Introduction: Brain

↑ expenditure of O₂

↓ antioxidant enzymes

↑ polyunsaturated fatty acids

Complex of metals

Depletion of antioxidants

Neuronal loss

↓ memory and learning

(BOURDEL-MARCHASSON et al. 2001; MARIANI et al., 2005; ZHU et al., 2007; ANSARI e SCHEFF, 2010).
Short Communication

Nutritional status of selenium in Alzheimer’s disease patients

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Table 1. Selenium concentrations in plasma (μg/l), erythrocytes (μg/l) and nails (μg/g), and selenium content in diet (μg/d) of elderly with Alzheimer’s disease (AD) and those in the control (C) group

<table>
<thead>
<tr>
<th>Groups</th>
<th>AD (n 28)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>C (n 29)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plasma</td>
<td>Erythrocyte</td>
<td>Nails</td>
<td>Diet</td>
<td>Plasma</td>
<td>Erythrocyte</td>
<td>Nails</td>
<td>Diet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60-00–120-00</td>
<td>90-00–90-00</td>
<td>0-30</td>
<td>45</td>
<td>60-00–120-00</td>
<td>90-00–120-00</td>
<td>0-40</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>32-59</td>
<td>43-74</td>
<td>0-30</td>
<td>40-99</td>
<td>50-99*</td>
<td>79-16*</td>
<td>0-40</td>
<td>48-91*</td>
<td></td>
</tr>
<tr>
<td>sd</td>
<td>21-99</td>
<td>23-02</td>
<td>0-14</td>
<td>11-23</td>
<td>21-07</td>
<td>46-38</td>
<td>0-13</td>
<td>15-50</td>
<td></td>
</tr>
<tr>
<td>Below normality (%)</td>
<td>89-3</td>
<td>96-3</td>
<td>–</td>
<td>61-5</td>
<td>75-9</td>
<td>67-9</td>
<td>–</td>
<td>37-0</td>
<td></td>
</tr>
<tr>
<td>Normality (%)</td>
<td>10-7</td>
<td>3-7</td>
<td>–</td>
<td>38-5</td>
<td>24-1</td>
<td>25-0</td>
<td>–</td>
<td>63-0</td>
<td></td>
</tr>
<tr>
<td>Above normality (%)</td>
<td>0</td>
<td>0</td>
<td>–</td>
<td>0</td>
<td>0</td>
<td>7-1</td>
<td>–</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

* P<0-005.
High selenium content
75 – 90% as selenomethionine


One nut daily...

... improved selenium status in older adults.

Behr C. 2004 (Not published)

... improved selenium status and glutathione peroxidase activity
and reduced atherogenic risk in obese women.


... improved oxidative stress and inflammation biomarkers in
hemodialysis patients.

Stockler-Pinto et al. Biol Trace Elem Res. 2014 Apr;158(1):105-12
Effects of Brazil nut consumption on selenium status and cognitive performance in older adults with mild cognitive impairment: a randomized controlled pilot trial

Bárbara Rita Cardoso · Daniel Apolinário · Verônica da Silva Bandeira · Alexandre Leopold Busse · Regina Miksian Magaldi · Wilson Jacob-Filho · Silvia Maria Franciscato Cozzolino

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Abstract

Purpose Oxidative stress is closely related to cognitive impairment, and the antioxidant system may be a potential therapeutic target to preserve cognitive function in older adults. Selenium plays an important antioxidant role through selenoproteins. This controlled trial aimed to investigate the antioxidant and cognitive effects of the consumption of Brazil nuts, the best selenium food source.

Methods We enrolled 31 older adults with mild cognitive impairment (MCI) who were randomly assigned to ingestion of Brazil nuts or to the control group. Participants of the treatment group consumed one Brazil nut daily (estimated 288.75 µg/day) for 6 months. Improvements in verbal fluency ($p = 0.007$) and constructive praxis ($p = 0.031$) were significantly greater on the supplemented group when compared with the control group.

Conclusion Our results suggest that the intake of Brazil nut restores selenium deficiency and provides preliminary evidence that Brazil nut consumption can have positive effects on some cognitive functions of older adults with MCI.

Keywords Brazil nuts · Selenium · Oxidative stress · Mild cognitive impairment
We aimed to investigate whether the consumption of Brazil nuts improves cognitive function, selenium status and oxidative stress in Mild Cognitive Impairment (MCI) elderly.
Participants

MCI older adults from Hospital das Clinicas of the São Paulo University Medical School (São Paulo, Brazil)

Inclusion criteria:
- Aged 60 years or more
- Without acute inflammation, infection, fever, diarrhea, cancer;
- Non intake of selenium supplement
- Non regular consumption of Brazil nut
- Non intolerance to oleaginous food
31 patients were enrolled

- 16 treated group
- 11 treated group

- 15 control group
- 9 control group

Consumed 1 nut daily (288.75 µg of selenium) during 6 months
### Assessment

| **Selenium plasma and erythrocyte** | • Hydride generation atomic absorption spectroscopy (Hao D et al. Talanta. 1996;43:595–600) |
| **Erythrocyte GPx** | • Randox kit |
| **Malondialdehyde (MDA)** | • HPLC (Hong YL et al. Clin Biochem 33: 619–625, 2000) |
| **Cognitive assessment (6 subtests of CERAD battery)** | • Verbal fluency  
• Boston naming test  
• Constructional praxis  
• Word list naming test  
• Word list recall |
## Results

