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Health Effects of Human Exposure to Barium in Drinking Water

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HEALTH EFFECTS OF HUMAN EXPOSURE
TO BARIUM IN DRINKING WATER

by

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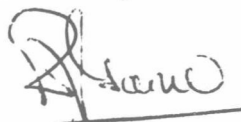
FOREWORD

The primary mission of the Health Effects Research Laboratory is to provide data which are based on health-related research to support the regulatory activities of the Environmental Protection Agency. Research data are used in the Agency's standards setting procedures to insure that man and his environment are protected.

The objectives of the investigation reported herein were to determine whether health effects could be identified in a population exposed to barium in their drinking water. The investigation consisted of an analysis of death rates for communities exposed to barium at a concentration of 2 mg/l or greater as opposed to those with no significant exposure. This analysis showed higher death rates for the communities exposed to barium. The investigation also included a comparison of health data that was collected by household survey from nearly 2,400 people living in two communities whose water supply contained 7 mg/l (West Dundee) and 0.1 mg/l of barium (McHenry) respectively. The comparison of health data showed significant differences in blood pressure with higher readings notable in the male population of West Dundee when the data were refined to correct for the influences of water softening, blood pressure medication, hypertension, and duration of exposure.

The investigators emphasize that the analysis of death rates must be interpreted with caution because of factors that could not be controlled including a greater population change in the high barium communities and the use of home water softeners. They further noted that their household survey data were inconclusive because the blood pressure elevations were not consistent for the total West Dundee population and that additional study was necessary.

This study did not produce a distinctive conclusion that permits us to recommend a safe standard for barium in drinking water. However, the differences identified in death rates at a barium concentration of greater than 2 mg/l and the elevation in blood pressures at 7 mg/l are of primary public health concern. We agree that further study is necessary and plan to conduct a morbidity survey of a population exposed to 2 mg/l of barium in drinking water in order to better identify a no-effect level. In the interim, we do not think it is advisable for the current barium limit of 1 mg/l to be relaxed and we think that communities exceeding the MCL should proceed with plans to reduce barium exposure and avoid the possibility of the occurrence of adverse health effects.



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ABSTRACT

The overall objective of this study was to examine by epidemiologic and supportive laboratory studies, the human health effects associated with ingestion of barium in Illinois drinking water exceeding the maximum contaminant level (MCL) for barium of 1.0 mg/l as stipulated in the National Interim Primary Drinking Water Regulations (NIPDWR). This study is the first of its kind to assess the chronic human health effects associated with ingestion of elevated barium levels in drinking water.

A retrospective epidemiological analysis of age and sex-adjusted cardiovascular death rates for the years 1971-1975 was conducted to examine differences between Illinois communities with elevated drinking water barium levels (>1.0 - 10.0 mg/l) and communities with little or no barium (0.0 - 0.2 mg/l). Results of the mortality study revealed that the high barium communities had significantly higher ($P < 0.05$) death rates for "all cardiovascular diseases" and "heart disease" compared to the low barium communities. Since there was a greater population change in some of the high barium communities compared to the low barium communities and no method of controlling for removal of barium by home water softeners, any inferences drawn about this finding must be interpreted with caution.

A morbidity study was conducted in West Dundee, and McHenry, Illinois to examine whether or not there are differences in mean blood pressure levels and the prevalence of hypertension, cardiovascular, cerebrovascular and renal disease between the populations of these two communities. The major difference between the two communities is that West Dundee has a mean barium concentration in its drinking water approximately 70 fold greater than that found in McHenry's drinking water. Although some significant differences ($P < 0.5$) were found for mean age and sex-adjusted levels of systolic blood pressures between the high barium and low barium communities, the blood pressure data were inconclusive because of inconsistencies in the findings. For instance, a significant difference was found for females living 10 years or less in the community, while no difference was found for females living greater than 10 years in the community. A significant difference was found for males living greater than 10 years in the community when the data were corrected for water softeners and high blood pressure medication. Female blood pressures were not significantly different under these circumstances. Finally, no significant differences were found between the two communities with respect to the prevalence of hypertension, heart disease, stroke, or kidney disease.

This report was submitted in fulfillment of Grant No. R-803918 by the University of Illinois, School of Public Health, Chicago, under the sponsorship of the U.S. Environmental Protection Agency. This report covers the period August 11, 1975 to October 31, 1978.

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Permission to use Illinois mortality tapes was given by Joyce C. Lashof, Director, State of Illinois Department of Public Health in 1976. Her co-operation was especially appreciated.

Analysis of the water samples in 1976-77 was conducted by the Illinois Environmental Protection Agency, Chicago Laboratory. James Miller, Manager, Division of Laboratory Services, approved the use of the Chicago Laboratory for this project; John Murray and James Daugherty directed the water analysis; and Pankaj Parikh performed the atomic absorption analysis. Quality control was conducted by the U.S. Environmental Protection Agency, Region V, Central Regional Laboratory, Chicago, under the direction of Thomas Yeates, Richard Ronan, and Edmund Huff. We are especially grateful to Dorothy Bennett, Division of Public Water Supplies, Illinois Environmental Protection Agency, for supplying us with film records of mineral analyses for water treatment plants in Illinois.

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The cooperation of the West Dundee Village Board, McHenry City Council, McHenry County Department of Health and all residents of these two Illinois communities who participated in the study was greatly appreciated.

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