HIROSAKI UNIVERSITY

Radiation Environment and Medicine 2021 Vol.10, No.2 108–114

REM
Radiat Environ Med

Report

Meeting Report on "The 6th Educational Symposium on Radiation and Health by Young Scientists (ESRAH2019)"

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Received 4 March 2021; revised 29 April 2021; accepted 7 May 2021

This is a report on the sixth Educational Symposium on Radiation and Health by Young Scientists (ESRAH2019) held at Hirosaki University in Japan on September 14, 2019. Nuclear power plants play a major role in catering to Japan's energy demand, and therefore, emergency response and coordination in case of radiation-related accidents are essential for nuclear facilities. In the wake of the accident at the Fukushima Daiichi Nuclear Power Plant followed by the Great East Japan Earthquake in 2011, the establishment of a radiation emergency response system is currently underway, and it also takes into consideration the research on the effects of radiation on human tissues. Further to this, human resources with knowledge about radiation who can respond to radiation accidents in an emergency should be trained further. The ESRAH has been held jointly by Hirosaki University and Hokkaido University since 2014. This symposium aims to provide young researchers the latest developments and knowledge on radiation by inviting eminent researchers from across the globe and promoting the exchange of ideas among young researchers from various radiation fields. At ESRAH2019, four educational lectures by eminent researchers from Ireland, Indonesia, Hungary, and Italy and 30 poster discussions by young researchers were held. The young researchers were provided a meaningful opportunity to build an international research network.

Key words: radiation accidents, F1-NPP, ESRAH, radiation effects

1. Introduction

Numerous studies have been conducted on the effects of radiation on human tissues from the viewpoints of physics, chemistry, and biology, and multiple studies are ongoing. In medicine, not only image diagnosis but also radiotherapy have been achieved by leveraging

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Table 1. List of Educational Lecture (EL)

No.	Title	First author	Affiliation
EL1	Estimating the Annual Average Dose to the Public from Ionizing Radiation in Ireland	K. Kelleher, Ph.D.	Environmental Protection Agency Ireland
EL2	Safety Assessments for People and Environment in Supporting the Application of Nuclear Technology in Indonesia	A. Ikram, Ph.D.	The National Nuclear Energy Agency (BATAN) Indonesia
EL3	Radiological Characterisation of Reused By-product in Building Materials	T Kovács, Ph.D.	University of Pannonia Hungary
EL4	Interstitial Lung Diseases (ILDs): Clinical and Radiological Features	S. Palmucci, M.D.	University of Catania Italy

the positive aspects of radiation (high permeability and energy convergence). However, the harmful effects of radiation on normal tissues cannot be ignored. On March 11, 2011, the Fukushima Daiichi Nuclear Power Plant (F1-NPP) was damaged by the Great East Japan Earthquake and the subsequent tsunami, following multiple hydrogen explosions and fire. Consequently, a large amount of radioactive substances were released to the environment[1-5]. The accident at F1-NPP, as well as the Chernobyl nuclear accident, had established that nuclear disasters may affect not only the countries in which they occur but also other countries around the world through the spread of the radioactive substance pollution.

Rokkasho Village in Aomori Prefecture in the northern part of Japan has several nuclear facilities, such as the Low-Level Radioactive Waste Disposal Facility[6, 7]. It is, therefore, important to work in close cooperation with the local population to develop human resources who can respond to any emergency due to radiation-related accidents. However, there is currently a scarcity of human resources in this field. Young researchers and healthcare workers who deal with radiation need to have sufficient knowledge of radiation and emergency response skills. To learn more about the effects of radiation on the human tissue, it is important to share knowledge among radiation research professionals.

Since 2008, seminars on radiation effects have been held alternately between the laboratories of Prof. Hiroyuki Date at Hokkaido University and Prof. Ikuo Kashiwakura at Hirosaki University once a year. After the accident at F1-NPP, this exchange meeting has been held internationally as the Educational Symposium on Radiation and Health by Young Scientists (ESRAH) since 2014[8]. The 1st, 2nd, and 4th ESRAH events were held at Hirosaki University, Japan in 2014, 2015 and 2017, while the 3rd and 5th ESRAH events were held at Hokkaido University, Japan, in 2016 and 2018[8-12]. These symposia helped to establish not only relationships and networks among many young scientists but also enhanced their knowledge of the effects from radiation on human health. In the 2019 edition of the symposium, there were 4 lectures by eminent researchers, including one in the field of radiological clinical medicine for the first time, and 30 poster presentations by graduate students and young researchers. In this report, we described the ESRAH2019 in detail.

