Avrupa Bilim ve Teknoloji Dergisi
Sayı 15, S. 433-439, Mart 2019

Araştırma Makalesi

www.ejosat.com ISSN:2148-2683

European Journal of Science and Technology
No 15, pp. 433-439, March 2019

Research Article

Cancer Risk Determination for IDA villages by using Annual Gamma Doses in Air, around Edremit & Ayvacık Districts; Balıkesir & Çanakkale, TURKEY

Muttalip Ergun Turgay[1*]

[1] Engineering Faculty, Yalova University, 77200, Yalova, Turkey

(First received 14 January 2019 and in final form 14 March 2019)

(DOI: 10.31590/ejosat.512562)

ATIF/REFERENCE: Turgay, M. E. (2019). Cancer Risk Determination for IDA villages by using Annual Gamma Doses in Air, around Edremit & Ayvacık Districts; Balıkesir & Çanakkale, TURKEY. *European Journal of Science and Technology*, (15), 433-439.

Abstract

Main focus of this study is to measure outdoor gamma dose rates for IDA villages around Edremit and Ayvacık districts. This touristy location, is so closest to seismic zone and thermal water sources, has lodgings huge human population especially in summer season. It is important that not only local people but also for visitors, too. Total measurings on 75 different stations, were obtained and then calculated the annual dose. Average dose rate was calculated to 162.04 $nGyhr^{-1}$. Annual dose is 198.66 µSv. On the other hand, access life time cancer risk was calculated for studing area. It is equal to $6.95x10^{-4}$. These values were compared with the World's references (UNSCEAR) and assumed. . This study would be referenced for futher works, besides it will be usefull while comparing with the different studies for IDA which, will be completed in the future, for example after a radioactive pollution, such as a reactor leakage, weapon's effect, etc., too.

Keywords: Radioactivity, ADRA, AEDE, air, Outdoor gamma dose, Cancer risk, Mount IDA.

Balıkesir&Çanakkale Bölgesi, Edremit&Ayvacık Sınırlarındaki Kazdağı Köylerinde Havadaki Yıllık Gama Dozlarını Kullanarak Kanser Risk Hesabı

Öz

Çalışmada Edremit ve Ayvacık ilçeleri sınırlarında bulunan Kazdağı Köylerinde, öncelikle havadaki gama doz hızlarının ölçülmesi hedeflenmiştir Deprem kuşağına ve termal su kaynaklarına yakın olan bu turistik bölgeyi de kapsayan Kazdağında, özellikle yaz sezonunda oldukça yoğun nüfus ağırlanmaktadır. Bu suretle sadece yöre insanını değil aynı zamanda ziyaretçilerini de ilgilendirmektedir. Toplamda 75 farklı ölçüm noktasında gama doz hızları alınmıştır. Ortalama doz hızı **162.04 $nGyhr^{-1}$** ve yıllık doz ise **198.66 µSv** hesaplanmıştır. Bu değerler yardımıyla kanser risk hesabı yapılmış ve **$6.95x10^{-4}$** bulunmuştur. Her üç değer de, literatürde geçen diğer ulusal/uluslararası değerlerle mukayese edilmiştir. Yine UNSCEAR değerleriyle de nisbeti görülmektedir. Bu çalışma, ileride yapılacak benzer/bölgesel araştırmalara referans olabilecektir. Yine muhtemel bir radyoaktif sızıntı sonrasında aynı ölçüm noktalarında yeniden alınacak değerlerle mukayesesi, sızıntı boyutu hakkında detaylı bilgi verebilecektir.

Anahtar Kelimeler: Radyoaktivite, ADRA, AEDE, Hava, Dış ortam Gama dozu, Kanser riski, Kazdağı.

