

Evaluation of Standards for the Hardness of Drinking Water

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In this article, we made an attempt to analyze acting standards for the hardness of drinking water in different countries. In a number of countries, there are some requirements for both upper and lower limits for the hardness, as well as for the separate concentrations of calcium and magnesium. We gave a short description of the effects of the drinking water hardness on the human health and also the actual values of hardness of tap water in a number of European and Russian cities. State standard for the drinking water was introduced in Russia in 1940 and has been changed since then several times, although the hardness index has been preserved at constant level of 7 mmol-equiv/l. We have stated in the paper that an optimization of the range of hardness of drinking water is necessary for both health care of the population and minimization of the corrosion of water supply equipment and pipelines.

References

1. Adzhienko G.V. Vodosnabzhenie. Nauchno-populyarnaya entsiklopediya Voda Rossii [Water supply. Popular science encyclopedia Water of Russia], 2014; <http://water-ri.ru/Glossarij/2372/Vodosnabzheniye>.
2. Golubev I.M., Zimin V.P. O standarte obshchey zhestkosti pit'evoy vody [On the standard of general hardness of drinking water], *Gigiena i sanitariya*, 1994, no. 3, pp. 22–23.
3. Goncharuk E.I., Bardov V.G., Garkavyi S.I., Yavorovskiy A.P. *Kommunal'naya gigiena* [Communal hygiene], Kiev, *Zdorov'ya*, 2006, 792 P.
4. Loseva M.I., Krasnikova L.B. Pokazateli zabolevaemosti arterial'noy gipertenzii i stenokardii sredi sel'skogo naseleniya, prozhivayushchego v geokhimicheski raznykh rayonakh Novosibirskoy oblasti [The incidence of arterial hypertension and angina in the rural population living in geochemically different regions of the Novosibirsk region], *Kardiologiya*, 1988, no. 28, pp. 31–34.
5. Lyutay G.F. Khimicheskiy sostav pit'evoy vody i zdorov'ya naseleniya [Chemical composition of drinking water and public health], *Gigiena i sanitariya*, 1992, no. 1, pp. 13–15.
6. Nauchnoe obosnovanie gigienicheskikh normativov (standartov) kachestva pit'evoy vody [Scientific substantiation of hygienic standards (standards) of drinking water quality], *Medportal*, 2015; https://medportal.com/gigiena-sanepidkontrol_733/nauchnoe-obosnovanie-gigienicheskikh-normativov.html.
7. Mudryy I.V. Vliyaniye mineral'nogo sostava pit'evoy vody na zdorov'e naseleniya (obzor) [Influence of mineral composition of drinking water on public health (review)], *Gigiena i sanitariya*, 1999, no. 1, pp. 15–18.
8. Piltman S.I., Novikov Yu.V., Tulakina N.V., Metel'skaya G.N., Kochetkova T.A., Khvastunov R.M. Po voprosu ob ispravlenii gigienicheskikh norm s uchetom zhestkosti pit'evoy vody [On the issue of the correction of hygiene standards, taking into account the rigidity of drinking water], *Gigiena i sanitariya*, 1989, no. 7, pp. 7–10.
9. Allwright S. P., Coulson A., Detels R. Mortality and water hardness in three matched communities in Los Angeles, *Lancet*, 1974, no. 2.
10. Aptel I., Cance-Rouzaud A., Grandjean H. Association between calcium ingested from drinking water and femoral bone density in elderly women: evidence from the EPIDOS cohort, *J. Bone Miner. Res.*, 1999, no. 14.
11. Bar-Dayyan Y., Shoefeld Y. Magnesium fortification of water, *Ann. Med. Interne*, 1997, no. 148.
12. Cepollaro C., Orlandi G., Gonnelli S., Ferrucci G., Arditti J. C., Borracelli D., Toti E., Costi D., Calcaterra P. G., Iori N., Vourna S., Nappi G., Passeri M. Importance of bioavailable calcium drinking water for the maintenance of bone mass in postmenopausal women, *J. Endocrinol. Invest.*, 1999, no. 22.
13. Coen G., Sardella D., Barbera G., Ferrannini M., Comegna C., Ferrazzoli F., Dinnella A., D'Anello E., Simeoni P. Urinary composition and lithogenic risk in normal subjects following oligomineral versus bicarbonate-alkaline high calcium mineral water intake, *Urol. Int.*, 2001, no. 67.