2. Educational Lectures

Four eminent researchers presented the relationship between radiation accidents and human health in detail. The titles, names of presenters, and the affiliations of the lectures are listed in Table 1. The current state of the research on radiation was presented in the lectures and discussions. In this section, we summarize the lectures delivered by the researchers.

2.1. Lecture I: Annual Exposure to Radiation on Common People in Ireland

Dr. Kevin Kelleher from the Environmental Protection Agency, Ireland, introduced the audience to the average exposure from ionizing radiation to the people in Ireland. The average annual exposure to a person in Ireland from all sources of radiation is now estimated as 4037 μSv, which is consistent with previous studies in this area but slightly above the worldwide annual average estimated by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). This is as a result of the high indoor Radon concentration in Ireland. Radon continues to be the principal cause of radiation exposure in Ireland, representing just over 55% of the radiation that the Irish population is exposed to. The second leading cause is the medical exposure to patients, which is by far the largest man-made contributor to the collective exposure. Other sources such as fallouts of nuclear accidents and weapons tests or discharges of nuclear or radioactive waste to the environment remain very low.

To estimate the annual exposure to a person in Ireland accurately, we need to evaluate the cosmic radiation based on elevation, terrestrial gamma radiation using

a comprehensive soil survey, and perform a better estimation of radioactivity in food sources through a comprehensive survey.

2.2. Lecture II: Radiation Safety and Epidemiological Studies in High-radiation Areas

Dr. Abarrul Ikram, head of the Center for Technology of Radiation Safety and Metrology (PTKMR) at the National Nuclear Energy Agency (BATAN) at Jakarta, Indonesia, delivered a lecture on *Radiation Safety in Indonesia* and *Effective Dose and Epidemiology Study in the High-Radiation Area in Mamuju.*

In the first half of the lecture, Dr. Ikram talked about BATAN and its role in safety. BATAN was formed in 1954 by the State Committee to Investigate Radioactivity to investigate the possibility of a radioactive fallout from nuclear weapons testing in the Pacific Ocean. The institute has five research locations: Jakarta, Serpong, Bandung, and Yogyakarta and its main task is to ensure protection of the population and our environment from the risk of radiation. In radiation metrology, PTKMR plays the role of Secondary Standard Dosimetry Laboratory to improve the quality of radiotherapy in Indonesia and the Designated Institute (DI) for ionizing radiation. PTKMR conducts research on design of protective materials for radiation workers in hospitals, in collaboration with other institutions. For ensuring safety during radio-diagnostic assessment in hospitals, it is necessary to implement microdosimetry by placing a special optically stimulated luminescence dosimeter and thermo luminescence dosimeter on physicians. The center also provides other services for radiation protection, ensuring safety of food products, monitoring air particulate and rain water radioactivity, and marine radio-ecology. Dr. Ikram placed particular emphasis on monitoring the marine radio-ecology. A large area of land in Indonesia faces the ocean; therefore, research must be conducted routinely on marine radioecology.

After the accident at F1-NPP, researchers began the continuous monitoring of the contours of ^{137}Cs concentrations in marine environments. For instance, the concentration of ^{137}Cs in fish from West Bangka, Indonesia and deep sea water, as well as that of ^{137}Cs, ^{226}Ra, ^{232}Th, and ^{40}K in the marine sediment was monitored regularly.

In the latter half of the lecture, Dr. Ikram talked about how BATAN had conducted the mapping of environmental radiation and radioactivity in all areas of Indonesia during 2005-2012. The mapping identified areas that have high natural radiation: Kabupatan Mamuju-West Sulawesi, Pulau Biak-Provinsi Papua, Pulau Tual-Provinsi Maluku, Provinsi Bangka Belitung, and Pulau Karimun. The environmental radiation mapping also indicates that Mamuju area in West Sulawesi has the highest level of natural radiation and the widest range as compared to other areas. Measurement of the indoor Radon concentration in the Simboro district Mamuju showed an average of 400 Bq/m^3, higher than the reference level of 300 Bq/m^3 prescribed by the International Commission on Radiological Protection (ICRP) and International Atomic Energy Agency (IAEA).

