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Outdoor Radioactivity and Health Risks for Nurdağı,Turkey

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Abstract

In order to determine the outdoor gamma dose rates, the study area was separated to 35 sampling stations with approximately 3 km distance. Measurings were done in 3 different locations for each sampling station. The average of these 3 measurements was taken and was specified as outdoor gamma dose rate for sampling stations. The outdoor gamma dose rates were measured by Eberline smart portable device (ESP-2) connected with an SPA-6 model plastic scintillation detector. Measurements were taken in air for two minutes at 1 m above the ground and the gamma dose rates were recorded nGy/h. The average outdoor gamma dose values measured at 35 locations measured per hour in the air at an altitude of 1 m was 59.4 nGy/h. The average annual outdoor gamma dose is determined to 72,8 μSv for Nurdağı province.

Keywords: Outdoor gamma döşe, Health risk, Eberline, Nurdağı.

1. INTRODUCTION

Mankind has been constantly and inevitably under the influence of radiation since its existence. Radiation is caused by radioactive nuclei in the earth, cosmic rays formed in the solar system, or artificial radiation produced by human beings. As long as there are radiation sources, it will not be possible to avoid radiation [1].

The basic source of radiation that people are exposed in the environment is natural radiation. The investigation of the dose, the effects on people's lifespan, and the harm they will cause is of great importance in the study of environmental radioactivity. The amount of dose varies according to the radio-nuclear composition in the soil and rocks and the geological structure of the region. Generally, the volcanic rocks have a higher dose level, which is associated with the amount of high silica (flintstone, quartz sand) present in the acidic rocks.

Measurement of environmental radiation is very important to determine the amount of natural basal radioactivity level. Thus, easily identifiable whether there is any radioactive contamination in the area. Observation of the contamination is very important for environmental protection. For this, the concentration of the radionuclides forming the natural radiation sources should be determined in the

environment. For this purpose, several measurements have been made in different areas in the world [2-18].

The influence of radiation on biological systems (especially humans) must be determined. In addition, the relationship between the radionuclides in the environment and the absorbed dose by the people from these sources must also be determined. However, after such an investigation; it can be decided whether a region is healthy in terms of natural radiation and suitable for life.

The main purpose of environmental radiation measurements is to determine the radiation dose that people receive from environmental sources and to assess the health risk they can generate [17]. Approximately 86% of the annual effective dose (2.8 mSv) that humans are exposed to is due to natural radioactivity. The main objective of environmental radiation measurements is to assess the radiation that the human body receives from the surrounding elements and to assess the health risk it can generate [18]. in this study, it is aimed to determine the environmental gamma dose rate around Nurdağı.

2. SURVEY AREA

Nurdağı district of Gaziantep is located between 36-37 eastern meridian and 37-38 northern parallels in the east of Nurdağı, Şahinbey and Şehitkamil districts of Gaziantep province, in the west; Bahçe district of Osmaniye province; in the north; Türkoğlu and Pazarcık districts of Kahramanmaraş province; in the south; Islahiye district of Gaziantep is located (Figure 1).

