Lithium in Portuguese drinking water
A preliminary study to assess its benefits to mental health

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INTRODUCTION

Lithium (Li) is a trace element present in grains, vegetables, some animal-derived foods and drinking water. Research is proving that it is an essential element that the human body needs for optimizing health and wellbeing. However, the human dietary Li requirement has not yet been established. Diet provides up to 2.5 mg/day and in some world regions high amounts of Li may be provided from drinking water. The effects of Li at therapeutic doses (600-1200 mg/day) on mental disorders are widely recognized by the psychiatric community. Research developed at geographical locations ascribed to different climates and natural habits and diets (e.g. Texas, USA; Ottå, Japan; Austria, Europe), about the effects of Li at natural water levels suggests that mortality from suicide was inversely associated with Li in drinking water [1,2,3]. Although controversial, some researchers suggest the possibility of adding lithium to drinking water supplies to benefit community mental health.

This study reports the preliminary results of lithium concentration and distribution in Portuguese drinking waters (both tap and bottled water) in order to:
- characterize the levels of this element in the principal sources of human diet intake
- assess if there is any relation between lithium concentrations in tap water and the mortality rate from suicide, for the period 2008-2011

METHODS

About 45 tap water samples (Fig. 1) were collected in 2011 from private houses from across 18 Districts on the Portuguese mainland.

Tap water may be derived from groundwater or from surface water (e.g. lakes, rivers, artificial reservoirs) and could be mixed in the distribution system.

Samples are representative of the water that Portuguese individuals drink or use to cook foodstuffs every day.

Around 23 brands of bottled waters (13 natural mineral and 10 spring waters) were purchased in supermarkets; they are bottled directly at the source or groundwaters pumped from drilled wells and subsequently bottled.

Lithium was analyzed by ICP-MS at a certified laboratory (Achats, Canada), after being acidified (HNO3, until pH < 2) and without sample filtration after collection.

Mortality rate from suicide (intentional self-harm): ICD-10 codes X60-X84.

RESULTS

**Tap waters**
- Li concentrations: < 1 to 190 µg/L (Fig. 2: median of 4 µg/L).
- Nine 3 municipalities with Li concentration higher than 40 µg/L.
- Maximum Li concentration detected in Castelo Branco City (Central Portugal).

**Bottled waters**
- Li concentrations: < 1 to 2210 µg/L (Fig. 2: median of 16 µg/L).
- Seven bottled mineral waters with Li concentration higher than 170 µg/L.
- Campina, Fife, Pedras Salgadas and Vidago (Fig. 3) present the highest Li concentrations.

DISCUSSION

Table 1 – Li concentrations in tap water from different sources.

<table>
<thead>
<tr>
<th>Data</th>
<th>Li (µg/L )</th>
</tr>
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<tbody>
<tr>
<td>This study (18/4)</td>
<td>&lt;1 190 11.5</td>
</tr>
<tr>
<td>[1] Texas (27/--)</td>
<td>&lt;1 170</td>
</tr>
<tr>
<td>[2] Ottå (38/--)</td>
<td>&lt;1 70</td>
</tr>
<tr>
<td>[3] Austria (95/440)</td>
<td>3.3 1300 11.3</td>
</tr>
</tbody>
</table>

Li concentrations: < 1 to 190 µg/L (Fig. 2: median of 4 µg/L).

- The highest Li concentrations in bottled mineral water reflect the geology of the source region (Northern Portugal, magmatic rocks with Li-rich minerals).
- Suicide (intentional self-harm) rate in the 45 Portuguese municipalities seems not to be correlated with lithium levels in tap waters (Fig. 4).
- No correlation between average Li levels in tap water (for 18 Portuguese Districts) and 2004 Standardised Mortality Ratio (SMR) for suicide (intentional self-harm) (Fig. 5).

CONCLUSIONS

- Portuguese tap waters present lower Li concentrations than natural mineral bottled waters.
- Lithium levels in the investigated tap waters are not correlated to mortality rate from suicide (intentional self-harm) for the period 2008-2011.
- To validate (or not) this preliminary study the research should be extended to all 308 Portuguese municipalities (even from Madeira and Azores islands).
- As suicide is a complex phenomenon with many variables, those should be also taken in account in a future research.
- The consuming of some bottled mineral water may contribute to increase the daily Li intake.
- Some of these mineral waters will be used in controlled studies to investigate possible additional benefits in patients suffering from mild to moderate major depressive disorders.


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