14. Costi D., Calcaterra P. G., Iori N., Vourna S., Nappi G., Passeri M. Importance of bioavailable calcium drinking water for the maintenance of bone mass in postmenopausal women, *J. Endocrinol. Invest.*, 1999, no. 22.
15. Das G. You and your drinking water: health implications for the use of cation exchange water softeners, *J. Clin. Pharmacol.*, 1988, no. 28.
16. Department of Health Report on Health and Social Subjects, London, *Nutritional Aspects of Cardiovascular Disease*, 1994, no. 46.
17. Durlach J., Bara M., Guet-Bara A. Magnesium level in drinking water and cardiovascular risk factor: a hypothesis, *Magnesium*, 1985, no. 4.
18. Eco-friendly water treatment against scale and rust, 2016; <https://www.cwt-international.com/cwt/ru/hard-water-problems.html/>.
19. Eisenberg M. J. Magnesium deficiency and sudden death, *Am. Heart J.*, 1992, no. 124.
20. Erb B. D. Water hardness and cardiovascular death rates in Tennessee, *Tenn. Med.*, 1997, no. 90.
21. Flaten P. D., Bolviken B. Geographical associations between drinking water chemistry and the mortality and morbidity of cancer and some other diseases in Norway, *Sci. Total Environ.*, 1991, no. 102.
22. Gennari C. Effect of calcium supplementation as a high-calcium mineral water on bone loss in early postmenopausal woman, *Calcif. Tissue Int.*, 1996, no. 59.
23. Hauschka R. Nutrition science. Understanding physiology of digestion and ponderable and imponderable qualities of nutrients, Frankfurt am Main, *Vittorio Klostermann*, 1951
24. Kobayashi J. On geographical relationship between the chemical nature of river water and death rate from apoplexy, *Berichte des Ohara Instituts fur landwirtschaftliche Biologie Okyama University*, 1957, no. 11.
25. Kozisek F. Health significance of drinking water calcium and magnesium, *National Institute of Public Health*, 2003.
26. Leary W. P., Reyes A. J., Lockett C. J., Arbuckle D. D., Van Der Byl K. Magnesium and death ascribed to ischaemic heart disease in South Africa: a preliminary report, *S. Afr. Med.*, 1983, no. 64, pp. 775–776.
27. Maksimovic J. Z., Jovanovic T., Rsumovic M., Dordevic M. Drinking water magnesium and calcium and mortality from cardiovascular diseases in Serbia, Beograd. In: *Pri simpozijum o magnezijumu*, Apstrakti, 1998.
28. Pocock S. J., Sharper A. G., Cook D. G., Packham R. F., Lacey R. F., Powell P., Russell P. F. British Regional Heart Study: geographic variations in cardiovascular mortality, and the role of water quality, *BMJ*, 1980, no. 280.
29. Punsar S., Karvonen M. J. Drinking water quality and sudden death: observations from West and East Finland, *Cardiology*, 1979, no. 4.
30. Rubenowitz E., Axelsson G., Rylander R. Magnesium in drinking water and death from acute myocardial infarction, *Am. J. Epidemiol.*, 1996, no. 143.
31. Rubenowitz E., Axelsson G., Rylander R. Magnesium and calcium in drinking water and death from acute myocardial infarction in women, *Epidemiology*, 1999, no. 10.
32. Rubenowitz E., Molin I., Axelsson G., Rylander R. Magnesium in drinking water in relation to morbidity and mortality from acute myocardial infarction, *Epidemiology*, 2000, no. 11.
33. Rylander R., Bonevik H., Rubenowitz E. Magnesium and calcium in drinking water and cardiovascular mortality, *Scand. J. Work Environ., Health*, 1991, no. 17.
34. Rylander R. Environmental magnesium deficiency as a cardiovascular risk factor, *J. Cardiovasc. Risk*, 1996, no. 3.
35. Saulvier J. P., Podevin G., Berthier M., Levard G., Oriot D. Staghorn lithiasis in an infant related to high-calcium level mineral water intake, *Arch. Pediatr.*, 72000.
36. Teitte J. E. Incidence of myocardial infarction and the mineral content of drinking water, *Z. Gesamte Inn. Med.*, 1990, no. 45.
37. Verd Vallespir S., Domingues Sanchez J., Gonzales Quintal M., Vidal Mas M., Mariano Soler A. C., de Roque Company C., Sevilla Marcos J. M. Association between calcium content of drinking water and fractures in children, *An. Esp. Pediatr.*, 1992, no. 37.