

STRONTIUM-90 CONTENT IN HUMAN BONE OF  
WEST GERMAN RESIDENTS

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## INTRODUCTION

Quantitative estimations of the radionuclide strontium-90 in human diet deriving from the fallout after nuclear weapons tests in the atmosphere, are still carried out today all over the world. To gain insight into transfer and discrimination of strontium-90 in comparison to calcium in the food chain, examinations of human bone and other tissues are a necessary addition to the estimation of this radionuclide in the food products.

From 1958 to 1971, in the Federal Republic of Germany extensive studies on the strontium-90 content in human tissues were made by the Institute of Forensic and Social Medicine of the University of Kiel. The results of these studies were the basis for evaluating the radiation exposure according to the recommendations of ICRP and they were published in the annual reports "Environmental Radioactivity and Radiation Exposure" by the Government of the Federal Republic of Germany. Furthermore they were included in the UNSCEAR Reports of the United Nations and represent a significant contribution to the stipulations, put forth within the framework of the Euratom contract, on the surveillance and control of environmental radioactivity. These studies were concluded in 1971. In the year 1977, the estimation of strontium-90 in human bone was resumed in co-operation with the Institutes of Forensic Medicine and of Pathology, both of the University of Munich, and the Institutes of Forensic Medicine and of Pathology, both of the University of Saarland/Homburg. Meanwhile results from five years are available.

## MATERIAL AND METHODS

In the years 1977 to 1982, defined sections of the femur or tibia diaphysis were taken from dead male and female persons of all age groups and deepfrozen after the surrounding tissue was removed. The samples collected in this manner were wet ashed with nitric acid and hydrogen peroxide and the subsequent radiochemical separation was made according to the procedures of the Environmental Measurements Laboratory (EML 1982) in a slightly modified method. The content of natural strontium as well as the chemical yield of the strontium carrier were estimated by atomic absorption spectrophotometry in the nitrous oxide/acetylene flame. The beta activity of the separated yttrium-90 counting sample was measured with a low-level omniguard counter and the quantitative determination of calcium was made by complexometric titration with EDTA.

## RESULTS AND DISCUSSION

The results from the year 1977 have shown that in the age group of approx. 15 to 25 years, the intake of strontium-90 into human bone was significantly increased as compared to the 25 to 55 years age group. This can be attributed to the fact that the 15 to 25 year age group were in the first stage of bone growth at the time of maximum fallout in the years 1964-65 and therefore incorporated the radionuclide in increased levels. As compared to other bones of the human body, that part of the femur or tibia diaphysis used for the examinations has only a low turn-over rate, so that the deposited strontium-90 is leaving the bone at a very slow rate. Since the fallout has considerably decreased, only a small amount of strontium-90 is incorporated into human bone today. A follow-up of the strontium-90 concentration in this bone section up to the year 1982 demonstrates that the radionuclide content in bone is slowly decreasing and the maximum concentration is simultaneously shifting to older age groups.

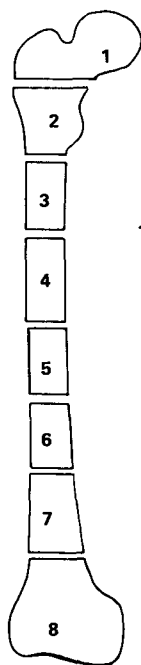
In the year 1982, further bone samples of the 55 years and older age group were examined. On this occasion it was found that a higher intake of strontium-90 is also indicated in this age group. This may be due to an increased osteoporotic or postclimacteric process in the skeletons of this age group which caused, on account of a higher turn-over rate, a stronger incorporation of strontium-90 during or after the maximum fallout period. Natural strontium, however, is absorbed from food and incorporated into the skeleton at uniform levels of concentrations whereby strontium experiences a discrimination in comparison to calcium. For this reason an age-dependent concentration of natural strontium in the examined bone section was not observed.

