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Future directions for research on radon gas in human blood using Airthing device

Amjad H. Ali[1, 2], Basim A. Almayahi[2]

[1]Directorate General of Education in Najaf Governorate, Najaf, Iraq
[2]University of Kufa, Faculty of Science, Department of Physics, Najaf, Iraq
Corresponding Authors: basim.almayahi@uokufa.edu.iq

Abstract: *This study aimed to examine and quantify the concentration of radioactive radon gas in blood samples collected from donors in Iraq using the Airthing device. The blood samples were obtained from the National Cancer Hospital of Najaf and Al-Manathira General Hospital for cancer patients and healthy individuals. The concentration of radon gas in the blood samples was determined using the Canary device, and the results showed an average concentration of 3.88 Bqm^{-3}. This study concluded that the concentration of ^{222}Rn in the blood samples was within the limits allowed by the World Health Organization.*

Keywords: Radon, World Health Organization, Najaf Hospital, blood

Introduction

The Airthing device shows promise in detecting radon gas in human blood, which could provide valuable insights for public health policy on radon mitigation strategies. However, there are several areas for further research. Validation of the device across different populations is needed, as well as examining its effectiveness in detecting radon gas in blood samples with varying levels of radon exposure. Additionally, large-scale epidemiological studies are necessary to explore the correlation between radon gas concentration in human blood and health outcomes such as lung cancer and respiratory disease. Finally, research efforts should focus on developing more accurate and sensitive detection methods for radon gas in human blood.

Developing new techniques for extracting radon gas from blood samples and using more sensitive instruments to measure radon gas concentration may be necessary. Radon gas is a colorless, odorless, tasteless, and radioactive gas known as the "invisible or silent killer". It contains three isotopes: ^{222}Rn, ^{220}Rn, and ^{219}Rn, which come from the ^{238}U series, ^{234}Th and ^{235}U series, respectively. The most common and dangerous isotope is ^{222}Rn, which has a half-life of 3.825 years and emits alpha particles that decay into the daughter radioisotopes polonium, bismuth, and lead from long-lived radionuclides like ^{226}Ra (half-life of 1600 years) in the uranium series, eventually producing the stable isotope 210Pb [1]. Radiation is ubiquitous in our lives, coming from three sources: the cosmos (external space), the earth (terrestrial), and human bodies [2]. Monitoring radon levels in the environment is crucial to prevent and limit the spread of harmful pollutants. Humans can be exposed to radionuclides and hazardous substances via the digestive or respiratory systems. Studies on cancer in Iraq suggest that the current increase in cases may be related to the use of nuclear weapons in the first and second Gulf Wars, with reports of lung, skin, bladder, stomach, breast cancers, leukemia, and lymphoma [3, 4]. To obtain a comprehensive understanding of human exposure to radon gas and harmful substances, it is important to study radon and other dangerous elements inside the human body. Blood samples are a vital biomarker in cancer research, and in this investigation, samples were obtained from a population model of men to determine the radioactivity of radon gas and other dangerous components. The study aims to assess the toxicity of radioactive pollutants in individuals exposed to them, taking into account age, gender, region, workplace, and smoking habits, and to compare the results with previous studies on malignancy. The Airthing device is used to detect radon gas in blood in this study.

Materials and Methods

The radon-monitor Canary is an effective and easy-to-use device for measuring radon concentration in a given area. It is designed to measure radon concentration for longer terms, which can help prevent severe diseases. The device can measure average share and measurement range between 0 and 35000 Bq m^{-3}, making it ideal for short and long-term measurement of radon concentration. The radon-monitor Canary can calculate and record even the average ratio per day or per week, and even the cumulative value for a whole year [5]. Its compact and simple design makes it easy to install in any corner of an apartment, house, or factory. The device is battery-driven and can be used in rooms that are connected to the underground. It is important to position the device at least 25 cm away from walls, at least 50 cm above the ground, and at least 150 cm away from the next aeration facility. The radon-monitor can help detect and locate the accession of radon into a building much more effectively than common technologies. It can be operated by anyone without any prior knowledge of measurement principles. If the device displays "ERR ###," it means that the batteries need to be replaced. If it displays "9999 Bqm^{-3}," it indicates a significantly raised radon concentration that may severely affect health. The device is widely used in research, such as in the current study where human blood samples were collected from male and female volunteers from Al-Najaf Governorate, Iraq. The concentrations of ^{222}Rn were measured for 25 blood samples collected from cancer patients and healthy subjects using a rapid measurement of radon using a Canary Digital

Electronic Radon Gas Monitor radiometer (Corentium AS, Norway). Blood samples were taken from healthy and cancer patient persons, and groups of cancer patients were collected from the National Cancer Hospital in Al-Najaf Governorate.

Results and Discussion

A portable digital canary device was utilized to measure radon gas concentrations in blood samples obtained from both cancer patients and healthy individuals. Both male and female participants were included in the study, with the measured radon gas concentration ranging from 1.86 Bqm^{-3} to 3.8883 Bqm^{-3}. The average concentration of radon gas was compared between males and females for both infected and healthy subjects. Among males, the level of radon gas ranged from 2.67-3.47 Bqm^{-3}, with an average of 3.07 Bqm^{-3}. Among females, the level of radon gas ranged from 1.99 - 3.3 Bqm^{-3}, with an average of 2.64 Bqm^{-3}. Additionally, a comparison was made between the average concentration of radon in smoking and nonsmoking individuals using the Canary device. The results showed that the radon concentration in males was higher than that of females. Notably, all measured radon blood concentrations were found to be lower than those reported in literature reviews [6-8]. The concentration of radon in human blood is an important issue, and recent studies have used the Airthing device to detect its levels. While this approach shows promise, further research is needed to validate the device across diverse populations, explore the link between radon exposure and health outcomes, and improve detection accuracy. In a study conducted at Najaf Hospital, the highest level of ^{222}Rn was found in a male who worked at the hospital and lived in a residential area that had been exposed to American bombing. Conversely, the lowest concentration was observed in a non-smoking healthy female. Males exhibited higher levels of radon in their blood, which was attributed to their work environment. The experiment also revealed variations in H and T values during its application. Despite these findings, the concentration of ^{222}Rn in the blood of all subjects remained within the limits allowed by the World Health Organization.

Conclusions

To summarize, while the Airthing device is a promising tool for detecting radon gas in human blood, there are still many areas that require further research. Future studies should focus on validating the device across diverse populations, investigating the relationship between radon exposure and health outcomes, and developing more precise detection methods. In one particular study, the concentration of ^{222}Rn was measured in various individuals, with the highest level found in a male who lived in a residential area that was exposed to American bombing and worked in a hospital. Conversely, the lowest concentration was observed in a healthy, non-smoking female. Males generally had higher ^{222}Rn concentrations than females, which was attributed to their work environments. The experiment also revealed variations in H and T values during its application. Ultimately, the study concluded that the concentration of ^{222}Rn in the blood of all participants was within the acceptable limits set by the World Health Organization.

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