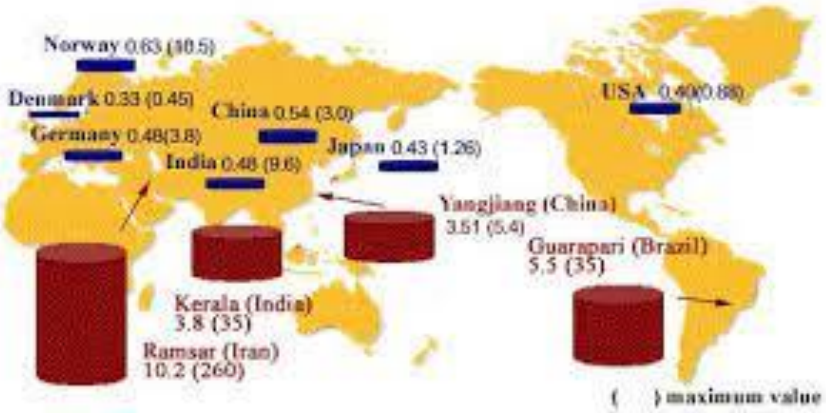
Reconfirmed After 20 years

Adaptive Response in the Residents of High Background Radiation Areas (HBRAs) of Ramsar



Reconfirmed after 20 years
Adaptive Response in the Residents of HBRAs of Ramsar

2002

VERY HIGH BACKGROUND RADIATION AREAS OF RAMSAR, IRAN: PRELIMINARY BIOLOGICAL STUDIES

Health Physics

M. Ghiassi-nejad,*† S. M. J. Mortazavi,*‡ J. R. Cameron,§ A. Niroomand-rad, and P. A. Karam¶

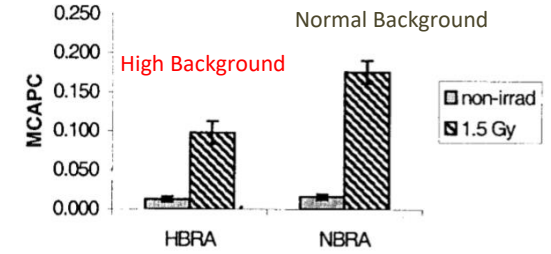
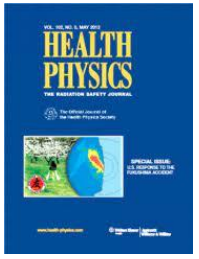


Fig. 5. MCAPC in irradiated and non-irradiated cells from inhabitants of HBRAs and NBRAs. Samples from inhabitants of both areas were examined for chromosomal abnormalities before and after irradiation with 1.5 Gy. Although there is no statistically

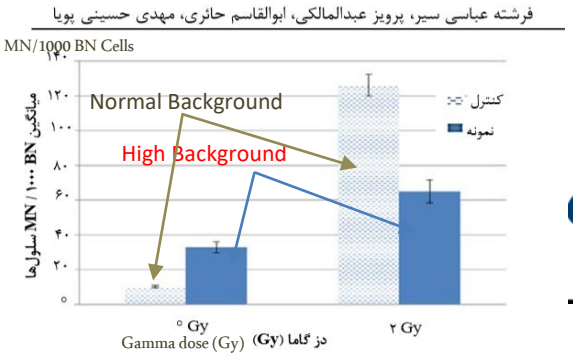


2022

Chronic exposure effect study on Ramsar high background natural radiation areas (HBNRAs) residents using micronucleus assay