1. Introduction

From beginning of humanity, radioation energy had been exposed to all over the world continuously. Radioactivity which a randomize event, occurs naturally (primordial nuclides) or by artificial processes. The largest contribution to total radiation dose received by humans, comes from Natural Radiation. Therefore environmental radioactivity measurements are necessary for

[1] Corresponding Author: Yolava University, Engineering Faculty, Yalova University, 77200, Yalova, Turkey

determining the background radiation level especially due to natural radioactivity sources. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 2008) estimates the global average human exposure from natural radiation sources as 2400 μSv per year [**1**]. Whenever measure the outdoor gamma dose rates, it contains of the additive values both terrestrial and cosmic effects. That' s important in advance to analysis the initial data.

1.a. Literature Survey

Over the past two decades, there are a lot of papers due to radioactivity levels have been published for absorbed dose in air for Turkish provinces [7],[9],[10],[11],[12],[13],[15],[17]. By the way there is not observed study for special **IDA** villages in literature. Besides there are also stated the worldwide studies in literature. As an example of them; in 2002, Ghiassi and Mortavazi have measured the absorbed gamma dose rates in air for Ramsar region of Persia. They have studied the effects of radiation on human life. The annual dose was also calculated that it is 260 mSv and this value is more higher than the stipulated annual limit of 20 mSv in North Persia. In genetic works, the effects of this high level were obtained the differency of the blood lenfosid samples of humans [8]. In this study, main thema is to measure dose rates in air where different locations throughout the IDA villages around Edremit and Ayvacık districts, and then assess the cancer risk to human life, after calculation of outdoor gamma doses.

2. Material and Method

2.a. Inhalation

The natural radiation which measured outdoor gamma dose, consist of cosmic rays and terrestrial radiation. Cosmic dose depends on the altitude and latitude as directly proportional. While measuring of outdoor gamma dose, cosmic and terrestrial doses, both are counted totally. Near by, Terrestrial effect can be measured via gamma-ray spectroscopy separately, too. To obtain of airborne radioactivity, provides the first oppurtunity to identify the spectrum of radionuclides making up the contamination. Radionuclides will very rapidly appear in ground level air, and air samples can give the first indication of the nature of the contamination. Radioactive materials in the air may result in exposure to human by inhalation.

2.b. Measuring Area

IDA mountains, the northwestern region of Turkey, are closed to Egean Sea. some 20 miles southeast of the ruins of Troy, along the north coast of the Gulf of Edremit. It is located to 39°37′- 39°27′ N as latitudes and 26°56′- 26°16′ E as longitudes. Highest pick is Karataş (1774 m). It is located between Edremit (Balıkesir) and Ayvacık (Çanakkale). The summit is windswept and bare with a relatively low tree line due to exposure, but the slopes of this mountain, at the edge of mild Mediterranean and colder central Anatolian climate zones, hold a wealth of endemic flora, marooned here after the Ice Age. The climate at lower altitudes has become increasingly hot and dry in the deforested landscape. The dry period lasts from May to October. Rainfall averages between 631 and 733 mm per year. The mean annual temperature is 15.7 degrees Celsius. Currently a modest 2.4 km² of Mount Ida are protected by Kaz Dağı National Park, created in 1993 [**2**]. Location of Mount Ida is shown in Figure 1.

Figure 1: Regional Map of IDA Mountains, Turkey **[3]**

2.c. Measurement System

The outdoor air dose gamma rate measurements around Hatay province were perfected by using a counter (Eberline, ESP-2), portable device and connected with a SPA-6 model plastic scintillator. Instrument was kept up to 1m from soil surface and at the sampling point, measurement duration was 60 second. Then the average dose rates were recorded. The main instrument is ESP-2. Related detector was connected to the ESP-2 via an MHV-series coaxial connector. Readout of detector has been presented with 2×16 alphanumeric display, LCD. This ratemeter is operated by CPU/Intel 80C31 processor family and has got external RAM 8KB, EPROM 16KB. The scintilation detector body (SPA-6) connected to the counter (ESP-2), was selected to optimize its output for the radiation of interest. It provides the pulse signal to the electronics for counting. The pulse rate from the detector is proportional to the radiation field intensity at the detector. The high voltage supply provides the required bias voltage to the detector. The high voltage is keyboard adjustable and provides the correct operating voltages for a large selection of detectors. The low voltage supply regulates the operating voltage for the ESP-2 electronics (Figure 2). The amplifier is a linear, adjustable gain, multistage design. It amplifies the signal from the probe to a usable level at the amplifier output. The discriminator provides a signal on its output only if the signal from the amplifier exceeds the adjustable threshold. This provides a means for rejecting noise and/or unwanted signal.