Dr. Ikram also described the steps of the mapping methodology:

1. Systematic grid sampling has been used for sampling, grid size is 60 km × 60 km for five main islands and 20 km × 20 km for the other islands.
2. Environmental gamma dose rate measurement was performed continuously in the car during the trip within the grid, as well as at the soil sampling point outside the car.
3. Soil samples were taken at each grid at a depth of 0-5 cm and 5-20 cm.
4. Radionuclide concentrations were measured with a gamma spectrometer using a HPGe detector.

Environmental gamma dose rates in Mamuju were surveyed by BATAN, and found to be 200-3000 nSv/h. Even in areas with much higher dose rates from natural radiation, it has been reported that no detrimental biological effects have ever been detected. Since 2015, chromosome aberration, comet assay, and foci-gamma H2AX, polymorphism TP53, gene expression and immunology data surveys have been done in collaboration with Hirosaki University. The survey team was unable to observe significant differences as compared to the control conditions. BATAN and Hirosaki University continue the cooperation in measurement as well as other fields such as health sciences.

2.3. Lecture III: Radiological characterisation of reused by-products in building materials

Dr. Tibor Kovács from the University of Pannonia, Hungary, delivered a lecture titled "Radiological characterisation of reused by-products in building materials". Nowadays, the Naturally Occurring Radioactive Materials (NORM) are reused as secondary raw material for various uses, for example, in the building industry. However, the design of new synthetic building materials based on NORM is raising concerns about the health risk. Dr. Kovács introduced a protocol of NORM investigation focusing on the mobility of the toxic components (leaching properties) and radiation exposure (gamma dose rate and Radon/Thoron exhalation). Based on the protocol, different by-products (red mud, manganese mud, coal ash, drilling mud, phosphogypsum, etc.) were characterised in terms of reusability as building material. According to the results, the classic gamma dose surplus determination and Radon exhalation do not contain enough information because of the strong

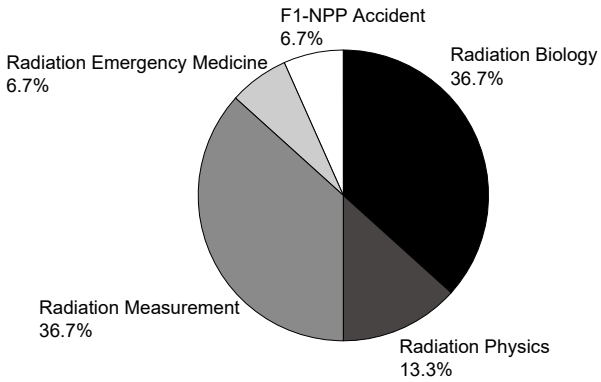

Fig. 1. Percentage of each category in the poster session for young scientists.

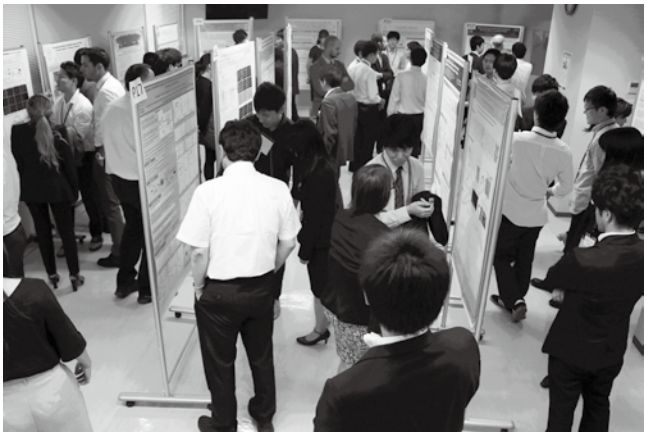

Fig. 2. The scene of discussion between young scientists and top researchers.

influence of the inner structure (microporosity) on the Radon potential. Therefore, to get more reliable Radon potential estimation, comprehensive study is necessary. The leaching test is a very important approach for the assessment of long-term environmental behavior and its impact. But there is still no commonly accepted method for the evaluation of the leaching characteristics of NORM in the European Union (EU). To characterise the leaching behavior, three leaching procedures (Hungarian standard, the international CEN/TS and the Tessier 5-step method) were applied and compared. The results suggest that the standard method complementing the Tessier speciation method gives a better insight into the fraction of radioisotopes bound to the material.