In the year 1982 a complete right femur (72 years, female) divided into eight sections was examined. The measurement results show that the bone section from slightly below the centre towards the knee joint contains the lowest amount of strontium-90 and the concentration increases in the direction of the epiphyses by about 60 %. This may be explained by the fact that in the maximum fallout period in the years 1964 - 65 the bone growth of the femur was already complete and strontium-90 was incorporated and decorporated again merely by a small turn-over rate in the medium bone section. The increase of the turn-over rate in the direction of the epiphyses caused a higher intake of the fission product. In spite of the also increased decorporation from bone matrix, a higher concentration than in the centre of the femur diaphysis can today still be observed in this region.

Current studies in bone samples, as, e.g., vertebra or ribs no longer report age-dependent concentration of strontium-90. Apparently the radionuclide has largely left the bone matrix on account of the increased turn-over rate in these bones.

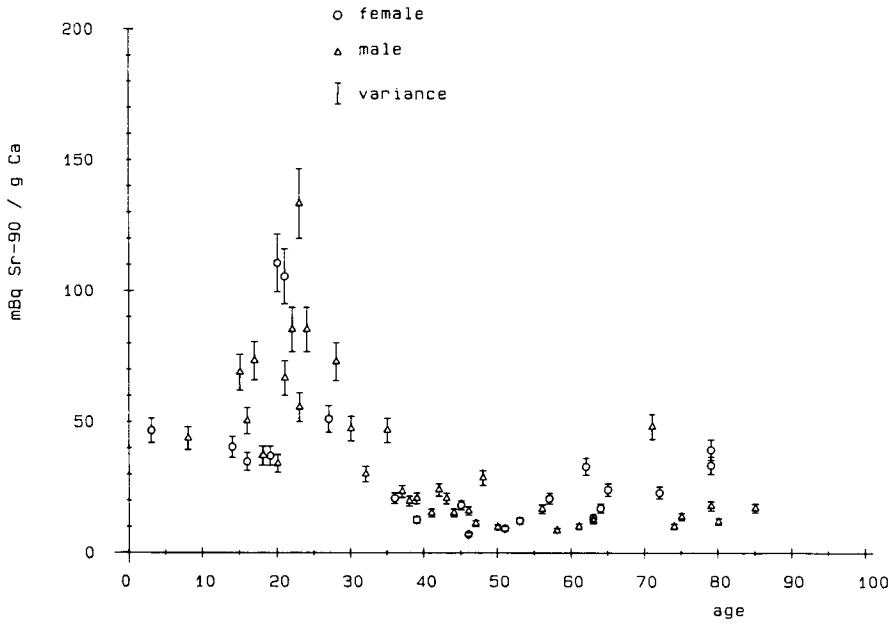
## REFERENCE

- EML 1982 1982 EML Procedures Manual (HASL 300), 25<sup>th</sup> Edition  
Eds. H.L. Volchock, G.de Planque, Environmental  
Measurements Laboratory, U.S. Dept. of Energy, N.Y.



bone section	mBq Sr-90 pro g Ca	mBq Sr-90 pro mg $Sr_{nat}$	mg $Sr_{nat}$ pro g Ca
1	$23 \pm 2$	$97 \pm 10$	$0,24 \pm 0,01$
2	$22 \pm 2$	$98 \pm 10$	$0,22 \pm 0,01$
3	$16 \pm 2$	$74 \pm 7$	$0,21 \pm 0,01$
4	$15 \pm 2$	$73 \pm 7$	$0,20 \pm 0,01$
5	$13 \pm 1$	$63 \pm 6$	$0,20 \pm 0,01$
6	$12 \pm 1$	$56 \pm 6$	$0,22 \pm 0,01$
7	$13 \pm 1$	$63 \pm 6$	$0,21 \pm 0,01$
8	$18 \pm 2$	$80 \pm 8$	$0,23 \pm 0,01$

strontium-90 in human bone of West German residents  
results for 1977



strontium-90 in human bone of West German residents  
results for 1982

