

Comparison of lithium levels between Japanese and foreign mineral waters

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ABSTRACT

Purpose: To measure the lithium levels of mineral waters and compare those of Japanese mineral waters to foreign ones. **Methods:** The lithium levels of Japanese mineral waters, foreign mineral waters, and Japanese tap waters were compared using the Kruskal-Wallis test due to a skewed distribution. **Results:** As a whole, there was a significant difference between the 3 groups. Post hoc comparison by Bonferroni correction revealed that the lithium levels of foreign mineral waters were significantly higher than Japanese mineral waters and tap waters, though there was no significant difference between Japanese mineral waters and tap waters. **Discussion:** The present findings indicate that foreign mineral waters may have higher lithium levels than Japanese mineral waters and tap waters. In future studies, it is desirable to consider which type of mineral waters (Japanese or foreign) the residents drink, for adjustment of the analytic data of any potential lithium effect on suicide rates and other mental states.

Keywords: *Lithium, Mineral Water, Japanese products, Foreign products, Anti-suicide effects*

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INTRODUCTION

Several epidemiological studies have shown the inverse association of lithium levels in tap water and suicide rates [1-6], although a few studies failed to find such association [7] or have reported an ambiguous association [8]. However, many people drink both mineral water and tap water. In order to estimate the anti-suicide effect of lithium in drinking water, it is necessary to also measure lithium levels in mineral water. In the present study, we measured the lithium levels of mineral waters and compared those of Japanese mineral waters and foreign ones.

MATERIALS AND METHODS

The lithium levels of water were measured by using mass spectroscopy analyzed by a third party [2, 4,

5]. This method can measure very small amounts of lithium; the limit of quantification of lithium is 0.1 ppb (0.1 µg/L). Previously, we measured the lithium levels of 9 Japanese mineral waters (Rokko no oishiimizu, Fujisan no oishiimizu, Wilkinson tansan, Kumanokodosui, Arukariion no mizu, Mori no mizudayori Daisensanroku, Irohasu, Okudaisen no tennensui, Minami Alps no tennensui) and 7 foreign mineral waters (Crystal Gayser, San pellegrino, Gerolsteiner Sparkling, Evian, Contrex, Perrie, Volvic) twice (August 12, 2013 and December 5, 2013). Using this data and other data which we obtained from tap water all over Japan (808 regions from Hokkaido to Kyushu, unpublished data), the lithium levels of Japanese mineral waters, foreign mineral waters, and Japanese tap waters were compared by the Kruskal-Wallis test because of skewed distribution.

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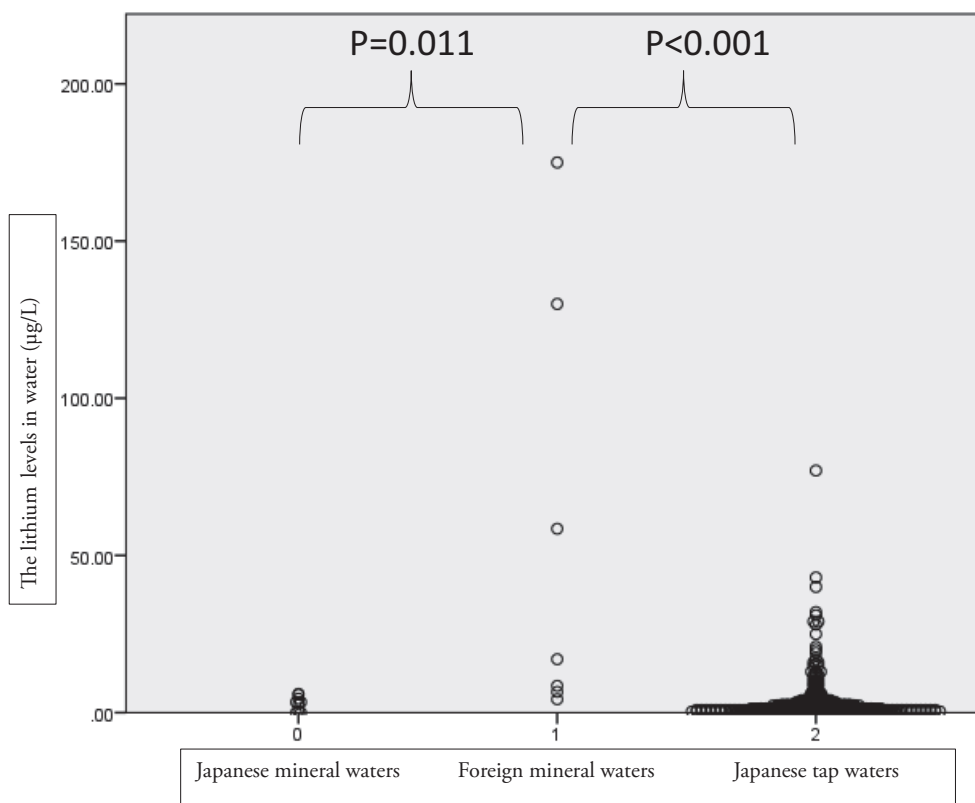