2.4. Lecture IV: Interstitial Lung Disease (ILDs): Clinical and Radiological Features

Dr. Stefano Palmucci from the University of Catania, Italy, gave a lecture titled "Interstitial Lung Disease (ILDs): Clinical and Radiological Features", based on a significant research performed on diagnostic imaging and radiation therapy. Dr. Palmucci explained the clinical features of interstitial lung diseases and focused on how to derive an accurate diagnosis. ILDs are classified into four main categories: 1) Diseases with known causes, 2) Idiopathic Interstitial Pneumonias (IIPs), 3) Granulomatous disorders, 4) Miscellaneous disorders. The most severe form of IIP manifests as idiopathic pulmonary fibrosis (IPF)[13, 14]. This is an idiopathic condition with the most life-threatening prognosis. Overall survival is estimated to be 3 to 5 years from the time of diagnosis. Chest radiography has been used to diagnose ILDs. Chest X-rays are cost-effective and widely available. For most ILDs, chest radiographs reveal a decrease in the lung volume with reticulation. However, neither conventional chest radiography nor conventional Computer Tomography (CT) was able to reliably detect early parenchymal pulmonary fibrosis. Therefore, High Resolution Computed Tomography (HRCT) scanning has been developed, which provides a much greater spatial resolution than conventional CT and can detect and characterise a wide range of pulmonary interstitial diseases such as IPF, sarcoidosis, and lymphangitis[15]. HRCT is used for accurate imaging of IPF, and plays an important role in the characterisation of IPF radiation patterns, referred to as Usual Interstitial Pneumonia (UIP) appearance. There are various patterns in UIP, and each pattern is explained in patient data and paper reports. Moreover, IPF may indicate "atypical" or "atypical pattern". These situations require an interdisciplinary assessment involving a respiratory specialist, a radiologist, a rheumatologist and a surgeon.

Dr. Palmucci concluded the lecture by stating that the reliability of HRCT is not affected by technical parameters or performance. Certain diagnostic functions such as reticular tissue and pulmonary cystic changes in HRCT are subjective and show significant variability between observers. Therefore, patterns need to be integrated into the Medical Device Directive (MDD) approach. The accuracy of the diagnosis has improved with the technical advancement of the apparatus, but it cannot be denied that the subjectivity of the diagnostician does have an impact. Therefore, in this lecture, it was stated that further development of an integrated approach should be pursued for eliminating elements such as human error and further interdisciplinary discussion is required.

3. Poster Presentations by Young Scientists

Young scientists from eight countries including Ireland, Hungary, Cameroon, China, Indonesia, Singapore, Thailand and Japan participated in this session. There

