High Background Radiation Areas of Ramsar, Iran

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Humans, animals and plants have been exposed to natural radiation since the creation of life. Interestingly, life evolved in a radiation field that was much more intense than today. The annual effective radiation dose from natural and man-made sources for the world's population is about 3 mSv, which includes exposure to alpha radiation from radon and its progeny nuclides. Nearly 80% of this dose (2.4 mSv) comes from natural background radiation, although levels of natural radiation can vary greatly. Ramsar, a northern coastal city in Iran, has areas with some of the highest levels of natural radiation measured to date. The effective dose equivalents in very high background radiation areas (VHBRAs) of Ramsar in particular in Talesh Mahalleh, are a few times higher than the ICRP-recommended radiation dose limits for radiation workers.

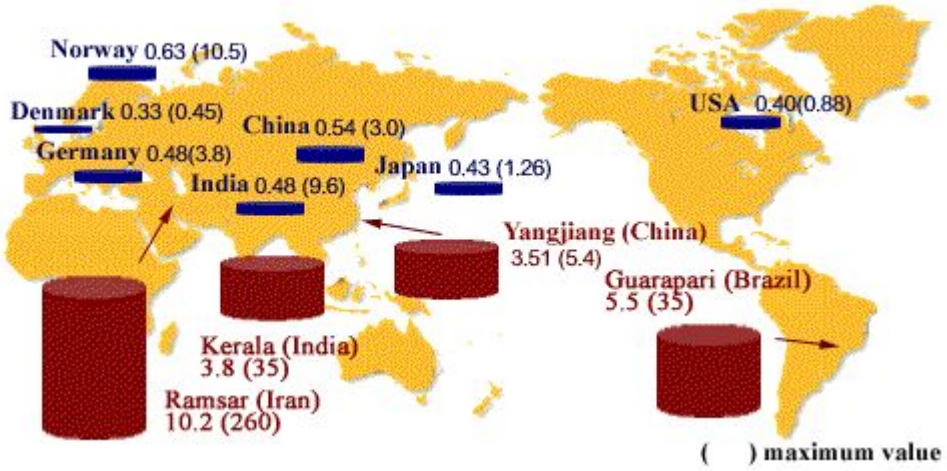

Figure 1. High Background Radiation Areas Around the World. Numbers given are in mSv/year.

Figure adapted from Health Research Foundation, Kyoto, Japan, with permission.

According to UNSCEAR 2000 report, Ramsar, in northern Iran, has some inhabited areas with the highest known natural radiation levels in the world.

In Guarapari, Brazil, a city of 80 000 inhabitants built on the seaside, peak measurements made by EFN on the thorium-rich beach were as high as 40 microSv/hour (about 200 times higher than the average natural background radiation in other areas of the world).

But the highest known year-average human exposure levels measured in an inhabited location up to date is in Ramsar, Iran.

Inhabitants who live in some houses in this area receive annual doses as high as 132 mSv from external terrestrial sources. The radioactivity of the high background radiation areas (HBRAs) of Ramsar is due to Ra-226 and its decay products, which have been brought to the surface by the waters of hot springs. There are more than 9 hot springs with different concentrations of radium in Ramsar that are used as spas by both tourists and residents.

Figure 2. Hot water containing different concentrations of Radium flows through streams.

According to the results of the surveys performed to date the radioactivity seems primarily to be due to the radium dissolved in mineral water and secondarily to travertine deposits having elevated levels of thorium combined with lesser concentrations of uranium (Sohrabi 1990). Due to extraordinary levels of natural radiation in these areas, in some cases 55-200 times higher than normal background areas, some experts have suggested that dwellings having such high levels of natural radiation need urgent remedial actions (Sohrabi 1997). In spite of this, many inhabitants still live in their unaltered paternal dwellings.

Figure 3. A calibrated survey meter shows the contact dose rate.

The preliminary results of cytogenetical, immunological and

hematological studies on the residents of high background radiation areas of Ramsar have been previously reported (Mortazavi et al. 2001, Ghiassi-Nejad et al. 2002 and Mortazavi et al. in press), suggesting that exposure to high levels of natural background radiation can induce radioadaptive response in human cells. Lymphocytes of Ramsar residents when subjected to 1.5 Gy of gamma rays showed fewer induced chromosome aberrations compared to residents in a nearby control area whose lymphocytes were subjected to the same radiation dose. Despite the fact that in *in vitro* experiments lymphocytes of some individuals show a synergistic effect after pretreatment with a low dose(Mortazavi et al. 2000), none of the residents of high background radiation areas showed such a response.

Based on results obtained in studies on high background radiation areas of Ramsar, high levels of natural radiation may have some bio-positive effects such as enhancing radiation-resistance. More research is needed to assess if these bio-positive effects have any implication in radiation protection (Mortazavi et al. 2001). The risk from exposure to low-dose radiation has been highly politicized for a variety of reasons. This has led to a frequently exaggerated perception of the potential health effects, and to lasting public controversies.

Figure 4. A group of scientists are visiting HBRAs of Ramsar.

Current radiation protection recommendations are based on the predictions of an assumption on linear, no-threshold dose-effect relationship (LNT). Beneficial effects and lack of detriment after irradiation with low levels of ionizing radiation, including a prolonged exposure to high levels of natural radiation of the inhabitants of HBRAs, are inconsistent with LNT (Mortazavi et al. 1999).

Our preliminary results suggest that prolonged exposure to very

high levels of natural radiation could lead to the induction of radiation resistance among exposed individuals, which has interesting implications for many aspects of radiation protection policy.

Figure 5. Experts are measuring dose rates in different points of an inhabited area.

The phenomenon of radioresistance in living organisms has long been a matter of interest for scientists. Experiments on Drosophila nebulosa collected in the woods of a high background radiation area in Brazil indicated the addition of some genes caused the radioresistance found in these flies compared to flies collected from adjacent control woods. In humans it is also possible that genetic alterations have occurred over the span of many generations to induce the radioresistance noted in our study. More research is needed to clarify the mechanisms that make individuals radioresistant.

Figure 6. Two survey meters show the dose rates of 142 and 143 micro Gy/h on the wall of the bedroom of one dwelling.

There are many other areas with high levels of background radiation around the world, and epidemiological studies have indicated that natural radiation in these areas is not harmful for the inhabitants. Results obtained in our study are consistent with the hypothesis that a threshold possibly separates the health effects of natural radiation from the harm of large doses. This threshold seems to be much higher than the greatest level of natural radiation.

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Bruno Comby and Javad Mortazavi in Kyoto on April 19th, 2002, discussing about high natural background radiation in Guarapari and Ramsar, and sharing their scientific work and knowledge on the effect of low doses of radiation.

With courtesy to S. M. Javad Mortazavi, Biology Division, Kyoto University of Education, Kyoto, Japan