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Perceptions of Individuals on The Concepts of Radiation and Radioactivity

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Abstract

Radiation can be defined as energy that is both naturally occurring and used in scientific, medical and industrial wide perspectives. While it can provide many benefits with proper use, it can cause irreversible damage if necessary precautions are not taken. The biggest concern with radiation in societies is the possibility that in people exposed to radiation, cancer and inherited diseases will occur in future generations. The aim of this study is to examine the perceptions of individuals about radiation and radioactivity concepts. The study group consists of 134 individuals selected by systematic sampling method. An open-ended questionnaire form was used to collect data. At the end of the research, the data were analyzed by using frequency analysis, percentage analysis and descriptive analysis. Although there are factors such as the type, dose, distance from the source of radiation and duration of action to effect the radiation to affect human health and to create a lasting effect, the majority of the people who participated in the study regardless of these factors, it is seen that all kinds of radiation will cause disability, mental retardation in humans and will affect children to be born.

Keywords: Individual, Perception, Radiation, Radioactivity.

Bireylerin Radyasyon ve Radyoaktiflik Kavramlarına İlişkin Algıları

Özet

Radyasyon, hem doğal olarak meydana gelen hem de bilimsel, tıbbi ve endüstriyel geniş perspektiflerde kullanılan enerji olarak tanımlanabilir. Doğru kullanımla birçok fayda sağlamakla birlikte, gerekli önlemler alınmazsa geri dönüşü olmayan hasara neden olabilmektedir. Toplumlarda radyasyon ile ilgili en büyük endişe, radyasyona maruz kalan insanlarda, kanser ve gelecek nesillerde kalıtsal hastalıkların ortaya çıkması olasılığıdır. Bu çalışmanın amacı, bireylerin radyasyon ve radyoaktivite kavramları hakkındaki algılarını incelemektir. Çalışma grubu, sistematik örnekleme yöntemi ile seçilen 134 kişiden oluşmaktadır. Veri toplamak için açık uçlu bir anket formu kullanılmıştır. Araştırma sonunda veriler frekans analizi, yüzde analizi ve betimsel analiz kullanılarak analiz edilmiştir. Radyasyonun insan sağlığını etkilemesi ve kalıcı bir etki yaratması için radyasyonun türü, dozu, radyasyon kaynağına uzaklığı ve etki süresi gibi faktörlerin etkisi olmasına rağmen, bu faktörlerden bağımsız olarak çalışmaya katılan kişilerin çoğunluğunun, her türlü radyasyonun insanlarda sakatlığa, zeka geriliğine neden olacağı ve çocukların doğmasını etkileyeceğini düşündükleri görülmektedir.

Anahtar kelimeler: Birey, Algı, Radyasyon, Radyoaktivite.

1 Introduction

Radiation is a fact that we are intertwined in our daily lives. We are exposed to radiation from artificial and natural sources in the usual course of life. The source of the radiation we are exposed to may be a radiation emitting substance near us or a source too far away. It is possible to define the radiation in different ways.

(Dural & Ruacan, 2001) describe radiation as “the general expansion of energy in waves or particles (photons) in space. Radiation having different forms, is a natural energy from the moment, when the world was created. Radiation cannot be seen, smelled, tasted or felt but can be detected and measured with various devices (Fastman, 1998). Radiation can be divided into ionizing and non-ionizing form. Ionizing radiation; is any type of electromagnetic radiation having quantums carrying sufficient energy to remove electrons from ionizable atoms or ionizable molecules. Non-ionizing radiation is any type of electromagnetic radiation that does not have quantums carrying enough energy to remove electrons from ionizable atoms or molecules (Cleveland & Ulcek, 1999). Examples of ionizing radiation are high-energy x-rays and gamma rays that have the energy to generate ions by breaking electrons from atoms and molecules. High-energy ionizing electromagnetic waves cause ionization in living cells, thus disrupting the cell structure and causing molecular changes that can cause damage to the DNA structure. Ionizing radiation can change the chemical structure of something and the structure of living tissue (Fastman, 1988). Low-energy electromagnetic waves, such as visible light, infrared radiation and RF (radio frequency) waves, are examples of non-ionizing radiation.

Subjects such as radiation, radioactive material, radiation exposure, radiation transport and propagation are confused. It is seen that these concepts are used interchangeably in many scientific studies (Eijkelhof, 1996; Henriksen, 1996; Lijnse, Eijkelhof, Klaassen & Scholte, 1990; Millar & Gill, 1996). Many people think that the syringes and clothes sterilized using radiation will be radioactive and then these substances will emit radiation.

