

New findings in the very high natural radiation area of Ramsar, Iran

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Abstract. Ramsar, a northern coastal city of Iran, has some high levels of natural radiation areas (HLNRAs) as well as about 50 hot springs with low and high radium contents usually used for medical treatment purposes. Different radiological measurements, as well as cytogenetical, immunological and preliminary biological and epidemiological studies have already been performed in this region. The purpose of this study is to review new findings in very high background radiation areas of Ramsar, in order to identify information relevant to exposures in these areas and the potential and known impacts of such exposures on public health, and also to make recommendations for further studies. At present, there is no reliable radio-epidemiological data regarding the incidence of cancer in HLNRAs of Ramsar. In this regard, more extensive researches are invited, in particular on epidemiology and radiobiology as well as on internal dose assessment. © 2004 Elsevier B.V. All rights reserved.

Keywords: Natural radiation; Exposure; Ramsar

1. Introduction

Ramsar region, a northern coastal city of Iran, has been the subject of concern as a highly radioactive region for the past 40 years. The hot springs, which are used by the inhabitants and visitors as spas, are the main sources for the distribution of natural radionuclides (especially for ²²⁶Ra and its decay products), in turn leading to the creation of high levels of natural radiation areas (HLNRAs) in the region [1].

The present study briefly reviews the investigations that have already been carried out in HLNRAs of Ramsar, with the emphasis on new findings and related results, to mainly

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identify the potential and known impacts of exposures in HLNRA of this region on public health, and also to make recommendations for further studies.

2. Studies on HLNRA of Ramsar

The most studies carried out in such areas include a survey of environmental indoor and outdoor gamma exposure; external personal dosimetry of inhabitants; determination of ^{226}Ra in soil, beans, food stuff, public water supplies, hot springs, etc.; determination of ^{222}Rn levels in rooms and different locations of houses, schools and Ramsar Hotels in different seasons; cytogenetic and preliminary biological studies of inhabitants compared to that of a control area; radiological studies of a house with a high potential for internal and external exposure; studies of building construction materials; air particle size distributions; vegetable-to-soil concentration ratios (CRs) for ^{226}Ra ; exposure to ^{226}Ra from consumption of vegetables and biosorption of ^{226}Ra via bacterial strains [1–14]. The geographical location of Ramsar is illustrated in Fig. 1.

3. Results and discussion

People in some areas of Ramsar receive an annual effective dose from background radiation of up to $260 \text{ mSv year}^{-1}$, substantially higher than that is permitted for radiation workers [8]. However, the preliminary results of the studies of the people living in high background radiation areas of this region show no observable detrimental effect [9]. Furthermore, the frequency of chromosome aberrations (CA) in the lymphocytes of the inhabitants of very high background radiation areas of Ramsar after exposure to a challenge dose of 1.5 Gy gamma rays was significantly lower than that of the inhabitants of a normal background radiation area [8], suggesting enhanced repair of induced DNA damage resulting from exposure to elevated levels of background radiation [9]. These findings suggest that exposure to high levels of natural radiation does not require remedial or corrective actions [9].

The results of studies on the long-term effects of high level natural radioactivity on some immunological and cytogenetical parameters in Ramsar inhabitants showed a



Fig. 1. Geographical location of Ramsar region.

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