Figure 2: ESP-2 Rate meter and SPA-6 scintillation detector, Eberline **[4]**

3. Results and Discussion

3.a. Outdoor dose rates as originated to both terrestrial and cosmic ray effects totally.

Absorbed gamma doses are originated to terrestrial and cosmic rays together. In order to obtain the absorbed gamma dose rates in air, the instrument was kept about 1 meter upperside from ground level. Because about on this level; it is important that how much dose exposed in air against to human gonad. The human gonad is the more important organ against to radiation damage. Annual doses in air were also calculated by using the gamma dose rates. Coordinates, dose rates, annual doss and cancer risk which related to 75 pcs points were given in **Table 1**. Besides, dose rate map was also given in Figure 3. Bar chart for Annual dose was depicted in Figure 4. Due to village' s name, the vertical bars are arranged consequently as well as in Table 1.

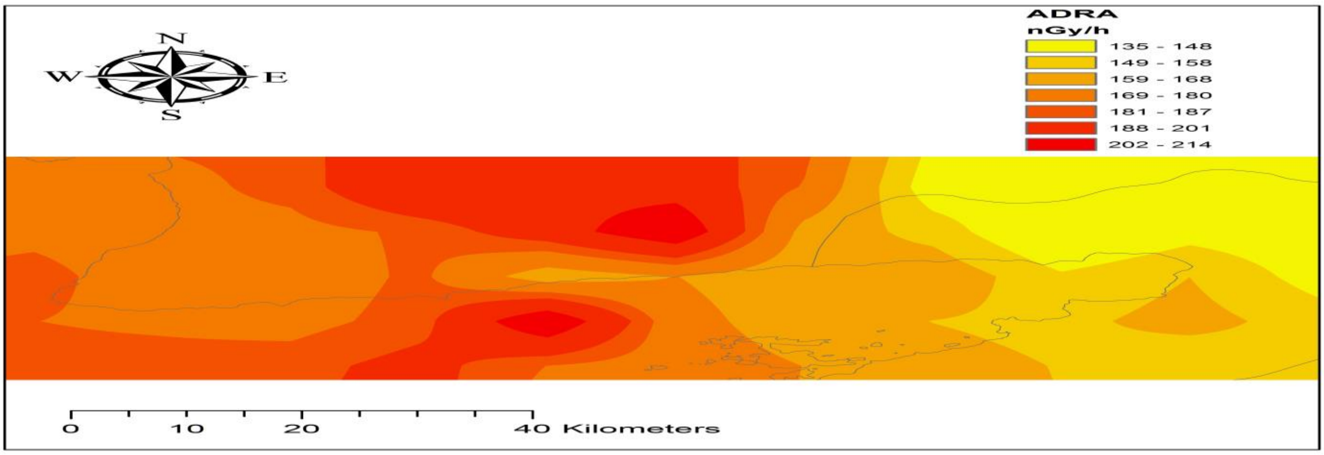

Figure 3: Outdoor gamma dose rate map (nGyh^{-1}) **[5]**

3.b. Determination of Annual Effective Dose Equivalent (AEDE) by using absorbed gamma dose rates in air (ADRA)

It is possible to calculate annual effective dose equivalent (AEDE) by using average measured (absorbed) gamma dose rate for all counties via using the values given in Table 1 with reference of (UNSCEAR, 2008) [**1**]:

$$AEDE= ADRA* DCF* OF* T \qquad Eq.\ 1$$

where *ADRA* is absorbed dose rate in air ($nGyh^{-1}$), DCF is dose conversion factor ($0.7\ Sv\ Gy^{-1}$), OF is outdoor occupancy factor (0.2), T is exposure time ($8760\ h\ y^{-1}$). *AEDE* is annual effective dose equivalent (μSv). The annual effective dose equivalent values were shown for all counties in the **Table 1**.