Radiation and radioactivity studies have shown that people believe the walls of the x-ray rooms used for medical purposes are filled with radiation, that these walls should be considered as radioactive waste and the objects in this room emit radiation (Eijkelhof, 1996; Janssen & Wellens, 1989; Mubeen, Abbas & Nisar, 2008). It was also thought that workers who were exposed to experimental animals irradiated for experimental purposes would be exposed to radiation themselves, and an industrial worker who accidentally received radiation, was considered as radioactive material by his friends and neighbors (Eijkelhof, 1996).

There are different opinions about the effects of radiation on living health. The exposure of radiation changes the genetic structure of the living organism and affects subsequent generations; Although it depends on many factors such as the type of exposure, dose, duration of exposure, affected area, distance between radiation source and living beings, there is widespread belief among the public that radiation will harm human health, disrupt the cell structure and cause hereditary diseases (Matsuura & Iiri, 1994).

In this study, it is aimed to reveal individuals' perceptions about radiation and radioactivity concepts.

2 Material and Methods

Research methods used in educational sciences show that different methods such as quantitative and qualitative research methods intersect and are often used together (Baran, 2013; McMillan & Schumacher, 2006). The qualitative research of the study however, the data obtained for the research were quantified with percentage and frequency values.

2.1 Study group

The study group consisted of 134 individuals. Individuals are selected from random sampling types by systematic sampling method. In systematic sampling, individuals to be included in the sampling are formed by selecting each unit or individual from the universe according to certain criteria and at certain intervals (Yıldırım & Şimşek, 2008). The research was conducted in a period of six weeks in the 2017-2018 academic year.

2.2 Data collection tools

Open-ended interview was used as a data collection tool. Expert opinion was taken to determine the usefulness of the items included in the questionnaire. In order to ensure the validity of the questionnaire, the literature studies, textbooks and related media publications on the subject were examined and survey questions were prepared. In order to see if the prepared open-ended survey questions are suitable for the main study; the questionnaire was pre-treated with 72 people and the questions that were left unanswered were removed from the questionnaire and the expert opinion was obtained and the questionnaire was prepared for the main study (Kilinç & Salman, 2007; Oppenheim, 1966).

2.3 Analysis of data

In the analysis of the data, the answers to the open-ended questionnaire used in the study were examined and coded and divided into specific categories. The frequency and percentage values of the answers given to each item of the questionnaire were converted into tables and converted into quantitative data such as qualitative data, frequency and percentage ratio. In order to see how often the generated codes are repeated, the percentage of data is the most frequently used data analysis method in qualitative research (Tutty, Rothery & Grinnell; Yıldırım & Şimşek, 2008). Descriptive and content analysis were used for data analysis. In addition, qualitative data were quantified as frequency and percentage values. In the descriptive analysis, direct quotations are frequently included to reflect the views of individuals interviewed or observed (Yıldırım & Şimşek, 2008).

In the study, expert opinion was obtained in order to establish data collection tools and to analyse the data in order to ensure the validity of the research. In addition, the researcher; the possibility of meeting with the participants, the proximity to the research environment, the factors that increase the validity of the study. In order to ensure the reliability of the research, data collection tools were clearly defined, the study group consisted of who the sample group was selected and the methods used and the time of the study. However, the position of the researcher is clearly stated to increase reliability. It was stated that the researcher had direct contact with the individuals in the study group (Yıldırım & Şimşek, 2008).

3 Results and Discussion

In this section, the responses of the individuals to the open-ended questionnaire prepared by the researchers and the percentage-frequency values of the codes related to these answers are given as tables. While creating codes, unanswered questions are coded as zero data and meaningless answers that are not related to the question are coded as meaningless data kod. In addition, some of the answers given to the questions by individuals are shown with direct quotations.

Table 1. Does radiation spread from one region to another? If you think it will spread, how do you think it can be spread? Distribution of answers to the question according to the codes.

	individual (n=134)	
Code	***f*** **(**frequency)	**%**
Zero data	9	6,7
I don't know	5	3,7
Meaningless data	7	5,2
Not spread	10	7,5
preads with mobile phones	22	16,4
I don't know how, but it's spread	28	20,9
Propagated in waves	17	12,7
Propagated by air, wind, rain, soil	27	20,1
Propagated by radiation exposed organisms	5	3,7
Propagated by rays	4	3,0

As shown in table 1, it is observed that the total of the answers given in the form of answers (Zero data, meaningless data and I do not know) is 15.6%. It is seen that 20.1% of the group said that radiation is spread through air, wind, rain and soil.