### Characteristics of participants at baseline.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>All</th>
<th>Treatment</th>
<th>Control</th>
<th>P-value for between-group comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y), mean±SD&lt;sup&gt;a&lt;/sup&gt;</td>
<td>77.7±5.3</td>
<td>77.7±4.3</td>
<td>77.6±6.6</td>
<td>0.945</td>
</tr>
<tr>
<td>Education (y), mean±SD&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.4±4.3</td>
<td>5.5±4.0</td>
<td>5.4±4.9</td>
<td>0.996</td>
</tr>
<tr>
<td>Gender, % male&lt;sup&gt;b&lt;/sup&gt;</td>
<td>30.0</td>
<td>27.3</td>
<td>33.3</td>
<td>1.000</td>
</tr>
</tbody>
</table>

<sup>a</sup> t-test  
<sup>b</sup> Fisher’s exact test
Selenium status, GPx activity, ORAC and MDA of the treated and the control group at baseline and after 6 months.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Treatment</th>
<th>Control</th>
<th>P-value for between-group comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre ±SD</td>
<td>Post ±SD</td>
<td>Change (95% CI)</td>
</tr>
<tr>
<td>Selenium plasma (μg/L)</td>
<td>56.2 ±18.3</td>
<td>290.6 ±74.6</td>
<td>234.3 (190.8 - 277.9)</td>
</tr>
<tr>
<td>Selenium erythrocyte (μg/L)</td>
<td>59.5 ±20.6</td>
<td>574.6 ±181.4</td>
<td>515.00 (401.02 - 629.0)</td>
</tr>
<tr>
<td>GPx activity (U/g Hb)</td>
<td>40.73 ±15.20</td>
<td>59.55 ±20.79</td>
<td>18.80 (0.955 - 36.68)</td>
</tr>
<tr>
<td>ORAC (μmol)</td>
<td>0.95 ±0.45</td>
<td>1.09 ±0.26</td>
<td>0.15 (-0.21 - 0.51)</td>
</tr>
<tr>
<td>TE/mL</td>
<td>±0.45 ±0.05</td>
<td>±0.26 (-0.21 - 0.51)</td>
<td>0.39 ±0.14</td>
</tr>
<tr>
<td>MDA (μmol/L)</td>
<td>0.42 ±0.05</td>
<td>0.52 ±0.12</td>
<td>.10 (0.00 - 0.19)</td>
</tr>
</tbody>
</table>

\( ^a \) t-test
\( ^b \) Mann-Whitney U test
Cognitive evaluation in the treated and the control group at baseline and after 6 months.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Treatment</th>
<th>Control</th>
<th>P-value for between-group comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre±SD</td>
<td>Post±SD</td>
<td>Change (95% CI)</td>
</tr>
<tr>
<td>CERAD total scorea</td>
<td>59.2±8.1</td>
<td>60.3±10.3</td>
<td>1.1 (-4.0 – 6.2)</td>
</tr>
<tr>
<td>Verbal fluencya</td>
<td>12.8±3.3</td>
<td>14.1±3.9</td>
<td>1.3 (0.6 - 2.6)</td>
</tr>
<tr>
<td>Boston naming testa</td>
<td>11.7±2.3</td>
<td>11.9±1.2</td>
<td>0.2 (-1.5 – 1.5)</td>
</tr>
<tr>
<td>Constructional praxisa</td>
<td>7.7±2.3</td>
<td>9.2±2.2</td>
<td>1.5 (0.0 – 3.1)</td>
</tr>
<tr>
<td>Word list learning testa</td>
<td>15.3±3.5</td>
<td>14.2±4.4</td>
<td>-1.1 (-4.6 – 2.4)</td>
</tr>
<tr>
<td>Word list recalla</td>
<td>3.7±2.2</td>
<td>3.6±2.1</td>
<td>-0.1 (-1.2 – 1.0)</td>
</tr>
</tbody>
</table>

*a t-test
Conclusions

The intake of one brazilian nut daily may restore selenium deficiency and this is important for some populations as older adults.

Brazil nut intake may have positive effects on some cognitive functions in MCI elderly, namely semantic verbal fluency and constructional praxis.

These positive effects on cognition are associated with improvement of selenium status.
Studies to better elucidate the mechanisms involved in the role of selenium in cognition are required, since our data suggest that the nutritional status of this mineral may directly impact on cognition.
X. ISTERH CONFERENCE

Selenium status in elderly: Relation to cognitive decline

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Mild cognitive impairment
Oxidative stress
Selenium

ABSTRACT

Studies show that decreased antioxidant system is related to cognitive decline. Thus we aimed to measure selenium (Se) status in Alzheimer’s disease (AD) and mild cognitive impairment (MCI) elderly and compared them with a control group (CG). 27 AD, 17 MCI and 28 control elderly were evaluated. Se concentration was determined in plasma and erythrocyte by using hydride generation atomic absorption spectroscopy. Erythrocyte Se concentration in AD group was lower than CG (43.73 ± 23.02 μg/L and 79.15 ± 46.37 μg/L; p = 0.001), but not statistically different from MCI group (63.97 ± 18.26 μg/L; p = 0.156). AD group exhibited the lowest plasma Se level (34.49 ± 19.94 μg/L) when compared to MCI (61.36 ± 16.08 μg/L; p = 0.000) and to CG (50.99 ± 21.06 μg/L; p = 0.010). It is observed that erythrocyte Se decreases as cognition function does. Since erythrocyte reflects longer-term nutritional status, the data point to the importance of the relation between Se exposure and cognitive function. Our findings suggest that the deficiency of Se may contribute to cognitive decline among aging people.

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Selenium

Conclusions

1 billion people could be Se deficient in the world
THANK YOU
OBRIGADA!