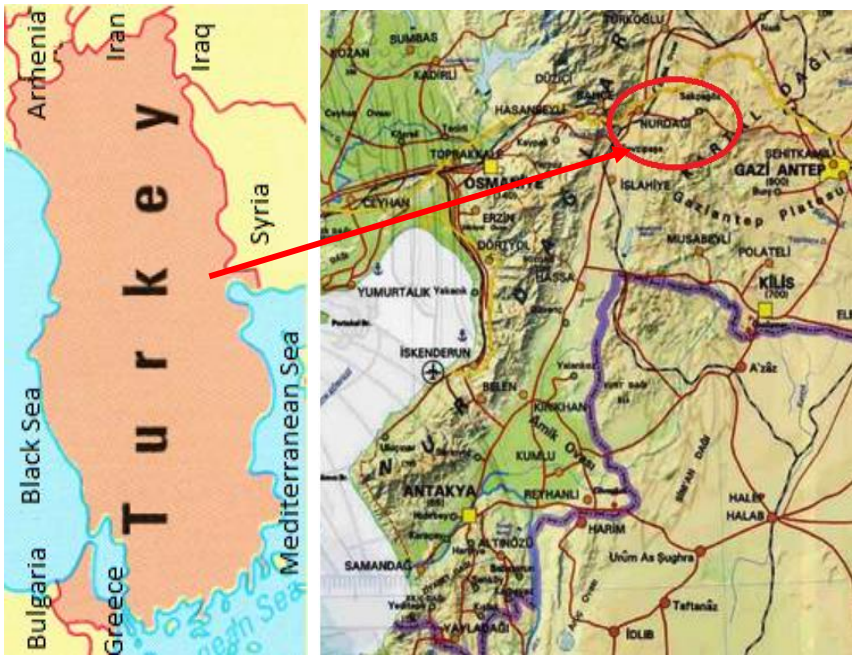

FIG. 1. Survey area

Nurdağı is located on E-24 Highway; same time it is located at crossroads where the east connects to the west and the north connects to the south. Nurdağı is 21 km to Islahiye, 67 km to Gaziantep, 48 km to Kahramanmaras and 18 km to Bahçe. The central altitude of Nurdağı district is 570 m.

Nurdağı; between the Mesopotamia and the Mediterranean, where the first civilizations were born, it is on the passages passing through the Syrian Anatolian and Cebeli Bereket-Adana plain. It is understood from the excavations made in the surroundings that since the prehistoric era [Early Bronze Age - Middle Bronze Age - calceolatics] migrations were made by in this ways and commercial great relations were obtained from these roads. A large part of the land in Nurdağı is located in the fertile " Fertile Crescent", which is known throughout history. Therefore, great importance is given to agriculture. The "Atatürk Viaduct", one of the biggest art works on the Tarsus-Adana-Gaziantep highway known as TAG highway, is located in the town of Nurdağı. This work is considered Turkey's highest and Europe's 2nd highest viaduct. The Nurdağı villages have rich chrome deposits [19].

3. MATERIALS AND METHODS

Measurements were carried out in 35 different regions around Nurdağı (Figure 2). Eberline Smart Portable (ESP-2) model, which a portable microcomputer and a device connected to the end of the SPA-6 model plastic scintillation detector, was used in the measurements. Three readings were made at each measurement point above 1 meter height from earth surface. The gamma dose values of each measurement area were determined by taking the average of these measurements. The results include both cosmic and terrestrial radionuclides.

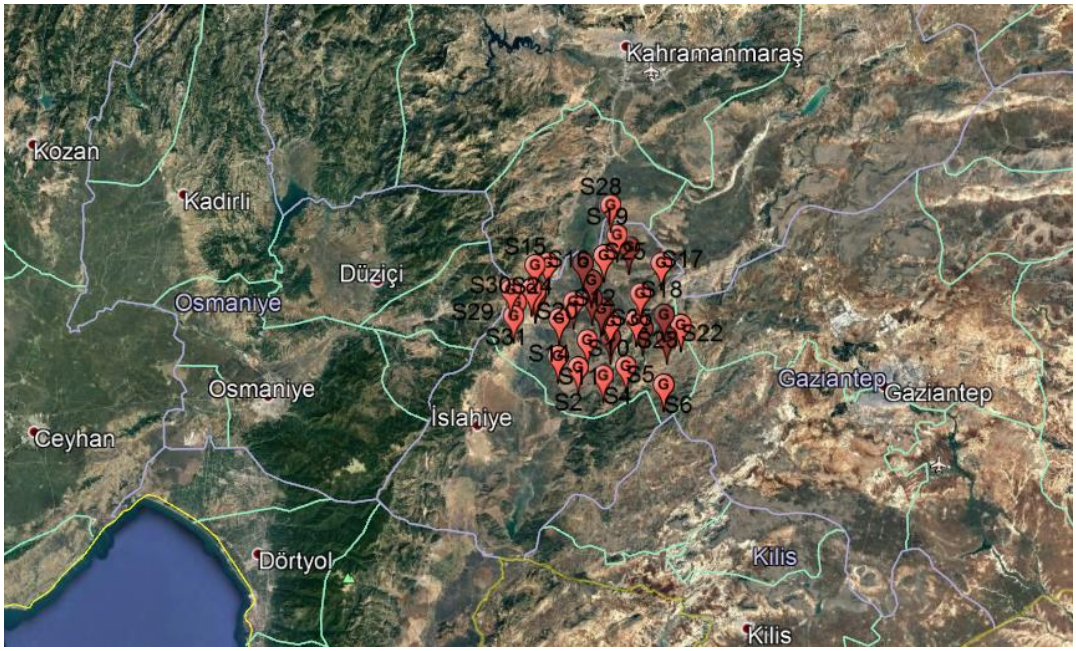

FIG. 2. Places where measurements are made

The detector used in the measurements shows the measurement results in μR / h. The results obtained were converted to nGy / h using a conversion factor (8.7 nGy / μR).
The annual effective dose equivalent (AEDE) of an individual exposed to radiation from various radiation sources in the open area; is calculated using the following equation [4]. The obtained results are given in Table 1.

$$AEDE=ADRA*DCF*OF*T \quad (1)$$

In this equation: ADRA; absorbed dose rate in air, DCF; environmental gamma conversion factor, OF; occupation factor, T; time. The environmental gamma conversion factor was set at 0.7 Sv / Gy to convert the absorbed dose ratio to the annual effective dose equivalent. In addition, people are exposed to

radiation for about 8760 hours a year. Taking into account that 20% of these duration spend in outdoor open spaces, a coefficient of 0.2 is used for OF.

