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Depremlerin Doğal Radyasyon Seviyelerine Etkisi: KSÜ Avşar Kampüsünde Bir Çalışma

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Öz

Yer kabuğundaki uzun yarı ömürlü radyoaktif çekirdekler nedeniyle insanlar düzenli olarak doğal radyasyona maruz kalırlar. Toprak, kaya ve yeraltı suyu, genellikle sismik faaliyetlerle yer değiştiren önemli doğal radyasyon kaynaklarıdır. Bu nedenlerden dolayı sismik faaliyetlerin, özellikle topraktan yayılan doğal radyasyonu nasıl etkilediği belirsizliğini koruyor. Bu çalışma, Kahramanmaraş Sütçü İmam Üniversitesi (KSÜ) Avşar Kampüsü Tıp Fakültesi (MF) çevresindeki ve kampüsteki çeşitli noktaları (VP) deprem öncesi ve deprem sonrası radyasyon düzeylerini ölçmeyi amaçlamıştır. Ölçümler 2024-Mayıs sonuna kadar 10 günlük aralıklarla yapılmıştır. Deprem öncesi ortalama MF ve VP değerleri sırasıyla MF-13±0.2 µR/h ve VP-12±0.3 µR/h olarak bulunmuştur. Deprem sonrası MF seviyeleri MF-14 ± 0,4 µR / h ve VP-13 ± 0,7 µR / h olarak bulunmuştur. Bu sonuçlar, sismik olaylarla ilişkili çevresel değişikliklerin değerlendirilmesinde devam eden araştırmalara yeni veriler katarak, depremler ve doğal radyasyon seviyeleri arasındaki ilişki hakkındaki bilgimizi geliştirmek için sürekli izleme araştırmalarına duyulan ihtiyacı vurgulamaktadır. Ayrıca ölçüm yapılan alanlardaki doğal radyasyon düzeyinin yaşanabilir bir ortama uygun belirlendiği belirlenmiştir.

Anahtar Kelimeler: Doğal Radyasyon, Deprem, Radyoaktivite.

The Impact of Earthquakes on Natural Radiation Levels: A Study at KSU Avsar Campus

Abstract

People are regularly exposed to natural radiation due to long half-life radioactive nuclei in the Earth's crust. Soil, rock, and groundwater are significant natural radiation sources, often displaced by seismic activities. Due to these reasons, it remains unclear how seismic activities affect natural radiation, especially those emitted from the soil. This study aimed to measure radiation levels before and after earthquake areas surrounding the Faculty of Medicine (MF) at Kahramanmaras Sutcu Imam University (KSU) Avsar Campus and various points (VP) on the campus. Measurements were taken at 10-day intervals until 2024-May's end. Pre-earthquake mean values in MF and VP were MF-13±0.2 µR/h and VP-12±0.3 µR/h, respectively. After-earthquake, MF levels were MF-14±0.4 µR/h and VP-13±0.7 µR/h. These results contribute new data to the ongoing research in assessing environmental changes associated with seismic events, emphasizing the need for sustained monitoring research to enhance our knowledge of the relationship between earthquakes and natural radiation levels. Additionally, it has been determined that the measured areas maintain natural radiation levels suitable for a livable environment.

Keywords: Natural Radiation, Earthquake, Radioactivity.

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1. Introduction

People are exposed to radiation in the water, soil and air in the environment in which they live. The normal limits of these amounts of radiation to which living things are exposed have been determined by organizations whose reliability is accepted by scientific circles. National Council for Radiation Protection and Measurements (NCRP), United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and International Commission on Radiological Protection (ICRP) are a few of these organizations. Exposure to a dose above these limits affects the life of a living being. This effect can be defined as the difficulty of maintaining a life or maintaining a healthy one. Therefore, it is important to determine the natural radiation in a region, determine the changes in possible radiation doses, and take the necessary measures.

Determination of the natural basic level radiation of a region or a place means a radiological examination of that place, or, in other words, the determination of the natural radioactivity contained in the soil, water, and air of that place (Bayrak & Baltaş, 2023). The mineralogical structures of the soil and rocks and the geographical height affect the basic radiation level of the region (Tzortris et al., 2003). It is necessary to determine the environmental concentrations and the effect of radiation, especially on humans, and assess its effect on biological systems. A person is exposed at any time to various types of radiation emitted from sources in the natural environment in which he lives. It is known that the largest contribution to the world's population's average dose comes from terrestrial and cosmic radiation. For this reason, research is being conducted to evaluate the doses and types of radiation caused by environmental factors and the risks it may pose to human health (Kam et al.,2007; Kam et al., 2010; Al-Azmi, 2013; Bal & Karatepe, 2015; Karatepe et al., 2019). In addition, the impact of seismic activities on the earth's crust, particularly how they influence the natural radiation emitted from the soil, remains unclear. For this reason, much research has been conducted on these activities and their results. The effect of the Kahramanmaras earthquake on the natural radiation level in the region is not yet known.

This study aimed to measure the radiation levels in the areas surrounding the Faculty of Medicine (MF) within Kahramanmaras Sutcu Imam University (KSU) Avsar Campus and various points (VP) on the campus before and after the earthquake.