The outdoor gamma dose rate map is given in Figure 3. The average outdoor gamma dose rate was calculated to **162.04 $nGyhr^{-1}$**. By using average gamma dose rate; the *average* annual outdoor gamma dose was determined to **198.66 μSv** for IDA villages.

3.c. Determination of Excess Lifetime Cancer Risk

Excess Lifetime Cancer Risk was calculated using by AEDE value (ICRP, 2007);

$$ELCR= AEDE* DL* RF \qquad Eq.\ 2$$

where *AEDE* is annual effective dose equivalent (μSv), *DL* is duration of life (70 year), RF is risk factor (Sv^{-1}) as fatal cancer risk per Sv [calculate to stochastic effects; ICRP 60 [**6**] uses values of 0.05 for the public (ICRP, 2007). AEDE and ELCR values were given in Table1.

Table 1: Coordinates, Dose Rates, Annual Doses and Cancer Risk for 75 different stations around IDA

Village's Name (nm. of sampling)	Latitude [(° ' ''), N], range	Longitude [(° ' ''), E], range	Abrosbed Dose Rate [$nGyhr^{-1}$], range/average	Annual av. Dose (μSv)	Excess Lifetime Cancer Risk [$*10^{-4}$]
Zeytinli (10)	39 37 21- 39 37 34	26 56 17- 26 56 36	26.07-295.46/137.15	168.15	5.89
K.keçili (6)	39 37 08- 39 37 57	26 55 07- 26 55 16	69.52-269.39/145.54	178.43	6.25
Güre (7)	39 36 46- 39 37 08	26 52 52- 26 55 07	69.52-295.46/162.95	199.78	6.99
Avcılar (6)	39 34 09- 39 34 57	26 48 11- 26 54 19	43.45-269.39 /140.42	172.16	6.03
Altınoluk (7)	39 33 50- 39 34 58	26 44 03- 26 44 28	43.45-295.46/144.92	177.67	6.22
Narlı (5)	39 32 57- 39 34 24	26 37 19- 26 43 45	52.14-295.46/150.34	184.32	6.45
EDREMIT (41)	39 32 57- 39 37 57	26 37 19- 26 56 36	26.07-295.46/146.20	179.24	6.27
Adatepe (5)	39 32 56- 39 34 02	26 36 57- 26 37 28	69.52-321.53/163.48	200.43	7.02
Yeşilyurt (5)	39 33 14- 39 33 27	26 34 12- 26 34 18	52.14-443.19/216.50	265.43	9.29
Nusratlı (2)	39 34 39- 39 34 46	26 32 38- 26 32 39	104.28-321.53/183.23	224.64	7.86
Arıklı (3)	39 30 48- 39 33 55	26 28 42- 26 31 48	78.21-321.53/173.02	212.12	7.42
Ahmetçe (3)	39 30 46- 39 32 49	26 28 39- 26 29 31	34.76-434.50/186.57	228.74	8.00
Sazlı (3)	39 30 52- 39 31 15	26 27 49- 26 29 27	34.76-199.87/116.85	143.26	5.01
Kozlu (3)	39 27 57- 39 29 17	26 28 32- 26 29 00	104.28-356.29/226.64	277.86	9.73
Büyükhusun (3)	39 30 32- 39 30 51	26 24 13- 26 29 24	78.21-312.84/178.70	219.09	7.67
Behram (7)	39 29 13- 39 29 34	26 16 57- 26 20 18	43.45-391.05/178.12	218.38	7.64
AYVACIK (34)	39 27 57- 39 34 46	26 16 57- 26 37 28	34.76-443.19/181.13	222.07	7.77
TOTAL (75)	**39 27 57- 39 37 57**	**26 16 57- 26 56 36**	**26.07-443.19/162.04**	**198.66**	**6.95**