The Excess lifetime cancer risk (ELCR) is calculated by the following equation [4] and the results are given in Table 1.

$$ELCR=AEDE*LS*RF \quad (2)$$

In this equation: AEDE; annual effective dose equivalent, LS; average life span (mean 70 years) and RF is a risk factor. ICRP risk factors for fatal cancer (RF) (1 / Sv); ICRP 103, BEIR[20] VII and ICRP 60 uses values of 0.057, 0.064 and 0.072, respectively [21].

4. RESULTS AND DISCUSSION

The gamma dose measurements made in 35 different regions around Nurdağı (Figure 2), and The arithmetic mean of ADRA is calculated as 59.4 nGy / s. The mean value of the annual effective dose equivalent calculated using external gamma dose was found to be 72,848 μSv / y. These values are compared with the literature in Table I.

TABLE I. The absorbed dose ratio (ADRA) in the open area and the annual effective dose equivalent (AEDE) and excess lifetime cancer risk (ELCR), compared to the values reported in the literature.

	ADRA (nGy/h)	**AEDE (μSv/y)**	**ELCR x10^{-3}**
Kastamonu [2]	54.8	67.21	
Şanlıurfa [3]	60.9	74.70	
Kırklareli [4].	118.0	144.70	0.50
Çanakkale [5].	66.4	81.40	
Çankırı [6]	69.6	87.70	
Trabzon [7]	59.0	72.40	
Yalova [8]	84.3	103.38	0.42
Balıkesir [9]	127.0	155.80	
Mersin [10]	51.0	62.00	0.22
Adana [11]	48.9	59.96	0.42
Turkey [12]	**54.6**	**70.00**	**0.29**
Nigeria [13]	148.2		0.635
Pakistan [14]	89.0	164.00	0.543
Malaysia [15]	141.6	169.00	
USA. [16]	47.0		
Greece [16]	56.0		
Bulgaria [16]	45.0		
World [16]	**60.0**	**70.00**	**0.29**
Nurdağı (This work)	59.4	72.85	0.29

The calculated AEDE value for Nurdağı is greater than the world average of 70 μSv / y. These calculated mean values are considerably smaller than the 1 mSv / y value determined by the ICRP as the limit value of the annual effective dose equivalent. Lifetime cancer risk values for Nurdağı and its surroundings were found to be percentile average 0.0290, 0.0326 and 0.0367 for ICRP 103, BEIR VII and ICRP 60, respectively. These values of the neighbouring Adana (Turkey) province is quite low compared with.

5. CONCLUSION

The absorbed dose rate in air (ADRA), annual effective dose equivalent (AEDE), and excess lifetime cancer risk (ELCR) were calculated to determine the health effects of background radiation levels on the population living in the studied region. The arithmetic means of the gamma dose measurements performed in 35 different regions around Nurdağı was calculated as 59.4 nGy / s. The mean value of the annual effective dose equivalent calculated using the external gamma dose was found to be 72.85 μSv/y. The value of the annual effective dose is 70 μSv/y (UNSCEAR, 2000). This value is greater than the world average value. As seen in Table 1, the external gamma dose ratio values in regions around Nurdağı are higher than the external gamma dose ratio values of some provinces and it is lower than the external gamma dose ratio values of some provinces. U-238, Th-232 and K-40 natural radionuclides in soil and rocks are the most important source of external gamma radiation. A small contribution comes from the CS-137 space-induced cosmic rays. The mean value of the annual effective dose equivalent calculated at 72,85 μSv/y in Nurdağı and its vicinity is quite small from the 1 mSv / y value determined by the ICRP as the limit value of the annual effective dose equivalent (ICRP, 1990).

Findings obtained by performing environmental gamma dose measurement around Nurdağı and its surroundings; can be used as the basis for future studies. These values might be created reference for future evaluations. It is also thought to be very beneficial in the case of any nuclear accidents that may arise in the future, in terms of radiation follow-up and in assessing radiological risks for human health.

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