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Research Article

Determining the Relationship of Awareness of Radioactivity and Radiation Protection with the Level of Education in Turkey

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Abstract:

In this study, it was aimed to determine the level of awareness of Turkish society about radiation and the level of knowledge about radiation protection, and the relationship between the knowledge and education levels. A 22-item questionnaire was prepared for the participation of individuals who did not receive any academic training in the field of radiation. The prepared questionnaire was published on the web and 737 participants answered the questions. The answers of participants were evaluated using the SPSS 26 program. Relationship analyzes were made with the Pearson chi-square test on the data obtained from the questionnaire, and the data with a p value less than 0.05 were considered statistically significant. It was determined that the participants were aware of artificial and technological radiation sources, while their awareness about natural ionizing radiation sources was not at a sufficient level. The participants stated that they are aware of the effects of technological developments and the devices used in health institutions and also they trust the radiation workers working in the radiation fields. In addition it was determined that Turkish people had a low level of awareness of radioactivity and radiation protection information.

1. Introduction

Radiation affects us in every aspect of our life since the beginning of our world and is necessary for the continuation of our lives. Radioactive elements in the soil and cosmic rays from the sun are the fundamental elements of the world ecosystem. These sources described as natural radioactive elements, are necessary for the life-cycle of our ecosystem. However, radiation can negatively affect the body according to the level of exposure. People are exposed to radiation from cosmic rays originating from the sun and elements such as potassium-40, carbon-14, and radium can be affected in the body [1, 2]. With the development of technology, there is an increase in non-ionising (electromagnetic origin) and ionising (particle origin) radiation sources. Ionising radiation is used for scientific studies, diagnostic and surgical techniques, food industry, industrial establishments, and the health sector [3]. Technological developments are indispensable for our lives, especially in the field of health. Therefore, the exposure levels of artificial radiation that affect our ecosystem and people are increasing. Increased exposure can cause instantaneous cell structure change in biological organisms or mutations of genetic material. Furthermore, radiation can cause structural disorders in future generations from inheritance and can promote the formation of cancer cells [4]. For this reason, it is important to be aware of and protect from radiation, which has now become integral in our lives because of technology. In this study, a survey was conducted to determine the awareness level of Turkish people about radiation and their level of knowledge of radiation protection.

2. Materials and methods

Within the scope of the study, a 22-item questionnaire was prepared for participants who were also screened to determine those who had received training in the field of radiation. Ethics approval was obtained from Isparta University of Applied Sciences Ethics Committee on 01/09/2022 (E-96714346-050.99-45454). In order to obtain the

demographic characteristics of the participants, three questions regarding sex, age, and educational status were asked. To measure participant awareness of radiation and radio production, 19 questions with basic information about radiation, were presented to the participants. The 22-item questionnaire was presented to the participants online and was answered by 737 participants.

The data obtained from the participants were evaluated using the SPSS 26 software. Correlation analyses were performed with the Pearson chi-square test and data with a p value less than 0.05 were considered statistically significant. The data of the study were evaluated in terms of the significance of the relationship between radioactivity and radiation protection and the education level of Turkish participants.

3. Results and discussion

737 participants were evaluated for this study. 9.5% of the participants were under 19 years old, 12.1% were 20-29 years old, 25% were 30-39 years old, 33.6% were 40-49 years old, 13.5% were 50-59 years old, and 6.3% over the 60 years old. It was determined that 25.9% of participants had high school education, 20.3% had an associate degree, 43.9% had bachelor's degree, and 9.9% had a MSc or PhD degree.

Participants were asked to give a yes or no answer in agreement or disagreement to the statement: "Some of the devices we use daily, such as mobile phones, televisions, and computers also emit radiation to the environment". 96.3% of participants with a high school education, 97.3% with an associate degree, 99.1% with a bachelor's degree, and 95.8% with either a MSc or PhD degree answered yes. For this question, the difference between the answers and the level of education were found to be statistically significant (p=0.014).