Figure 1. The lithium levels of Japanese and foreign mineral waters, and Japanese tap waters

RESULTS

The lithium levels of mineral waters at the first measurement was almost the same as those at the second measurement (the first vs. the second; mean, 25.59 µg/L vs. 27.66 µg/L, range 0-170 vs. 0-180). Pearson's coefficient was 0.998 ($p < 0.001$). Therefore, we used the mean of the first and the second values of the lithium levels of mineral waters. The mean of the lithium levels were 2.90 µg/L (SD=2.33, range 0-5.95) for Japanese mineral waters (each mean values: Rokko no oishiimizu, 2.85; Fujisan no oishiimizu, 0.40; Wilkinson tansan, 3.35; Kumanokodosui, 0.00; Arukariion no mizu, 0.00; Mori no mizudayori Daisensanroku, 5.75; Irohasu, 5.95; Okudaisen no tennensui, 4.45; Minami Alps no tennensui, 3.35), 57.13 µg/L (SD=68.95, range=4.25-175.0) for foreign mineral waters (each mean values: Crystal Gayser, 17.00; San pellegrino, 130.00; Gerolsteiner Sparkling, 175.00; Evian, 6.60; Contrex, 58.50; Perrie, 4.25; Volvic, 8.55), and 2.48 µg/L (SD=4.80, range 0-77.0) for Japanese tap waters (data not shown). The distribution of the lithium levels of foreign mineral waters and Japanese tap waters were remarkably skewed and, as aforementioned, we used a nonparametric method (i.e. the Kruskal-Wallis test) but not a para-

metric ANOVA.

As shown in Figure 1, there was a significant difference between the 3 groups ($H=18.89$, $P < 0.001$). Post hoc comparison by the Bonferroni correction revealed that the lithium levels of foreign mineral waters were significantly higher than Japanese mineral waters ($p=0.011$) and Japanese tap waters ($p < 0.001$), though there was no significant difference between Japanese mineral waters and tap waters ($p=0.980$).

DISCUSSION

This study showed that the lithium levels of Japanese mineral waters and tap waters were not significantly different, but that foreign mineral waters had significantly higher lithium levels than Japanese mineral waters and tap waters. It is likely that the source of foreign mineral waters originates from water with mineral salts including calcium, magnesium, and possibly lithium whereas that of Japanese mineral waters originates from water containing less mineral salts. Therefore, in future studies, it is desirable to consider which type of mineral waters (Japanese or foreign) the residents drink, for adjustment of the analytic data of any potential lithium

effect on suicide rates and other mental states [9-11].

CONFLICTS OF INTEREST

All authors declare no competing interests.

REFERENCES

- [1] Schrauzer GN, Shrestha KP. Lithium in drinking water and the incidences of crimes, suicides, and arrests related to drug addictions. *Biol Trace Elem Res* 1990; 25: 105-113.
- [2] Ohgami H, Terao T, Shiotsuki I, et al. Lithium levels in drinking water and risk of suicide. *Br J Psychiatry* 2009; 194: 464-465.
- [3] Kapusta ND, Mossaheb N, Etzersdorfer E, et al. Lithium in drinking water and suicide mortality. *Br J Psychiatry* 2011; 198: 346-350.
- [4] Isii N, Terao T, Araki Y, et al. Low male suicide and lithium in drinking water. *J Clin Psychiatry* 2015; 76: 319-326.
- [5] Shiotsuki I, Terao T, Ishii N, et al. Trace lithium is inversely associated with male suicide after adjustment of climatic factors. *J Affect Disord* 2016; 189: 282-286.
- [6] Kabacs N, Memon A, Obinwa T, et al. Lithium in drinking water and suicide rates across the East of England. *Br J Psychiatry* 2011; 198: 406-407.
- [7] Sugawara N, Yasui-Furukori N, Ishii N, et al. Lithium in tap water and suicide mortality in Japan. *Int J Environ Res Public Health* 2013; 10: 6044-6048.
- [8] Sher L. Suicide in men. *J Clin Psychiatry* 2015; 76: e371-e372.
- [9] Terao T. Aggression, suicide, and lithium treatment. *Am J Psychiatry* 2008; 165: 1356-1357.
- [10] Terao T, Goto S, Inagaki M, et al. Even very low but sustained lithium intake can prevent suicide in the general population? *Med Hypotheses* 2009; 73: 811-812.
- [11] Matsuzaki H, Terao T, Inoue T, et al. Re-analysis of the association of temperature or sunshine with hyperthymic temperament using lithium levels of drinking water. *J Affect Disord* 2017; 223: 126-129.