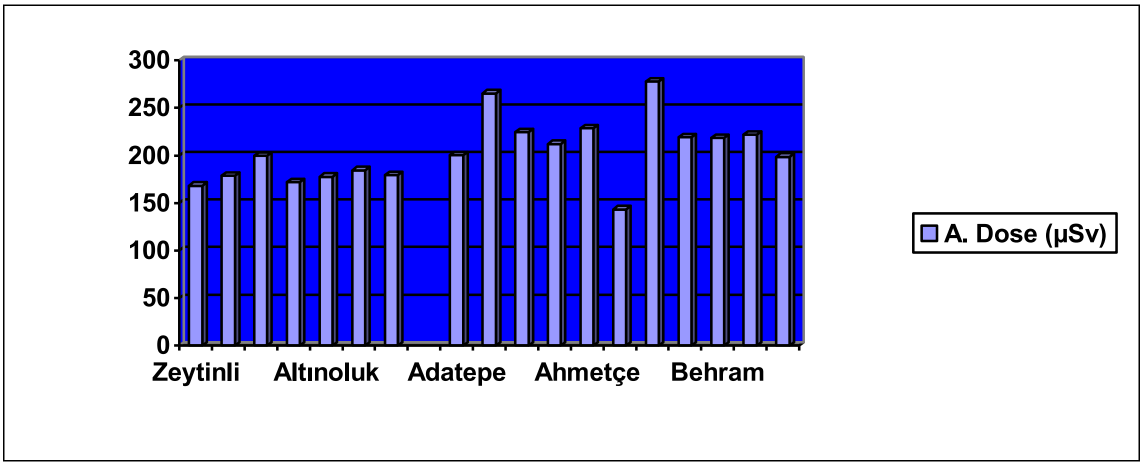

Figure 4: Bar chart for Annual Dose

4. Conclusions and Recommendations

4.a. Statistics and comparison

In our study, the mean values of outdoor gamma dose rate and annual outdoor gamma dose were obtained to **162.04** nGy hr^{-1} and **198.66** µSv, respectively. Excess Lifetime Cancer Risk was also calculated to **6.95** ($*10^{-4}$). With analyzing of Table 4, it could be seen the annual dose and cancer risk, both are up to the World's averages. Near by less than the Artvin's values, too. It is may be geographical similarity and will be usefull to compare both interland due to soil and water samples. That' s are also closed to the Balıkesir's averages. This study' s results are matched them. It is necessary to do further research to assess the causing after soil and water samplings were perfected.

Table 4: Comparison Chart for AEDE and ELCR

[ref no], Region (Nm. of sampling)	**Av. Annual Effective Dose Equivalent [µSv]**	**Av. Excess Lifetime Cancer Risk [$x10^{-4}$]**	**Reference, year**
[10] Adana	82.00	2.87	Değerlier, 2008
[17] Ankara (341)	71.83	2.69	Kapdan, et all, 2018
[15] Artvin (204)	214.5	7.50	Taşkın, et all, 2015
[**] Bolu (74)	27.23	0.95	Turgay, et all.
[**] Hatay (215)	63.93	2.24	M. E. Turgay.
[13] Balıkesir (92)	156.3	6.30	Kapdan, et all, 2011
[12] Çanakkale (379)	81.4	2.85	Kam, et all, 2007
[7] İstanbul (105)	79.72	2.79	G. Karahan, A. Bayülken, 2000
[11] Kastamonu (60)	58.88	2.06	Kam, et all, 2007
[9] Şanlıurfa	74.7	2.62	Kam, et all, 2007
IDA villages (75)	**198.66**	**6.95**	**This study**
[1] World	**73.6**	**2.90**	**UNSCEAR, 2008**
[14] R. De Janeiro, Brasil	90.0	3.15	Licinio, et all, 2013
[8] Ramsar, Iran	105.0	3.68	Ghiassi, et all, 2002
[16] Canary Island, Spain	91.95	3.22	Arnedo, et all, 2017

**not published yet

4.b. Conclusion

Human population in these villages is around 50,000 just for eight months of the year and may be ten times more for summer season. So, this study is important not only for local population but also for the summer house vacationist, too. Maximum dose is calculated for Kozlu village as 277.86 µSv and also minimum cancer risk is obtained to 5.01[$x10^{-4}$] for village Sazlı. This study would be also reference for future investigations. Besides it will be usefull and baseline while comparing with the different studies for around IDA which, will be completed in the future, for example after a radioactive pollution, such as a reactor leakage, or regional/global weapon's attacks, etc., too.