The percentages of answers given by the participants to the question: "I have knowledge about radiation protection methods", are given in table 1 and the variation between of participants with different education levels was statistically significant (p=0.015). The percentages of the answers given by the participants to the multiple-choice question: "Which of the following is the competent institution dealing with the developments and precautions regarding radiation in Turkey?" are given in table 2. A high degree of statistical significance was found between the awareness of the official institution dealing with radiation in Turkey and the education level of the participants (p=0.000). 24.4% of the participants answered yes to the question: "The radiation we take into our body with food and drinks causes internal irradiation in our body", and a statistically significant relationship could not be obtained with the level of education (p=0.264).

Table 1. *Percentages of participant answers to the question: "I have knowledge about radiation protection methods"*

	Yes	**No**	**No idea**
High school	42.0%	42.6%	15.4%
Associate degree	50.7%	29.1%	20.3%
Bachelor's degree	56.6%	30.6%	12.8%
MSc or PhD degree	45.8%	34.7%	19.4%
Total	50.5%	33.8%	15.7%

p=0.015.

The majority of the participants (85%) answered yes in agreement to the statement: "Radiation is harmful to living things", and stated that they are aware of the harm of radiation to human health. It was determined by statistical analysis that this awareness was significantly related to education level (p=0.017). To the question: "Radiation is harmful only for pregnant women", the majority of participants answered no and the minimum percentage of this question (88.9%) were given by high school degree participants. No statistical significance was found for this question with education level (p=0.195)

51.0% of the participants answered yes in agreement to the statement: "The dosage of artificial radiation we are exposed to from medical applications and from nuclear sources is higher than the dosage we are exposed to from natural sources including cosmic radiation". It was found that the answers given were related to the level of education (p=0.000). The percentages of the answers given by the participants to the statement: "Our body needs some radiation for vital activities", are given in table 3. Also, 75.5% of the participants stated that they do not need radiation for vital activities. When the answers given were evaluated statistically, no significant difference was found between education levels (p=0.282).

To the statement: "Radon gas, which is a natural radiation source, is a source of ionizing radiation that accompanies us at every stage of our lives", 30.3% of participants answered yes, and there is a meaningful relationship with education levels (p=0.255). 77.8% of participants selected the medical waste symbol correctly (p=0.813) and 91.6% chose the radiation symbol correctly. It was determined that the awareness of the symbol was not significant with the education level.

Table 2. *Percentage of answers given by the participants to the question: Which of the following is the competent institution dealing with the developments and precautions regarding radiation in Turkey?*

	TBMM Grand National Assembly of TURKEY	**TAEK** Turkish Atomic Energy Authority	**TUİK** Turkish Statistical Institute	**Ministry of Health**	**No idea**
High school	4.3%	24.6%	3.2%	26.2%	41.7%
Associate degree	0.7%	22.6%	2.1%	34.9%	39.7%
Bachelor's degree	0.6%	37.0%	1.9%	24.1%	36.4%
MSc or PhD degree	0.0%	50.0%	0.0%	16.7%	33.3%
Total	1.5%	32.2%	2.1%	26.1%	38.1%

p=0.000

In addition, 94.0% answered yes to the question: "When I see the signs indicating radiation areas in health institutions, I can understand that the area is a radiation area", which was significant between the awareness of field marks in health institutions and the level of education (p=0.043).

Table 3. *Response percentages of the participants to the statement: "Our body needs some radiation for vital activities"*

	Yes	**No**	**No idea**
High school	23.9%	31.9%	44.1%
Associate degree	21.6%	38.5%	39.9%
Bachelor's degree	25.3%	38.4%	36.3%
MSc or PhD degree	28.2%	43.7%	28.2%
Total	24.5%	37.3%	38.2%

p=0.282

71.6% of participants correctly responded that the devices used in the health sector for medical imaging and treatment are an important source of radiation and can cause diseases such as cancer in later years of life (p=0.091). Also, 41.0% of participants answered correctly that these devices emit radiation even when turned off (p=0.102). There was no significant relationship between the participants' views about radiation emitting devices used for examination and treatment in health institutions and their education levels.

