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Preliminary results of the risk perception of radon exposure

F. COPPOLA(1)(2)(*), G. LA VERDE(1)(2), F. LOFFREDO(1)(2), M. QUARTO(2)(3), V. ROCA(1)(2) and M. PUGLIESE(1)(2)

(1) *Dipartimento di Fisica "Ettore Pancini", Università degli Studi di Napoli Federico II Napoli, Italy*
(2) *INFN, Sezione di Napoli - Napoli, Italy*
(3) *Dipartimento di Scienze Biomediche Avanzate, Università degli Studi di Napoli Federico II Napoli, Italy*

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Summary. — The Council Directive 2013/59/Euratom regulates radon exposures in dwellings for the first time in the European Union. It establishes that Member States, to address long-term risks from radon exposures in dwellings, buildings with public access and workplaces for any source of radon ingress, shall establish a national action plan considering the issues set out in Annex XVIII. Member States shall increase public awareness about indoor radon risk, the importance of carrying out indoor radon concentration measurements and the availability of radon concentration reduction techniques. In this paper we present preliminary data, collected in the district of Naples (Italy), on the public's knowledge regarding the risks associated with exposure to radon. The collected data, based on a specifically designed questionnaire, provide some points of reflection both for the optimization of the questionnaire itself, for future surveys, and for the information program for the population.

1. – Introduction

Radon (222-Rn) is a radioactive noble gas with a half-life of 3.8 days, arising from the decay chain of uranium-238, which is present throughout the Earth's crust. Radon and its short-lived decay products in indoor places are recognized as the main sources of public exposure by natural radioactivity, contributing for nearly 50% of the global mean effective dose to the general population [1]. Radon was classified as a human lung carcinogen by the International Agency for Research on Cancer (IARC) in 1988 [2], and EPA 2003 [3] has reported that the radon is the second risk factor for lung cancer

(*) Corresponding author. E-mail: fulvio.coppola@unina.it

after smoking. Two of the short-lived progeny, polonium-218 and polonium-214, can be deposited, after inhalation, in the bronchial epithelium and, emitting alpha particles, they can damage the lung tissue, thereby increasing the probability of having lung cancer.

Pooled analyses of epidemiological case-control studies on lung cancer risk and radon exposure in dwellings have shown that the lung cancer relative risk increases with long-term average radon concentration, *i.e.*, radon concentration averaged over periods of 20–30 years [4-6]. Epidemiological studies on residential exposure to radon have demonstrated "a statistically significant increase of lung cancer risk from prolonged exposure to indoor radon at levels of the order of 100 Bq m^{-3}" [7].

In recent years some studies carried out on a local scale, in the territory of the Campania and Puglia regions (Italy) to investigate the radon concentration in dwellings, have shown that the annual average radon concentration ranges from 107 to 354 Bq m^{-3}, calculated as arithmetic mean of the measures [8-11]. Furthermore, the radon concentrations at underground and ground level are comparable and are statistically higher compared with that of first and second floors.

Within the European Union, the framework for national regulation on radon was previously based on the Council Directive 96/29/Euratom for radon in a workplace. This Directive did not impose requirements for residential radon exposures, which remained covered only by the European Recommendation 90/143/Euratom [12]. In the new Directive 2013/59/Euratom [7], protection against indoor exposure to radon in both workplaces and dwellings is clearly regulated. In Italy there is no legislation for protection against radon exposure in dwellings. The new Directive states that Member States shall establish a national Reference Level for annual average radon concentration, in workplace and in dwellings, which cannot be higher than 300 Bq m^{-3}. This reference level for dwellings is also recommended by the IAEA [13], as well as by the WHO [14] and ICRP [15].

"Member States shall establish a national action plan addressing long-term risks from radon exposures in dwellings, buildings with public access and workplaces". The Directive indicates, in Annex XVIII, the items to be considered in preparing the national action plan. Member States shall identify areas where the annual average radon concentration in a significant number of buildings exceeds the reference level. Moreover, Member States shall develop strategies to make available information "on indoor radon exposure and the associated health risks, on the importance of performing radon measurements and on the technical means available for reducing existing radon concentrations". These policies shall aim to "increase public awareness and inform local decision makers, employers and employees of the risks of radon, including in relation to smoking". The European project Radon Prevention And Remediation (RADPAR) has dedicated a specific section to the "improving radon risk communication" [16]. Naturally it is also useful to verify the results achieved after an information campaign to the population.