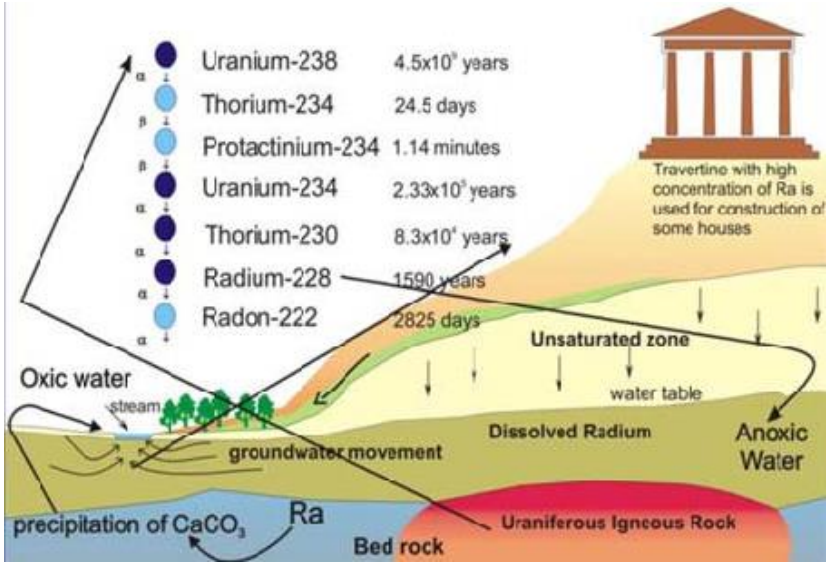
Journal of Nuclear Science and Technology

Abbasi Siar1,2, P. Abdolmaleki*2, A. Haeri1, M. Hosseini Pooya3



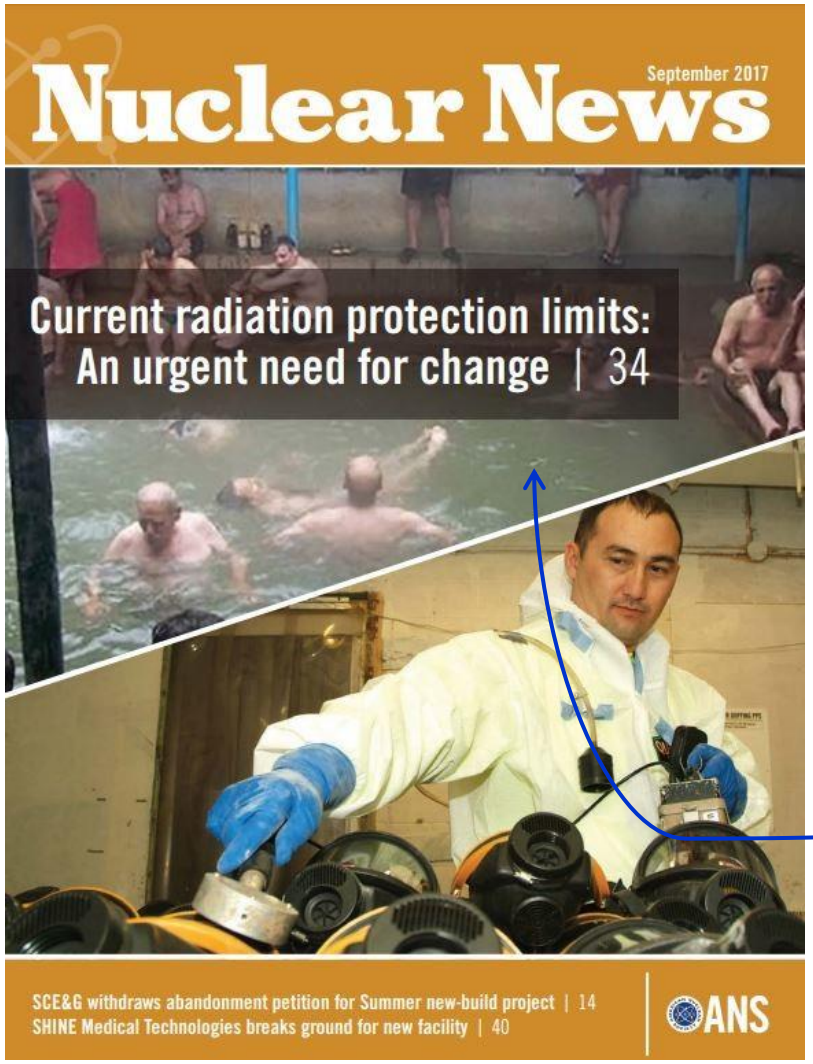
شکل ۶. تعداد هستک‌ها قبل و بعد از پرتودهی نمونه خون در نمونه‌های مورد مطالعه و کنترل.