References

[1] UNSCEAR., Report of the United Nations scientific committee on the effects of atomic radiation, sources, effects, and risks of ionizing radiation. United Nations Sales Publication, New York, 2008.
[2] IDA villages/ Wikipedia.
[3] IDA villages/ Google Earth.
[4] http://www.pchemlabs.com/manuals/pdf/eberline-esp2-technical-manual.pdf
[5] Drawing Software was used by CNAEM/TAEK.
[6] ICRP., ICRP Publication 103 recommendations of the ICRP: annals of the ICRP volume 37/2-4. International Commission on Radiological Protection. Pergamon Pres, 2007.
[7] G. Karahan, A. Bayülken, (2000), Assessment of gamma dose rates around **Istanbul** (Turkey), Journal of Environmental Radioactivity, 47, 213-221, doi: 10.1016/S0265-931X(99)00034-X
[8] Ghiassi M., Mortazavi S. M., Cameron J. R., (2002). Very High Background Areas of **Ramsar**, Iran: Preliminary Biological Studies, Health Physics, 82(1), 87-93.
[9] A. B., N. Y., E. Kam, G. Karahan and A.E. Osmanlioglu, (2007a), Assessment of environmental radioactivity for **Sanliurfa** region of southeastern Turkey, Radiat. Meas., 42, 1387-1391, https://doi.org/10.1016/j.radmeas.2007.05.052.
[10] Değerlier, M.,KARAHAN G. (2007b). Ph.D. Thesis: Annual Effective Dose of Natural Environmental Radioactivity Measurements for **Adana** region. N.S. Institue- CU/ Adana.
[11] E. Kam,et all., (2007c), Environmental radioactivity measurements in **Kastamonu** region of northearn Turkey, Applied Radiation and Isotopes, v.65, pp. 440-444, https://doi.org/10.1016/j.apradiso.2006.11.005.
[12] E. Kam, et all., (2010), A study of background radioactivity level for **Canakkale**, Turkey. Environ Monit Assess, 168: 685–690, doi: 10.1007/s10661-009-1143-y.
[13] E. Kapdan., et. all, (2011), Outdoor Radioactivity and Health Risks in **Balıkesir**, Northwestern Turkey, Radiation Protection Dosimetry, pp: 1-9, doi:10.1093/rpd/ncr038.
[14] Lic´ınio MV, et al. (2013), A high spatial resolution outdoor dose rate map of the **Rio de Janeiro** city, Brasil, risk assessment and urbanization effects. J Environ Radioact 126, 32-9. doi: 10.1016/j.jenvrad.2013.07.012.
[15] Yaşar Kobya, et all., (2015), Evaluation of Outdoor Gamma Dose Rate and Cancer Risk in **Artvin** Province, Turkey, Human and Ecological Risk Assessment: An International Journal, 21:8, 2077-2085, doi: 10.1080/10807039.2015.1017876.
[16] M. A. Arnedo, et all., (2017), Mapping natural radioactivity of soils in the eastern **Canary Islands**, Spain, Journal of Environmental Radioactivity, 166, 242-258, doi: https://doi.org/10.1016/j.jenvrad.2016.07.010.
[17] Enis Kapdan, et all., (2018), Outdoor radioactivity and health risk assessment for capital city **Ankara**, Turkey, Journal of Radioanalytical and Nuclear Chemistry, 318. 1033-1042, doi: 10.1007/s10967-018-6060-5.