Estimation of the radiological risk related to the presence of Radon 222 in a hydrotherapy centre in Tunisia.

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The (222)Rn concentration in air was measured in a thermal water spa used as a hydrotherapy centre in Tunisia. The associated health risk for employees and patients due to the inhalation of (222)Rn and its progeny was estimated. A protection scheme for the employees of the spas has been designed. Results show that the (222)Rn concentration varies in the range 33-589 Bq m(-3). The (222)Rn concentrations measured in the present study show lower values in comparison to those reported for thermal spas in other countries. The (222)Rn concentration in different rooms of the spa depends mainly on the ventilation rate. A model based on a dosimetric approach was adopted to estimate the radon risk considering the (222)Rn concentration, the time spent in the spa, and the radioactive equilibrium factor F. The annual effective dose was found to vary between 0.2 and 1.7 mSv for workers while the range for patients was from 2.8 x 10(-4) to 1.1 x 10(-4) mSv. These values are within the ICRP recommended values.

Long-term efficacy of radon spa therapy in rheumatoid arthritis--a randomized, sham-controlled study and follow-up.

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OBJECTIVE: To quantify the efficacy of a series of baths containing natural radon and carbon dioxide (1.3 kBq/l, 1.6 g carbon dioxide/l on average) versus artificial carbon dioxide baths alone in patients with rheumatoid arthritis. SUBJECTS: Sixty patients participating in an in-patient rehabilitation programme including a series of 15 baths were randomly assigned to two groups. DESIGN: Pain intensity (100 mm visual analogue scale) and functional restrictions [Keitel functional test, Arthritis Impact Measurement Scales (AIMS questionnaire)] were measured at baseline, after completion of treatment and 3 and 6 months thereafter. To investigate whether the overall value of the outcomes was the same in both groups, the overall mean was analysed by Student's t-test for independent samples. RESULTS: The two groups showed a similar baseline situation. After completion of treatment, relevant clinical
improvements were observed in both groups, with no notable group differences. However, the follow-up revealed sustained effects in the radon arm, and a return to baseline levels in the sham arm. After 6 months, marked between-group differences were found for both end-points (pain intensity: -16.9%, 95% confidence interval -27.6 to -6.2%; AIMS score: 0.57, 95% confidence interval 0.16 to 0.98). The between-group differences were statistically significant for both overall means (pain intensity, P: = 0.04; AIMS, P: = 0.01). CONCLUSION: Marked short-term improvements in both groups at the end of treatment may have masked potential specific therapeutic effects of radon baths. However, after 6 months of follow-up the effects were lasting only in patients of the radon arm. This suggests that this component of the rehabilitative intervention can induce beneficial long-term effects.

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[Effects of radon and peloid therapy on functional condition and quality of life in patients with seronegative spondyloarthritis]

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Radon and peloid therapy was given to 88 patients with seronegative spondyloarthritis. Of them, 58 had ankylosing spondyloarthritis (30 patients had a more severe affection of the spine and 28--of peripheral joints), 30 had reactive arthritis and Reiter’s disease. Water radon baths and low-temperature peloid applications produced in all the patients analgetic, anti-inflammatory effects, improved functional condition and quality of life, i.e. self-service, occupational skills, wellness, sleep and libido.

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Radon in the spas of Croatia.

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Radon concentrations in air and geothermal water of the spa pools in Croatia were measured and the average values of 40.3 and 4.5 kBq/m³ were obtained, respectively. Great difference between radon concentrations in pool and spring water was considered as a result of mixing normal and geothermal water in the
pool as well as the radon decay. Estimation of an effective dose, received by
the personnel in the Bizovac spa, gave the value of 0.27 mSv/y. At the location
Stubica, the transfer factor of the radon for air and thermal water in the pool
was calculated, and the value of 4.9+/-0.7 x 10(-3) was obtained.

Radon exposure in the thermal spas of Lesvos Island--Greece.

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The aim of this work is to study the exposure due to radon to bathers and
personnel in the spas of Lesvos Island under a specific use pattern. 222Rn
concentrations in the supplying water were measured during a long time
period. Variations in indoor 222Rn, attached and unattached progenies, and
influence of the ambient atmosphere were thoroughly analysed during bath
treatment for the purpose of investigating a consequent probable short-term
health impact. Concentration peaks both for 222Rn and PAEC were found to
appear during bathtubs filling. These peaks considered imposing an additional
short-term radiation burden for spa users. The additional doses delivered to
bathers during bath treatment were found to be very low and for personnel did
not exceed the value of 5 mSv per year.