"Mortazavi and his colleagues have previously investigated the health effects of exposure to above-the-normal levels of natural ionizing radiation in HBNRAs of Ramsar [22-28]. They have also published the first reports on the induction of radio-adaptive response in the inhabitants of these areas [21]".



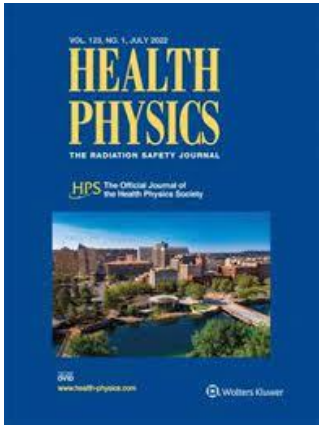
doi: 10.31661/jbpe.v0i0.671
PMCID: PMC6709348PMID: 31531291

Natural Hot Springs Spas in Ramsar



Cover of Nuclear News of the American Nuclear Society (ANS),Sep 2017

"In the upper photo, men in Ramsar, Iran, located in a region known for having the highest levels of natural background radiation on Earth— about 260 millisieverts per year versus the world average of 2.4 mSv per year— bathe in a natural hot springs spa, with high radium levels, in the city's Talesh Mahalleh district"



Adaptive response in the residents of High Background Radiation Areas (HBRAs)

M Ghiassi-Nejad, SMJ Mortazavi, JR Cameron, A Niroomand-Rad, PA Karam
Health physics, 2002
http://ww.nuceng.ca/refer/radiation/Ramsar.pdf

507 citations recorded by Google Scholar, as of Oct 3, 2022

VERY HIGH BACKGROUND RADIATION AREAS OF RAMSAR, IRAN: PRELIMINARY BIOLOGICAL STUDIES

M. Ghiassi-nejad,*† S. M. J. Mortazavi,*‡ J. R. Cameron,§ A. Niroomand-rad,‖ and P. A. Karam¶

Abstract—**People in some areas of Ramsar, a city in northern Iran, receive an annual radiation absorbed dose from background radiation that is up to 260 mSv y^{-1}, substantially higher than the 20 mSv y^{-1} that is permitted for radiation workers. Inhabitants of Ramsar have lived for many generations in these high background areas. Cytogenetic studies show no significant differences between people in the high background compared to people in normal background areas. An *in vitro* challenge dose of 1.5 Gy of gamma rays was administered to the lymphocytes, which showed significantly reduced frequency for chromosome aberrations of people living in high background compared to those in normal background areas in and near Ramsar. Specifically, inhabitants of high background radiation areas had about 56% the average number of induced chromosomal abnormalities of normal background radiation area inhabitants following this exposure. This suggests that adaptive response might be induced by chronic exposure to natural background radiation as opposed to acute exposure to higher (tens of mGy) levels of radiation in the laboratory. There were no differences in laboratory tests of the immune systems, and no noted differences in hematological alterations between these two groups of people.**
Health Phys. 82(1):87–93; 2002

Key words: health effects; naturally occurring radionuclides; radiation, background; exposure, population

INTRODUCTION

LIFE EVOLVED in an environment with higher radiation levels than exist today, and background radiation levels today are lower than at any time in the history of life on Earth. Since life first evolved, background radiation levels have decreased by a factor of about 10, although there has been a negligible reduction since the evolution of humans (Karam and Leslie 1999). At present, natural background radiation levels on Earth vary by at least two orders of magnitude today, so humans and other organisms are subject to a wide range of background radiation levels. The annual background doses in some areas of the world are given in Table 1. These do not include contributions from radon progeny in the lungs, which are estimated to be even greater than the absorbed doses shown if the radiation weighting factor of alpha particles is taken into account. Areas with unusually high background (high background radiation areas, or HBRAs) are found in Yangjiang, China; Kerala, India; Guarapari, Brazil; and Ramsar, Iran. Some areas of Ramsar, a city in northern Iran, have among the highest known background radiation levels in the world. For the purposes of this paper, "dose" will be used to mean absorbed beta/gamma radiation dose because the contribution of alpha emitters is not considered.