2. Materials and Method

2.1. Measurement Field

This study was made at Kahramanmaras Sutcu Imam University (KSU) Avsar Campus, Kahramanmaras/Onikisubat. To reduce the radiation effect from the buildings, distant areas were selected for the measurement points. Three (red) points have been selected around the Faculty of Medicine (MF), and five (blue) points have been selected around the various points (VP) on the campus. There is also no correlation between the points.

Figure 1. Selected Places for the Measurement Points in Kahramanmaras Sutcu Imam University (KSU) Avsar Campus

2.2. Geiger-Muller Detector

NEB.211B, Geiger counter (GM) is a device that detects and measures particles in ionized gases. It is widely used in applications like radiological protection, radiation dosimetry, and experimental physics. It is made of a metallic tube filled with gas (Mettler & Guiberteau, 2012).

Figure 2. Geiger-Muller Detector, NEB.211B

2.3. Method

Measurements started in July 2022 and were completed in May 2023. The total measurement time took 11 months. The eighth month represents February. During this period, measurements were made on the points marked with 10-day periods. Measurements were taken for 2 minutes with the G-M detector placed 30 cm from the ground. The mean measurement value has been calculated for each month. Mean values were compared before and after an earthquake to determine any changes. The measurement results are shown in Figures 3 and 4.

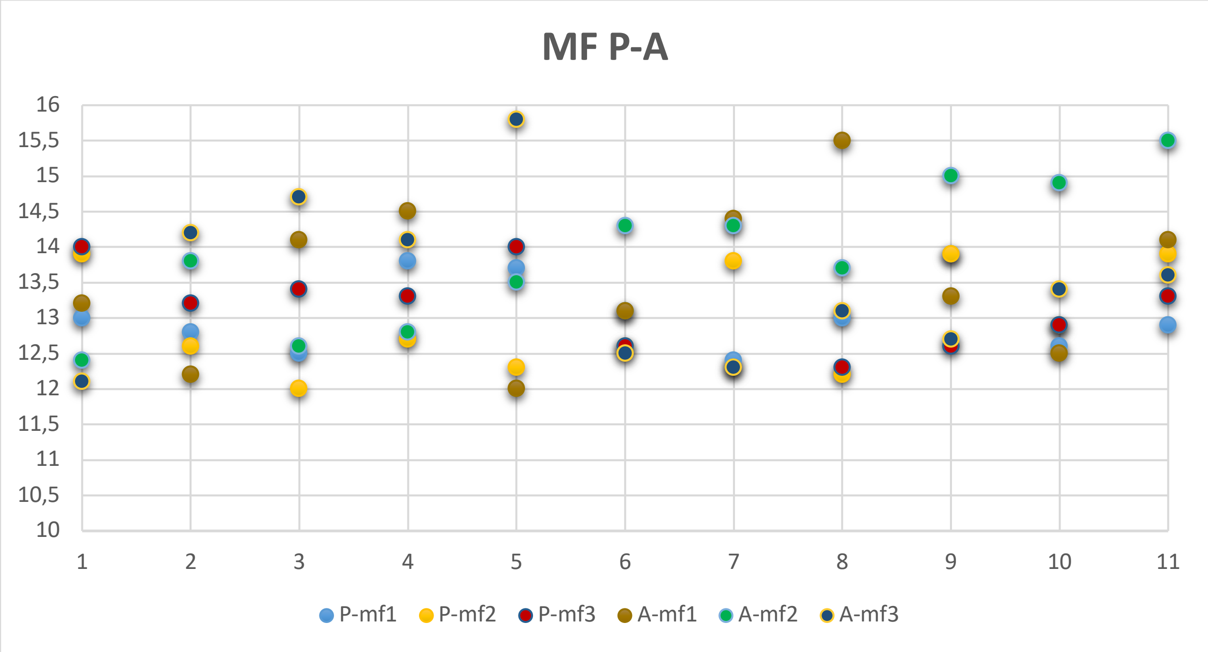

Figure 3. Faculty of Medicine (MF), pre-earthquake and after-earthquake, mean; P-MF, 13±0.2 µR/h; A-MF, 14±0.4 µR/h