Although the risk of radon exposure is a well-known problem in the scientific community, population awareness about this risk appears to be still lacking. The aim of this paper is to present and discuss the results of a survey conducted locally, in three cities (Ischia, Sorrento and Scafati) in the district of Naples, to understand the level of risk perception for exposure to radon widespread among the population.

2. – Materials and methods

A questionnaire was developed to collect information from the citizens of the three cities Ischia, Sorrento and Scafati. The questionnaire was elaborated with other research

TABLE I. – *Questions and preselected answers used in the survey.*

Questions	Gender	Age	Place of origin	Level of education	Knowledge of radon risk	Information source
Answers	male	< 30y	residential	primary school lower secondary school	Yes	newspaper TV
	female	30–50y	tourist	secondary school	No	training project
		> 50y		degree		events

groups to make the result of the survey homogeneous at national level. The questionnaire is composed of questions and preselected answers which are shown in table I. Only the data referring to the resident population are presented in this paper. The towns have been chosen considering that in these areas information and training projects on the risks associated with indoor radon exposures have been carried out: in Ischia and Sorrento training programs have been held for about 10 years, by collaboration among universities, research institutes and local schools, that have involved hundreds of students and dozens of teachers. In Scafati, only last year, an information program on the risks associated with radon was held at a single technical institute. The collected data can give information on the radon risk awareness widespread among the population and the effects of the training project.

The survey was conducted with the collaboration of the students and teachers who interviewed the population, over a period of four-five weeks, organizing teams placed in the main square of the town.

3. – Result and discussion

In Ischia, the people surveyed were 390, in Sorrento they were 276 and in Scafati they were 192. The results of the distribution according to gender and age are illustrated in fig. 1. The analysed population is distributed approximately uniformly with respect to gender and age.

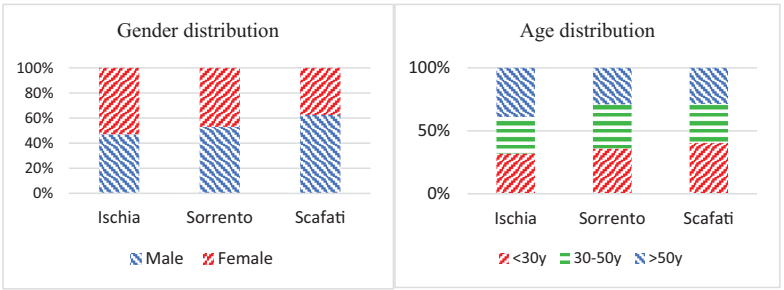

Fig. 1. – Distribution by gender (left) and age (right) of the interviewed population.

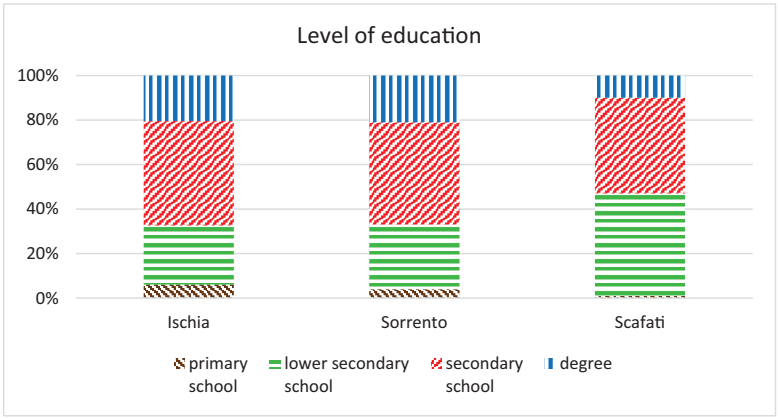

Fig. 2. – Level of education of the interviewed population.