The high background radiation in the "hot" areas of Ramsar is primarily due to the presence of very high amounts of ^{226}Ra and its decay products, which are brought to the Earth's surface by hot springs. Groundwater is heated by subsurface geologic activity and passes through relatively young and uraniferous igneous rock. Radium is dissolved from the rocks by hot ground water. Uranium is not dissolved because the groundwater is anoxic and uranium is insoluble in anoxic waters (Langmuir 1978; Grandstaff 1976). When the groundwater reaches the surface at hot spring locations, travertine, a calcium carbonate mineral, precipitates out of solution with dissolved radium substituting for calcium in the mineral. A secondary cause of high local radiation levels is travertine deposits with a high thorium concentration (Sohrabi 1990). The radioactivity in local soils and the food grown in them are also high because soils are derived from the weathering of local bedrock. Table 2 details the range of radioactivity levels measured in some local rocks and soil samples.

There are at least nine known hot springs with various concentrations of radioactivity around Ramsar. Residents and visitors use these springs as health spas. Residents of these "hot" areas have also used the residue of the hot springs as building materials to construct

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ELSEVIER

Radioactivity in the Environment

Volume 7, 2005, Pages 1141-1147

Apparent lack of radiation susceptibility among residents of the high background radiation area in Ramsar, Iran: can we relax our standards?

S.M.J. Mortazavi [a], P.A. Karam [b]

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https://doi.org/10.1016/S1569-4860(04)07140-2

S. M. J. Mortazavi and P. A. Karam, "Apparent lack of radiation susceptibility among residents of the high background radiation area in Ramsar, Iran: can we relax our standards?," in *Radioactivity in the Environment*, vol. 7: Elsevier, 2005, pp. 1141-1147.

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> J Biomed Phys Eng. 2019 Aug 1;9(4):483-486. doi: 10.31661/jbpe.v0i0.1138. eCollection 2019 Aug.

Martian Residents: Mass Media and Ramsar High Background Radiation Areas

Abbasi S [1], Mortazavi S A R [2], Mortazavi S M J [1 3]

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PMID: 31531302 PMCID: PMC6709356 DOI: 10.31661/jbpe.v0i0.1138

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Abstract

Considering current controversies regarding the health effects of low doses of ionizing radiation,

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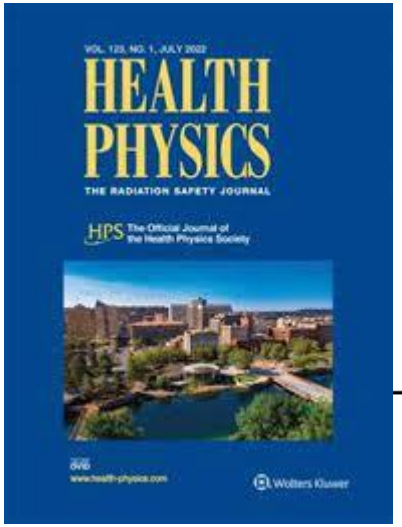

Note

Ramsar, Iran, as a Natural Radiobiological Surrogate for Mars

James S. Welsh, Joseph J. Bevelacqua, and S.M.J. Mortazavi[1]

***Abstract*—Terrestrial experiments involving acute exposures of low-LET radiation on inbred lab animals are quick, simple, and inexpensive but are relatively uninformative about the real radiobiological hazards of planned manned space missions. A more predictive model could involve human beings chronically exposed to "space-like" high-LET radiation. Such radiation exposure has been ongoing for thousands of years in Ramsar, Iran, and some other high-LET high background radiation regions on Earth. Examining the health of Ramsar residents can be illuminating and potentially relevant to space missions.**
Health Phys. 122(4):508–512; 2022

Key words: health effects; radiation, background; radiation, low-level; radiation protection

surface has been measured to be significantly higher still at approximately 0.5–1 mSv d^{-1} (Hu et al. 2009; Simonsen et al. 1990) The radiation dose during a round trip to and from Mars using a fuel-efficient Hohmann transfer has been estimated at between 906 mSv and 1,554 mSv (Bloshenko et al. 2021).

Despite common concerns about the potential of space radiation to induce aging and other adverse health effects, the data are ambivalent. For example, Honda et al. (2012) reported lifespan extension in roundworm (*Caenorhabditis elegans*) upon exposure to the space environment or when genes that were downregulated in space were experimentally