Table 2. Do you believe that radiation can be passed to someone who eats flesh of a sheep that feeds on grass in a radiation zone or drinks milk from a cow exposed to radiation? Distribution of answers to the question according to the codes.

	individual (n=134)	
Code	***f***	**%**
Zero data	12	8,9
I do not know	6	4,5
Meaningless data	8	6,0
Yes	102	76,1
No	6	4,5

As shown in table 2, the total amount of unrelated answers and I don't know answers is 19.4%. It is seen that 76.1% percent of respondents say that radiation can be passed to someone who eats flesh of a sheep fed in a radiation area and who eats the milk of a cow exposed to radiation.

Table 3. Do you think radioactive material is seen in the bodies of people who eat fish living in a river where radioactive wastes are discharged? Distribution of answers to the question according to the codes.

	individual (n=134)	
Code	***f***	**%**
Zero data	4	3,1
I don't know	18	13,4
Meaningless data	3	2,2
Yes	106	79,1
No	3	2,2

It is shown in table 3 and table 4 that the total number of answers not related to the subject and the answers given as I don't know is 18.7% in the group. 2.2% of the group said that the fish living in the waters where the radioactive wastes were discharged would not see any radioactive material.

The total of the answers that are not related to the subject and the answers given as I don't know is 16.4%. It is seen that 76.1% of the group said that people who were exposed to radiation could transmit the radiation to others by means of goods, blood or sweat.

Table 4. Persons Exposed to Radiation; Can the objects they use transmit the radiation to others via blood or sweat? Distribution of answers to the question according to the codes.

	individual (n=134)	
Code	***f***	**%**
Zero data	7	5,2
I don't know	12	9,0
Meaningless data	3	2,2

Yes	99	73,9
No	13	9,7

Table 5. Shopping Malls, Airports, Government Offices and so on. Do you think the radiation emitted by the box-shaped metal detectors, which are placed in the entrances of places, for security purposes, accumulates in the human body? Distribution of the answers to the question according to the codes.

	individual (n=134)	
Code	***f***	**%**
Zero data	9	6,7
I don't know	23	17,2
Meaningless data	8	6,0
Yes	64	47,8
No	30	22,4

As shown in table 5 and table 6 the sum of the answers not related to the subject and the answers given as I don't know is 29.9%, 47.8% of the group thought that radiation emitted by metal detectors accumulated in the human body.

The sum of the answers not related to the subject and the answers given as I don't know is 10.4%. It is seen that 73.1% of the group think that the radiation that affects us will affect our child to be born because of the radiation causing mutation.

Table 6. Is there any possibility that a radiation affecting you will affect your children? Distribution of the answers to the question according to the codes.

	individual (n=134)	
Code	***F***	**%**
Zero data	5	3,7
I don't know	5	3,7
Meaningless data	4	3,0
Yes by mutation, genes	98	73,1
No	5	3,7
It depends on the type of radiation, the dose, the area taken	17	12,7

Table 7. Which sources of artificial radiation affect people the most?

	individual (n=134)	
Code	***F***	**%**
Zero data	8	6,0
I don't know	7	5,2
Meaningless data	3	2,2
Radiation used in the diagnosis of diseases	95	70,9
Resources used in industry	9	6,7
Nuclear power plants	12	9,0

In table 7 it is seen that the sum of the answers not related to the subject and the answers given as I don't know is 13.4%. It is seen that 70.9% of the group think that the most radiation affecting people is caused by radiation used in the diagnosis of diseases.

Table 8. Distribution of the answers to the questions according to the codes.

		individual (n=134)	
	Code	***f***	**%**
Is there a radiation-related risk for the people living near the nuclear reactor?	Zero data	14	10,4
	I don't know	12	9,0
	Meaningless data	4	3,0
	Yes	88	65,7
	No	16	11,9
Is radioactive material released from the chimney of nuclear reactors?	Zero data	5	3,7
	I don't know	3	2,2
	Meaningless data	0	0
	Yes	110	82,1
	No	16	11,9
Is radiation used in magnetic resonance (MR) and ultrasound imaging?	Zero data	0	0
	I don't know	9	6,7
	Meaningless data	0	0