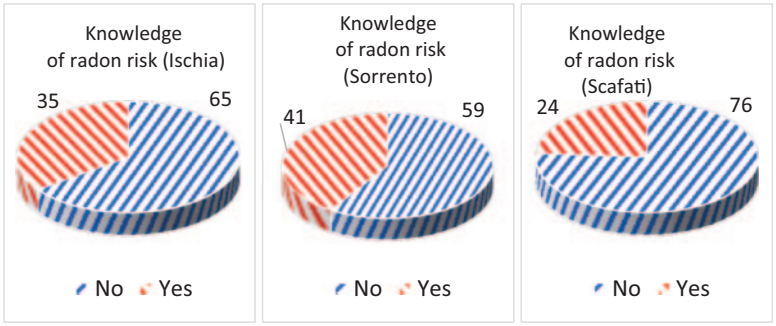

Fig. 3. – Percentage of people interviewed who know of the radon risk in Ischia (left), in Sorrento (centre) and in Scafati (right).

The level of education of the interviewed population can be considered a medium-high level (fig. 2): people who obtained a diploma are in the range 43–46% and those who obtained a degree are in the range 10–21%.

The results show that the percentage of people who know the risk of radon exposure is from 35 to 41 percent in cities where training projects have been held for about 10 years, while in Scafati it is equal to 24 percent (fig. 3). Among those who said that they knew the risk of radon the main source of information is represented by training projects (47–58%) in the Ischia and Sorrento cities, while for the city of Scafati the information sources have about the same importance.

4. – Conclusion

The public knowledge of the risk for exposure to radon was examined through a survey aimed at the population in a limited territory of the district of Naples.

The development, by universities and research institutes, of training projects with the involvement of local schools, can make an important contribution to increasing the public awareness of the radon risk. Newspapers and television can also contribute to achieving the same purpose.

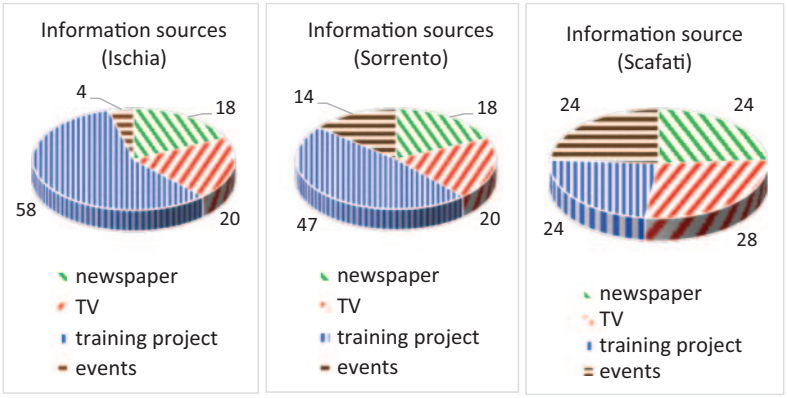

Fig. 4. – Percentage distribution of sources of information on the radon risk in Ischia (left), in Sorrento (centre) and in Scafati (right).

Although the results of this article are based on data referring to a small number of interviewed people, and for this reason they are presented in the form of preliminary results, they provide the basis for some reflections. Radon information campaigns can be improved. Probably better results can be achieved by using different information techniques: press releases, sessions on local radio, meetings with local communities with the participation of experts in radon risk, training programs for students. Naturally, satisfactory results will not be obtained unless political decision makers, local authorities and professional associations are involved.

It is equally important to assess the public's knowledge and perception of the radon risk after a radon communication campaign. The questionnaires can be improved for future surveys. It would be useful to have some not preselected questions to obtain, for example, more precise information on the quality and quantity of information assimilated by the interviewed person. Furthermore, it may be useful to introduce other questions to understand, for example, if it is known that smoking amplifies the risk from radon exposure at the population level. It would be equally important to ask the respondents whether they would be willing to make radon concentration measurements in their homes and possibly to take actions to reduce radon exposure.

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