



# HEALTH EFFECTS ASSESSMENT IN POPULATION EXPOSED TO $^{222}\text{Rn}$ IN DRINKING WATER

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## INTRODUCTION

Rn is colourless, odourless and tasteless gas; is both chemically inert and imperceptible, its decays into a series of progeny some of which are short-lived and emit bursts of harmful alpha-particles.

As a natural radioactive element  $^{222}\text{Rn}$  and its daughters enter the human body by inhalation or ingestion inducing neoplasia processes at the level lungs by inhalation, or ingestion inducing neoplasm processes, at the level of lungs and stomach. According to American literature  $^{222}\text{Rn}$  represents 55% of the total natural radioactivity. The main sources of  $^{222}\text{Rn}$  accumulations in humans has been considered to be the drinking water, soil, air, building materials.

The goal of the present paper was to elaborate the carcinogenic risks induced by the presence of  $^{222}\text{Rn}$  in drinking water consumed by general population and indoor air in two centres belonging to the different counties. The studied population differed from the living condition and density view point.

## MATERIALS AND METHODS

The water samples were collected in the Tirgu Mures and Miercurea Ciuc town. The results of the water analysis, performed by standard methods over several months according to Cross method and the IRPA instructions. The obtained value can be used to estimate indirectly the gastric and the bronchial dose.

In parallels, a ten years retrospective epidemiological study (1980-1991) was performed in order to evaluate the mortality rate by gastric and lung cancer. To define the possible construction of  $^{222}\text{Rn}$  to the malignant processes in humans, the carcinogenic risk a group of subjects exposed to Rn by drinking water and indoor air was compared to the specific mortality rate.

## RESULTS

The registered dates showed different concentrations of  $^{222}\text{Rn}$  in drinking water and indoor air in two studied towns as follows: Tirgu Mures 1.17 Bq/l water and 0.117 mBq/l air; in Miercurea Ciuc 0.24 Bq/l water and 0.024 mBq/l air. (Table 1)

Table 1. Indoor air and drinking water  $^{222}\text{Rn}$  Radon contribution to oncogenesis

Town	Cancer type	$^{222}\text{Rn}$ Bq/l water	$^{222}\text{Rn}$ mBq/l air	Pulmonary dose mSv/y	Gastric dose mSv/y	Estimated cancer $\cdot 10^{-6}$	Detected cancer $\cdot 10^5$	Cancer risk by $^{222}\text{Rn}$
Tirgu Mures	pulmonary	1.17	0.117	0.12		4.46	0.94	0.47
Tirgu Mures	gastric				0.03	2.02	0.85	0.23
Miercurea Ciuc	pulmonary	0.24	0.024	0.025		0.91	5.91	0.01
Miercurea Ciuc	gastric				0.066	0.41	6.72	0.015

Based on our dates and in agreement with literature the values of the gastric and lung disease were establish: for Tirgu Mures town - 0.03 mSv/year and 0.12 mSv/year; for Miercurea Ciuc 0.066 mSv/year and 0.025 mSv/year.

By comparing the estimated cancer with that found in our study, we can express the gastric and lung carcinogenetic risk attributed to  $^{222}\text{Rn}$  presence in drinking water and indoor air: for Tirgu Mures is 0.23% for gastric cancer and 0.47% for lung cancer, for Miercurea Ciuc - 0.015% and 0.01%

Numerous epidemiological studies have commented on the role of a single or associated risk factors in inducing the gastric and lung malignant processes. It appeared that in these cancers inducement they are many etiologic factors: climate, soil, air, water, smoking, habitat characteristics, food. Although, the relationship between environmental radioactivity and these cancers has been not clearly elucidated recently, the cancerogenetic role of  $^{222}\text{Rn}$  has been paid a growing interest. Our epidemiological studies show an low increasing trend of the mortality rate by gastric cancer : 0.85‰ in Tirgu Mures, 6.72‰ in Miercurea Ciuc and for lung cancer 0.94‰ for Tirgu Mures, respectively 5.91‰ for Miercurea Ciuc. (table 2)

Table 2. Specific mortality and lethality indicators for period 1980 -1991

Indicators	Sex	Cancer type	Mures county	Harghita county
Specific mortality * 10 <sup>-5</sup>		pulmonary	0.94	5.91
Specific mortality * 10 <sup>-5</sup>		gastric	0.85	6.72
Lethality (%)	M	pulmonary	81.75	86.30
Lethality (%)	F	pulmonary	18.25	13.70
Lethality (%)	M	gastric	75.50	73.30
Lethality (%)	F	gastric	24.50	26.70

The high mortality and lethality indices was observed in males and over 60 years old.

Table 3. Variation of lethality indicators by age - period 1980 - 1991

Age	Cancer type	Lethality (%) Mures	Lethality (%) Harghita
0 - 29	pulmonary	0	0
	gastric	0	0
30 - 39	pulmonary	0	0
	gastric	1.7	0
40 - 49	pulmonary	6.7	5.4
		6.5	7.8
50 - 59	pulmonary	22.3	12.1
	gastric	23.3	24.7
> 60	pulmonary	69.0	82.5
	gastric	68.5	67.5

### CONCLUSIONS

1. In the two towns, the <sup>222</sup>Rn content in drinking water was between 0.24-1.17 Bq/l water; in indoor air 0.024-0.117 mBq/l air
2. The specific mortality by gastric cancer was between 0.85\*10<sup>-5</sup>-6.72\*10<sup>-5</sup> and for lung cancer 0.94 \*10<sup>-5</sup>-6.72\*10<sup>-5</sup>

3. The contribution of  $^{222}\text{Rn}$  to the cancer mortality percentage as follows: for Tirgu Mures 0.47% (lung cancer), 0.23% (gastric cancer) and for Miercurea Ciuc 0.01% and 0.015%
4. These two cancers results of the effect of several etiologic factors actioning upon a receptive pathologic tissue acquired on a determined genetically. It has been difficult to delimit the isolated effects of the multiple etiologic factors; nevertheless, emphasis is placed upon the contributor role of natural radioactivity.

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## ABSTRACT

The carcinogenetic effect produce by ionizing radiation upon human health, mainly by drinking water consumption with an elevated  $^{222}\text{Rn}$  content is well documented.

The objective of the paper was to demonstrated the possible relationship between the incidence of pulmonary and gastric cance and  $^{222}\text{Rn}$  presence in water and indoor air. The  $^{222}\text{Rn}$  content was assessed by the standard method in drinking water sampled in two sources in Transylvania area from located in Tirgu Mures and Miercurea Ciuc towns. The  $^{222}\text{Rn}$  concentration in indoor air was indirectly determined.

On the basis of the registered values the pulmonary and gastric internal dose received by the residents of the towns was calculated. In parallel was performed a retrospective epidemiological study (1980-1992) regarding the incidence of gastric and pulmonary cancer in two towns in terms of morbidity. mortality and lethality indices.

By comparing the estimated cancerigenic risk for this type of cancer with the specific mortality rate registered in our study, we estimate the contribution of  $^{222}\text{Rn}$  to the cancer mortality percentage in the two towns, as follows: 0.47% for Tirgu Mures and 0.01% for Miercurea Ciuc town for pulmonar cancer and 0.23% and 0.015% for gastric cancer.

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