	Yes	106	79,1
	No	19	14,2
Is there any radiation risk in mammography examinations?	Zero data	8	6,0
	I don't know	18	13,4
	Meaningless data	0	0
	Yes	47	35,1
	No	61	45,5
Can pregnant women have radiological examination?	Zero data	0	0
	I don't know	5	3,7
	Meaningless data	0	0
	Yes	26	19,4
	No	103	76,9
Is the risk of radiation-based examinations more common for pediatric patients?	Zero data	8	6,0
	I don't know	16	11,9
	Meaningless data	0	0
	Yes	60	44,8
	No	50	37,3

In this section, the responses of the individuals to the open-ended questionnaire prepared by the researchers and the percentage-frequency values of the codes related to these answers are given as tables. While creating codes, unanswered questions are coded as zero data and meaningless answers that are not related to the question are coded as meaningless data code. In addition, some of the answers given to the questions by individuals are shown with direct quotations.

As shown in table 1, it is observed that the total of the answers given in the form of answers (zero data, meaningless data and I do not know) is 15.6%. It is seen that 20.1% of the group said that radiation is spread through air, wind, rain and soil.

In table 2, the total amount of unrelated answers and I don't know answers is 19.4%. It is seen that 76.1% percent of respondents say that radiation can be passed to someone who eats flesh of a sheep fed in a radiation area and who eats the milk of a cow exposed to radiation.

It is shown in table 3 and table 4 respectively that the total number of answers not related to the subject and the answers given as I don't know is 18.7% in the group. 2.2% of the group said that the fish living in the waters where the radioactive wastes were discharged would not see any radioactive material.

The total of the answers that are not related to the subject and the answers given as I don't know is 16.4%. It is seen that 76.1% of the group said that people who were exposed to radiation could transmit the radiation to others by means of goods, blood or sweat.

As shown in table 5 and table 6 the sum of the answers not related to the subject and the answers given as I don't know is 29.9%, 47.8% of the group thought that radiation emitted by metal detectors accumulated in the human body.

The sum of the answers not related to the subject and the answers given as I don't know is 10,4%. It is seen that 73.1% of the group think that the radiation that affects us will affect our child to be born because of the radiation causing mutation.

In table 7 it is seen that the sum of the answers not related to the subject and the answers given as I don't know is 13,4%. It is seen that 70.9% of the group think that the most radiation affecting people is caused by radiation used in the diagnosis of diseases.

4 Conclusion

In this section, since radioactive substances are sources of radiation, radiation is transmitted and transported by the transmission or transport of these substances. Radioactive substances can be transported and transported to very remote areas due to the effect of rain, by the movement of the soil or by the effect of the wind, as a result of the displacement of small radioactive particles. If a living organism does not contain radioactive material in its cells, it is not possible to transmit or transmit radiation to other areas where it is exposed to radiation. In the study does the radiation spread from one area to another? If you think it will spread, how do you think it can spread? when the answers given to the question are examined, it is understood that the group is also thinking that the people exposed radiation emits radiation. The same question, ''I do not know how, but spreads" from the excess of answers (20.9%) shows that the group does not have any information about how the transmission and transport of radiation.

In addition, the answers to the same question ''spreads with mobile phones" (16,4) show that people see mobile phones as a radioactive material and think that radiation is carried and transmitted by moving mobile phones from one place to another. Since it is known that it emits radiation during use, people may see the mobile phone as a radioactive substance. When the studies in the literature are examined, there are studies showing that people think of the substances exposed to radiation as radioactive material (Eijkelhof & Millar, 1988; Henriksen, 1996; Henriksen & Jorde, 2001; Lijnse, Eijkelhof, Klaassen & Scholte, 1990; Millar & Gill, 1996; Nakipoğlu & Bülbül, 2000; Neumann & Hopf, 2012; Yalçın & Kılıç, 2005).

If there are samples of radioactive material in the grasses grown in radiation areas, that is, if radioactive material is accumulated in these herbs, radioactive material is found in the meat and milk of the animals eating these herbs. However, animals that eat

radiation-exposed herbs or who are exposed to direct radiation will not emit radioactive properties and will not emit radiation from these animals. In the study, even if the radioactive material does not accumulate in the grass growing in the radiation areas, it is seen that the herbs in these regions gain radioactive properties and they will be exposed to radiation in the living organisms that exposed to radiation (%76,1). This thought that radiation exposed substances will gain radioactive properties is consistent with the results of the study in the literature (Eijkelhof, 1996; Henriksen & Jorde, 2001; Lijnse et al., 1990; Millar & Gill, 1996; Millar et al., 1990; Prather, 2005).