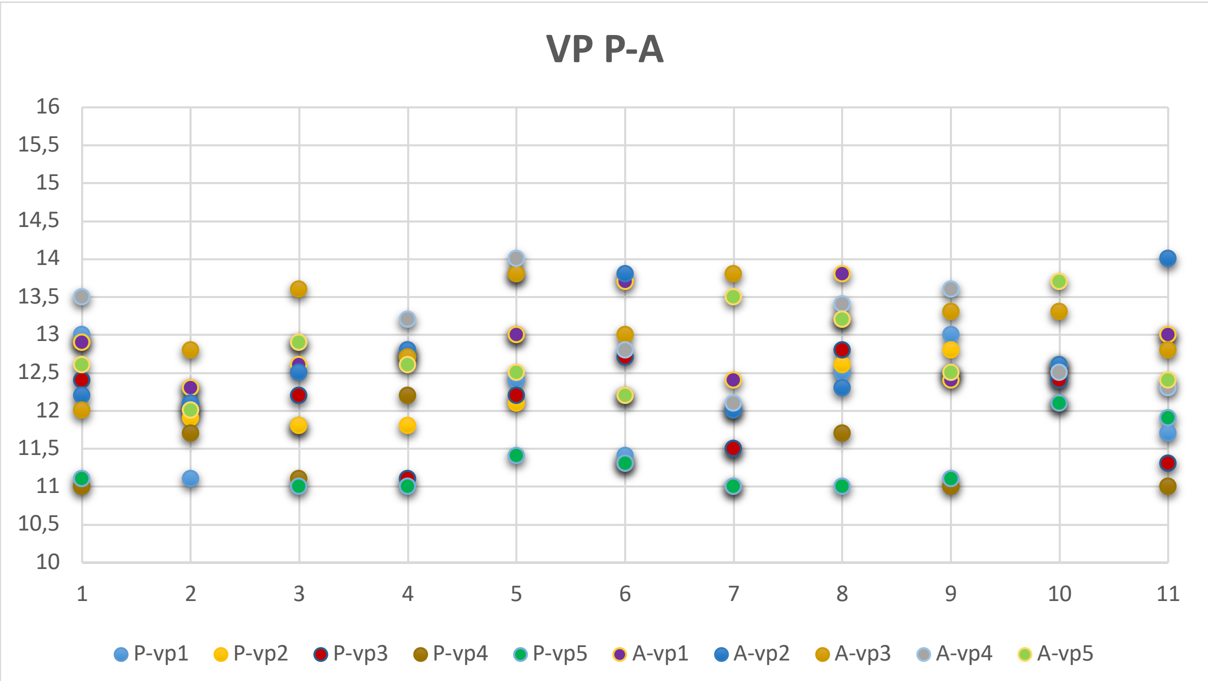

Figure 4. Various Points (VP) on the Campus, pre-earthquake and after-earthquake, mean; P-VP, 12±0.3 µR/h; A-VP, 13±0.7 µR/h

3. Results and Discussion

Living things are constantly exposed to natural radioactivity from the environment in which they are located. Natural radioactivity originates from cosmic rays, the earth's crust, building materials, the mineralogical structure of rocks, waters and radioactive nuclei in the human body. Natural radiation depends on the amount of sources of radioactivity present in the environment, which contributes to the radiation dose that people are exposed to. Since the amount of dose exposed varies depending on the geographical and geological structure of the environment, it also differs for different soil types on Earth (Kayakökü, 2022). The movement of the earth's crust changes many things. Measurements taken over an 11-month period to measure the impact that this movement may have are shown in Figures 2 and 3. Measurements up to the 8th Month in these figures have been accepted as reference values in this study since they are both pre-earthquake and long-term. The figures for the eighth month and after show measurements after the earthquake. In addition, since the purpose of this study was not to measure or determine the direct and indirect effects of radiation, such as the excess lifetime cancer risk (ELCR), we did not work with such formulas (Maden et al., 2020; Uyanık 2023).

The literature review is difficult because of the difference in the measuring instrument used and the very different probabilities of encountering earthquakes.

When the studies carried out in the region were examined, Değerliel et al.'s Adana-based studies detected radioactive material in the soil at a low level (Değerlier & Peştemalcı, 2012). In Kayakökü's study, she made radiation measurements within the borders of Malatya province. It has determined values on a wide scale between 12.50 and 86.80 (nGy/h) (Kayakökü, 2022). In the study by Gumbur et al. in Kahramanmaras, dose values of 49.2-162.6 (nGy/h) were measured (Gümbür et al., 2023). The measurements taken in this study are on a vast scale. In addition, the difference in measuring equipment makes it difficult to compare. In the measurements made by Karataşlı in Hatay, he shared the values of 2.63-17.89 (μR/h) (Karataşlı, 2018). Küçükönder et al., during the soil surveys in Kahramanmaraş, detected 238U, 232Th and 40K radionuclides with various activity levels in the soil (Küçükönder, 2023). These radionuclides cause natural radiation. In this study, the mean values in the VP and MF were found as MF-13±0.2 μR/h, VP-12±0.3 μR/h for the pre-earthquake and MF-14±0.4 μR/h, VP-13±0.7 μR/h for the post-earthquake. It can be seen that the measurement results in our study are among the values shared in Karataşlı's study.

The measurement results of Karataşlı's study and our study support each other. The fact that they are close to each other significantly increases the accuracy of our measurements. Taking our measurements in a narrower area rather than in the whole city explains the fact that they come out close to each other. In addition, our average values of pre-earthquake and post-earthquake are close to each other. There was a 7.69% and 8.33% difference in MF and VP of pre- and post-earthquake. Considering the measurement results in a wide range of values in previous studies, we can say that the difference in our measurements is acceptable.

4. Conclusion

These results contribute new data sources to the ongoing research on assessing environmental changes associated with seismic events. They emphasize the need for sustained monitoring research to enhance our knowledge of the relationship between earthquakes and natural radiation levels. Additionally, it has been determined that the measured areas maintain natural radiation levels suitable for a livable environment.

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