In this study, the majority of the participants (97.7%, p=0.014) stated that they were aware of the fact that technological developments increased the amount of radiation, and to the question " Which institution is responsible for radiation-related controls is Turkey?", 32.2% of the participants correctly suggested TAEK.

75.2% of the participants answered yes in agreement to the statement: "The radiation dosage that the human body can be exposed to decreases when moving away from the radiation source ", and a significant difference was found between damage caused by the distance from the radiation source and the level of education (p=0.000). In addition, 77.6% of the participants answered yes in agreement to the statement: "The amount of radiation damage to human health depends on the duration of exposure", but there was no significant relationship between the duration of exposure and damage and education level (p=0.291).

Some questions were prepared to determine the knowledge and attitudes about medical radiation-emitting devices used in health institutions, and the consequences for people working with these devices (table 4). 85.0% of the participants who had not received any radiation related training stated that radiation was harmful to living organisms, while 50.5% stated that they had sufficient knowledge about radiation protection. Paolicchi et al. (2016) showed with the participation of those working in the field of radiation, that 90.0% stated that they did not show the necessary sensitivity in taking radiological precautions [5]. While 24.5% (p=0.282) of participants thought that people receive low levels of radiation for vital activities, 37.5% (p=0.264) thought that people are exposed to radiation by internal irradiation from food intake. Dönmez et al. (2021) generated a survey for radiation workers and found that 85.6% of radiation workers correctly agreed to the statement that exposure to a small amount of radiation is healthy [3]. 77.8% (p=0.813) and 91.6% (p=0.133) of participants correctly identified medical waste and radiation symbols, respectively. Jafri et al., (2022) in their study of radiation workers found that 96.7% of participants had correct awareness of the radiation symbol [6]. In our study, 94.0% of the participants (p=0.043) stated that they could understand the radiation field from markers found in health institutions. 75.2% of the participants (p=0.000) agreed to the statement: " The radiation dosage that the human body can be exposed to decreases when moving away from the radiation source". Futhermore, 77.6% of the participants (p=0.291) answered correctly that the duration of exposure to radiation increases the effect of radiation. Dönmez et al. (2021) reported that 72.2% of radiation workers gave the correct answer to a similar question [3].

Table 4. *Response percentages and p value about the participants' knowledge and attitudes towards devices and the effects to staff in health institutions*

	Yes	No	No idea	p
I think that the most used x-ray method in diagnostic imaging examinations may increase the risk of developing cancer in the future.	71.6%	9.1%	19.2%	0.091
We are exposed to radiation without having an examination that involves a radiation-emitting device.	75.7%	8.6%	15.8%	0.041
Although radiation devices are switched off, they still emit radiation into the environment.	41.0%	26.5%	32.6%	0.102
I take care to use the following protection tools (such as lead apron, neck collar, gonad protector ...) while having an X-ray.	32.8%	67.2%	-	0.794
I trust the information of radiology units in health institutions about radiation protection and patient dose.	45.6%	54.4%	-	0.268

32.8% of participants stated that they took care to use protective measures such as lead aprons while having x-rays, and this was not related to their education level (p=0.794). Güden et al. (2012) found that 22.5% of radiation workers used protective measures such as lead aprons for themselves, 97.8% used a shielded cabin, and 15.7% allowed patients to use protective measures [7,8]. Conversely, 45.6% of participants in our study stated that they trust radiation workers in health institutions, and no significant relationship was found between this trust and education levels (p=0.268).

4. Conclusions

In this study, we determined that the awareness about radiation and radioprotection of individuals who did not receive any training about radiation or who did not work in these fields, was at a moderate level. Participants stated that they are aware of the effects of radiation-emitting technological developments and devices used in health institutions and that they moderately trust radiation workers. However, participants were not informed enough about natural radioactivity and radioactive elements. Therefore, Turkish people had a low level of awareness of radioactivity and radiation protection. In addition, no significant relationship was found between the low level of awareness and the level of education. As a result, in order to increase the level of knowledge and awareness about radiation in Turkish people, it would be beneficial to attract the attention of people with adverts or posters through social media, health institutions, educational institutions, and so on.

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
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