A significant proportion of the participants (79.1%) thought that radiation would be passed on to people who ate fish living in a river where radioactive wastes were discharged. The situation of living things that consume radiation-exposed food is completely different from that of living things that consume radioactive substances. Changes in physical conditions do not alter the radioactive properties of radioactive substances. Radioactive wastes contain radioactive properties. If these wastes are not properly stored, they can be transported to other areas by penetrating into the soil and water of the area where they are discharged. Therefore, if the radioactive wastes are discharged into a river, the radioactive substances in the waste may pass to water, fish and people consuming fish.

Although a radiation-exposed substance and radioactive material are completely different from each other, it is seen that the participants of this study think that both substances emit radiation. Likewise, although radiation-exposed individuals would not radiate radiation from their bodies with blood, sweat, or other body fluids because of the absence of radioactive material in their bodies, it was seen that most of the participants thought that they would emit radiation as if they were radioactive material (73.9%).

It is seen that the participants believe that the radiation accumulates in the human body (47.8%). Since radiation exposure is instantaneous, radiation exposure is terminated when the radiation source is removed and this radiation does not accumulate in the substance. However, as seen in the results of this study, it is seen in the literature that people believe that the radiation will accumulate in the substance, in case of exposure to radiation, the substance will absorb the radiation, such as the sponge absorbing the water and trapping it in its structure (Eijkelhof, 1990; Prather & Harrington, 2001).

Same way; In order for radiation to affect human health and cause a permanent effect, factors such as the type of radiation, its dose, distance to the source of radiation and duration of exposure are effective. It is seen that the people participating in the study think that all kinds of radiation will cause disability, mutation, mental retardation in humans and affect the children to be born (73.1%). This result of the study coincides with the literature results showing that people have similar thoughts (Hammick, Tutt & Tait, 1998; Matsuura, 1997).

70.9% of the group stated that the most radiation affecting people is caused by the radiation used in the diagnosis of diseases. Considering all artificial sources, 97% of the total radiation affecting people is reported in the literature because of the radiation used in the diagnosis of diseases (Lucas, 1987).

65.7% of the group is there a risk of radiation related to the people living near the nuclear reactor? answered ‘‘yes’’ to the question. Studies on many nuclear facilities have reported no such risk. 82.1% of the group gave the answer that the radioactive material is released from the chimney of the nuclear reactors. This result is partially compatible with the literature. Radioactive material is released but this radiation is extremely low dose and does not cause environmental damage. In coal-fired power plants, a small amount of radioactive material is released from the chimneys and in some cases the amount of this radiation may be higher than the nuclear power plant of the same energy (Bolus, 2017).

79.1% of the group responded that magnetic resonance (MR) and ultrasound imaging used radiation. However, it has been reported that no radiation is used in the literature. Is there a risk of radiation from mammography examinations? 35.1% of the group said ‘‘yes’’. The radiation sensitivity of breast tissue is higher than many tissues. The risk is perhaps not zero but is very low. For example, a 40-years-old woman who underwent mammography examination had a 1.41 / 100.000 chance of developing breast cancer due to radiation (Republic of Turkey Ministry of Health, 2013).

Can pregnant women undergo radiological examination? 76.9% of the group answered the question ‘‘no’’. Pregnant women, radiological examination (head, chest, arm, leg, etc.) in which the baby in the womb is not directly in the beam of radiation is not allowed to take the necessary precautions. Investigations where the baby will be irradiated directly and the radiation dose is higher (abdominal tomography and fluoroscopy examinations) may be postponed after a pregnancy if there is no medical need.

In case of necessity of examination, the baby in the womb should be subjected to a minimum radiation dose. Currently, infant births are between 1-6% due to natural causes, in a review where a high radiation dose can be considered for diagnostic examinations (eg, on a abdominal tomography), it is useful to note that this probability is very low, such as 0.012%, or 1: 8.000. The lower rate is 15% due to natural causes. Female patients should report to the physician if they are pregnant or if they are not pregnant, if they want to be examined (Republic of Turkey Ministry of Health, 2013).

Are there any risks of investigations using radiation for pediatric patients? 44.8% of the group answered ‘‘yes’’ to the question. The division of the cells in children is much faster than adults, and therefore they are more susceptible to radiation and therefore the risks are higher than in adults. These risks are more common in children who have a longer life span than adults because radiation-induced cancer occurs after a long period of time.

According to the findings obtained in the research, it is seen that individuals mix the concepts of radiation and radioactivity and use each other instead of artificial radiation sources as radioactive material. In addition, it was found in the study that people thought

that radiation exposed substances would acquire radioactive properties and that these substances would accumulate radiation over time.

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