Table 2. List of Poster Presentation by Young Scientists

No.	Title of poster presentation	First author	Affiliation
1	The effect of X-ray on elastic fibers formed by rat lung fibroblasts in vitro	Y. Kitayama	Hirosaki University, Japan
2	Investigation of radiation emergency medical preparation situation at nuclear emergency core hospitals and nuclear emergency medical cooperative institutions	M. Sakamoto	Hirosaki University, Japan
3	Current situation of triage methods for exposed patients in the acute phase of a nuclear disaster	Y. Suzuki	Hirosaki University, Japan
4	A simple and fast method of Radium-226 measurement in drinking water from high background radiation area	E. D. Nugraha	Hirosaki University, Japan
5	The effect of ultraviolet on ciliary zonules in vitro	Y. Shiroto	Hirosaki University, Japan
6	Occupational Natural Radiation Exposure at the Uranium Deposit of Kitongo, Cameroon	O. B. Modibo	Hirosaki University, Japan
7	Measurement of attached radon and thoron progeny size distributions in Mamuju, Indonesia using passive detectors	C. Kranrod	Hirosaki University, Japan
8	Determination the origine of organic acids in different hydrocarbon mixtures by ^{14}C analysis	R. Locskai	University of Pannonia, Hungary
9	Personal radon monitor using small containers for contact lenses	Y. Tamakuma	Hirosaki University, Japan
10	Differential kinetics of chromosomal aberrations after low and high dose-rate radiation on young B6C3F1 mice	V. S. T. Goh	Hirosaki University, Japan
11	The anti-tumor mechanisms of radiation response by retinoic acid-inducible-gene-I-like receptor agonist	Y. Sato	Hirosaki University, Japan
12	Measurements of cell surviving fraction for non-uniform irradiation fields	S. Naijo	Hokkaido University, Japan
13	Romiplostim regulates the activation of master redox regulator Keap1-Nrf2 system in mice exposed to lethal total-body irradiation	A. Chiba	Hirosaki University, Japan
14	Validation of Can Technique to Measure the Exhalation Rates of Radon and Thoron from Soil Sample	M. A. Saputra	Hirosaki University, Japan
15	A model analysis of cell survival after irradiations considering on repair probabilities of the lesions as time elapses	R. Seino	Hokkaido University, Japan
16	Identification of the radiation dose-responsive gene expression in mice exposed to total-body irradiation	T. Nishida	Hirosaki University, Japan
17	Investigation of radio-sensitivity enhanced by reactive oxygen species in the presence of 4-methylumbelliferone	R. Takahasi	Hirosaki University, Japan
18	Effects of ultraviolet on elastic fibers and collagen fibers in the dermis of the skin	S. Shiiya	Hirosaki University, Japan
19	Model estimation for the uncertainties of treatment planning in fractionated radiotherapy	T. Miyao	Hokkaido University, Japan
20	Neutron activation analysis for determining the chlorine content of crude oil	R. Katona	University of Pannonia, Hungary
21	Effect of the radiation study meeting as a new form of risk communication	K. Ogura	Hirosaki University, Japan
22	Electron track structure analysis for an update of cross sections	Y. Yoshie	Hokkaido University, Japan
23	Lung dose estimation of radon and thoron decay products based on IMBA	J. Hu	Hirosaki University, Japan
24	Cesium immobilization studies in different kind of geopolymer matrixes	A. Peka	University of Pannonia, Hungary
25	Hyaluronan synthesis inhibition regulates radiosensitivity of cancer cells acquired radioresistance	K. Hasegawa	Hirosaki University, Japan
26	Estimation of dose-response curve in oral squamous cell carcinoma cells including radioresistant cells	R. Fukui	Hirosaki University, Japan
27	Development of shortened chemical PCC assay for radiation emergency medicine	R. Nakayama	Hirosaki University, Japan
28	Dose Assessment of Radioactivity in Japanese Bottled Water	A. Kinahan	Environmental Protection Agency, Ireland
29	Radiation risk communication with evacuees of nuclear accidents-Trends from text mining analysis (FY 2018)	M. Shimizu	Hirosaki University, Japan
30	Optimization of etching time of CR-39 detector using Radonmeter measuring system	T. Ploykrathok	Hirosaki University, Japan

Fig. 3. Group photo of the participants from abroad and our staff.

were 30 posters presented: 11 on radiation biology, 4 on radiation physics, 11 on radiation measurement, 2 on radiation emergency medical treatment, and 2 on the accident at F1-NPP (Fig. 1). A one-minute summary presented by each young scientist was followed by a lively discussion on the contents of the presentation, which gave the young scientists new perspectives (Fig. 2). The research subjects are summarized in Table 2. During the closing ceremony of the symposium, Mr. Eka Djatnika Nugraha (Hirosaki University), Ms. Tamao Miyao (Hokkaido University), and Mr. Ryo Nakayama (Hirosaki University) were awarded for their work on the posters.

4. Summary and Future Prospects

In the 6th ESRAH held in 2019, young scientists in various fields such as radiation biology, radiation measurement, etc., gathered, shared their valuable experiences and discussed the direction of further research. The educational lectures delivered by senior researchers gave the young scientists an opportunity to gain knowledge. We express our gratitude to the four scientists who accepted our offer to deliver the lectures (Fig. 3).

However, since 2020, the spread of COVID-19 has made it challenging to hold international symposia as before. Therefore, we should devise newer methods to do so. ESRAH2020 was co-organized online with another symposium (details will be reported separately).

Acknowledgements

We would like thank the graduate students of Hirosaki University and Hokkaido University who cooperated in the organization of ESRAH2019.

Funding

This international symposium was supported by Strategic Theme 3: "International Education and Research Project based for Safety & Security on Radiation Medicine", Hirosaki University, Japan, and by an educational program on nuclear regulations "Comprehensive Educational Program on Contribution to Radiation Emergency Medicine for the Radiation Exposure Accident in a Nuclear Disaster", Nuclear Regulation Authority, Japan.

Conflict of Interest Disclosure

The authors declare that they have no conflict of interest.

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