



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; Oita, 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 one of the principal sources of human diet intake and
- 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 groundwaters which 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 (Actlabs, 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) for the period 2008-2011 was collected at Instituto Nacional de Estatística [4].

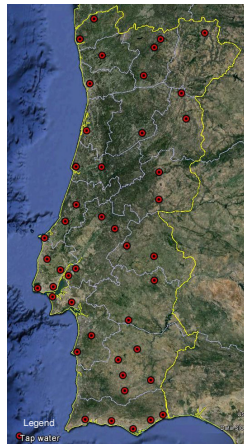


Figure 1 – Location in Portuguese mainland of the tap water sampling sites (source: 2014 Google Image Landsat).

DISCUSSION

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

Data	Li (µg/L)		
	min	max	media
This study (18/45)*	<1	190	11.5
[1] Texas (27/---)	<1	170	---
[2] Oita (18/---)	<1	70	---
[3] Austria (99:6460)	3.3	1300	11.3

* (Districts/tap water samples)
--- not available data

✓ Li concentrations in Portuguese drinking tap waters is not very different from other geographic locations (Table 1).

✓ 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 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).

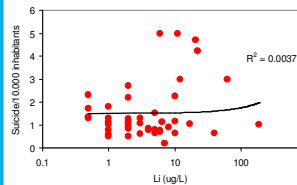


Figure 4 – Li concentration in tap water versus respective mortality ratio for suicide (2008-2011 [4]) for both sexes.

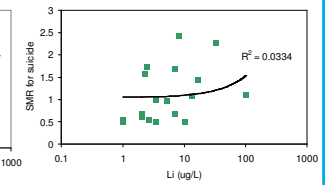


Figure 5 – Average Li concentration in tap water versus 2004 Standardised Mortality Ratio for suicide [5] for both sexes.

✓ As in other countries the consumption of bottled waters is significantly increasing and has become an important factor health issue. Adults consuming (0.5L/day) of some of the investigated mineral waters would reach the suggested provisional recommended dietary allowance (RDA) dose of 1 mg Li/day [6].

**SMR (the ratio of observed deaths in a population to the expected number of deaths as derived from rates in a standard population with adjustment of age and possibly others factors as sex or race)

RESULTS

Tap waters

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



(source: <http://www.asbeiras.pt/2012>)

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.
- Campilho, Frize, Pedras Salgadas and Vidago (Fig. 3) present the highest Li concentrations.

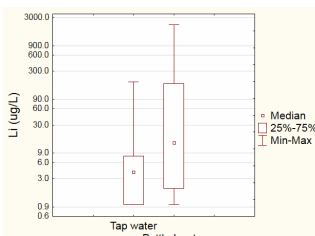


Figure 2 – Lithium concentration in the studied tap and bottled waters.



Figure 3 – Bottled waters with Li concentration higher than 1.5 µg/L (source: <http://www.unicer.pt>).

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.

[1] Schrauzer GN; Shrestha KP (1990), Lithium in drinking water and the incidences of crimes, suicides, and arrests related to drug addictions, *Biological Trace Element Research*, 25(2):105-113.
 [2] Ohgami H; Terao T; Shiotsuki I; Ishii N; Iwata N (2009), Lithium levels in drinking water and risk of suicide, *British Journal Psychiatry*, 194:464-465.
 [3] Kapusta ND; Mossaheb N; Etersdorfer E; Hlavin G; Thau K; Willeit M; Prashak-Rieder N; Sonneck G; Leithner-Dziubas K (2011), Lithium in drinking water and suicide mortality, *British Journal Psychiatry*, 198:346-350.
 [4] Instituto Nacional de Estatística (2013), Óbitos gerais por algumas causas de morte (lesões auto provocadas intencionalmente): ICD-10 codes X60-X84 para municípios do Continente (DT/CC), 2008-2011, www.ine.pt.
 [5] Direcção-Geral da Saúde (2009), Risco de Morte em Portugal 2006, Vol. 1, Direcção de Serviços de Epidemiologia e Estatísticas de Saúde, Lisboa, <http://www.dgs.pt>
 [6] Schrauzer GN (2002), Lithium: occurrence, dietary intakes, nutritional essentiality, *Journal American College Nutrition*, 21(1):14-21.

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