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Recent international recommendations have included exposure to natural
radiation as one of the sources to monitor in certain occupationally exposed
groups. Among those mentioned are workers in thermal spas, who may be
exposed to high radiation doses due to the high concentration of radon in the
indoor air of the spa. This paper presents the methodology and the results of
an evaluation of radiation doses to the staff in different thermal spas in Spain.
Different series of samples were collected and measurements made for the
radon concentrations in water in 54 spas and in air in 20 spas. In six of the
latter group, the air radon concentration was studied in different working areas
occupied by the employees. The radon concentrations in water were between
<2 and 775 x 10(3) Bq m(-3). The radon concentrations in air were between
<10 and 5,200 Bq m(-3). The latter were used to estimate the dose received
by each occupational group in the spa by taking into account the radon
concentration in their main working area. By means of an exposure-dose
conversion factor of 1.43 Sv per J h m(-3), the estimated effective doses were
found to lie between 1 and 44 mSv y(-1). This upper limit is higher than the
recommended annual limit of 20 mSv y(-1) for an occupational dose.
Radon variations during treatment in thermal spas of Lesvos Island (Greece).

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The aim of this paper was to study the variations of radon and daughter nuclei during treatment in the thermal spas of Lesvos Island (Greece). For this purpose, in the thermal spas of Lesvos we have measured the radon concentrations of thermal waters, as well as indoor radon, daughter and coarse particle (>500 nm) concentration. Various instruments and procedures were employed for measurements. Radon concentrations of thermal waters were found to lie in the range 10 and 304 Bq l\(^{-1}\). Concentration peaks both for radon, radon daughter and coarse particle, were found to appear during filling of baths in the treatment process. The doses delivered to the bathers during treatment were in the range of 0.00670 mSv per year to 0.1279 mSv per year, while the doses delivered to personnel were below 20 mSv per year.

Radioactivity in Spanish spas.

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There are large number of spas in Spain and there is a lack of data concerning their radioactivity. The levels of radioactivity in a wide sample of Spanish spas were measured with special attention being paid to the radon and radium concentrations in the water, and to radon concentration in the indoor air of the spas. This study is primarily concerned with the radioactivity of the spas of one region in Spain--Cantabria--and particularly one spa where we measured radon levels in water as high as 824 Bq/l and over 5000 Bq/m3 in the air of the rooms. We then considered a wider sample including virtually all of the radioactive spas in the country. The results indicate that a fairly large number
of spas have radon levels in water that are moderately high and they are used for the treatment of diseases without radiation protection measures for patients or staff at the spas.
natural and man-made ionising radiation in Cyprus. Radon levels in aquatic systems are relatively low due to an exhaustive utilisation of ground water resources and also to the increased input of desalinated sea water in the water distribution network and eventually into the ground water reservoirs.

Concentrations of radon and its progeny in the rooms of Polish spas.

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Radon concentrations and radon-daughter exposures of workers have been determined in three Polish spas where radon is used as a therapeutic agent. A wide range of values for both parameters was observed during the late 1970s, with some exposures above the annual limit of 3.5 WLM, particularly among technical personnel at a spa using uranium ore as a source. A downward trend in these exposures in recent years reflects the effect of improved practices.

Estimates of the dose due to 222Rn concentrations in water.

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About 300 samples of groundwater were collected in the region of Extremadura (Spain) in order to analyse their radon activity concentrations. Correlations with the geological characteristics of the aquifer soil were studied. Internal doses by inhalation due to radon exhalation from the water sample and doses by ingestion were estimated. A model was used to calculate the lung dose due to inhalation of radon exhaled from the water. The estimated lung dose range found for the samples was from $2.1 \times 10^{-3}$ to $13 \text{ mSv a}^{-1}$ (the average contribution to the dose due to radon inhalation in Spain being approximately $1.2 \text{ mSv a}^{-1}$). The estimated dose by ingestion ranged from $4.1 \times 10^{-4}$ to $3.3 \text{ mSv a}^{-1}$. 