Capacity Building in Japan: the Role of Young Professionals

Central Research Institute of Electric Power Industry (Japan)

Haruyuki OGINO, Ph.D.

IAEA International Experts' Meeting on Radiation Protection after the Fukushima Daiichi Accident – Promoting confidence and understanding

17-21 February 2014

CRIEPI
Central Research Institute of Electric Power Industry

IAEA Action Plan on Nuclear Safety

1. Safety assessment in the light of the accident at TEPCO's Fukushima Daiichi Nuclear Power Station
2. IAEA peer reviews
3. Emergency preparedness and response
4. National regulatory bodies
5. Operating organizations
6. IAEA Safety Standards
7. International legal framework
8. Member States planning to embark on a nuclear power program
9. Capacity Building
10. Protection of people and the environment from ionizing radiation
11. Communication and information dissemination
12. Research and development

Approved by the IAEA Board of Governors on 13 September 2011,
Available at: http://www.iaea.org/newscenter/focus/actionplan/reports/actionplanns130911.pdf

Outline

1. **Experiences of Young Professionals in Japan**
   - **What we faced and how we responded after the Fukushima Daiichi accident**

2. **Future perspectives**
   - **What we need as young specialists**

Young Researchers Association in Japan Health Physics Society (IRPA Associate Society)

- Established in 1988 (JHPS: since 1962)
- 50 members (under 35 years old, born after 1978)
  - About 5.6 % of the Associate Society members (900)
    - Universities (e.g., Tokyo, Kyoto, Nagoya)
    - Research institutes (e.g., JAEA, NIRS, AIST, CRIEPI)
    - Utilities (e.g., TEPCO, JNFL) and Manufactures (e.g., Fuji Electric, Chiyoda)
- Shocked by the nuclear accident (especially by the collapse of the safety myth) but highly inspired to overcome national difficulties
- Consultant of the Executive Committee
- Proposal of young researchers' opinions at the symposium (photo)

JHPS Fukushima Symposium (16 June 2011)

Chiba City Science café (left: 6 October 2012, right: 13 October 2013)

(Website) http://www.jhps.or.jp/wakate/wakate.html

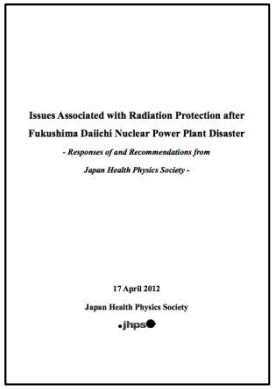
Radiological issues raised by Japan Health Physics Society (IRPA Associate Society)

➢ Comprehensive issues related to ALL situations

1. Strategies for reducing anxiety and doubts of the general public regarding radiation risk
2. Methods of measuring ambient dose rate, surface contamination density, and concentration of radioactive materials in foods

➢ Issues related to EMERGENCY exposure situation

3. Criteria for evacuation and sheltering
4. Administration of stable iodine
5. Principles of regulation of ingestion of food and drink
6. Screening criteria for decontamination
7. Dose limits for emergency workers
8. Post-disaster investigation of thyroid equivalent dose of radioactive iodine


Issues Associated with Radiation Protection after Fukushima Daiichi Nuclear Power Plant Disaster

- Responses of and Recommendations from Japan Health Physics Society -

17 April 2012

Japan Health Physics Society

jhps

➢ Issues related to EXISTING exposure situation

9. Provisional criteria for judging the safety of using school yards, silage, crop soil, fertilizers, bathing areas, etc.
10. Systems for temporary entry into restricted zones
11. Management of radioactive waste such as cesium-containing rubble, sludge and decontaminated soil

The report is available at www.jhps.or.jp/en/

(Source) http://www.jhps.or.jp/en/wp-content/uploads/2011/12/53224f1dbbc1063ffff46bb5cc3fa01c.pdf

Q&A website
(Available at: www.radi-info.com)

Search

Answers by specialists

Radiation in daily life

Japan Health Physics Society

(Total: 1,867, Last updated: 27 Feb. 2013)

Category

Title

Translation

Question

Similar questions

Answer

Share
(Twitter, Facebook,
Google+)

Procedures

1. Respectfully and carefully respond to all questions

- Do not ignore a question even if it seems quite similar to a previous question
- Publish the original questions on the website

2. State objective facts in plain language

- Calculate doses under each exposure situation
- Compare with scientific data

3. Modestly add the personal opinion of respondent

- Provide a basis for a commensurate response with radiological risks
- Assist people who posed questions in making their decisions

M. Shimo, Jpn. J. Health Phys., 46(3), 223-226 (2011)
Available at: https://www.jstage.jst.go.jp/article/jhps/46/3/46_223/_pdf (in Japanese)

Experience

◆ Establishment of Q&A website

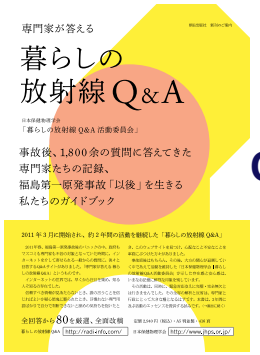
- ➢ 25 March 2011: Voluntarily opened by retired experts (20 members)
- ➢ 24 August 2011: New official committee in JHPS (53 members)
  - ■ 80 %: young professionals

◆ Achievements

- ➢ 1,867 Q&A with 5,000 Twitter followers
- ➢ Accepted new questions until January 2013
- ➢ Compilation with 80 questions published on July 2013
  - ■ with revised and rewritten versions of the original answers on the website to take into account information that had recently become available

Q&A website
http://radi-info.com/

Since 25 March 2011

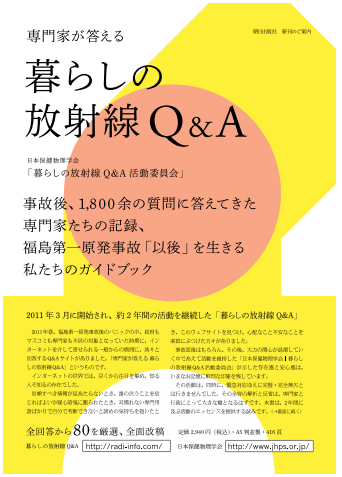


Compilation

Contents of the Compilation

- **Preface**
  - Names of responders (16 senior and 33 young professionals, and 13 others)
  - Meaning of 100 mSv
  - Doses related to human exposure (absorbed, equivalent and effective doses)
- **Record of the Fukushima nuclear accident**
  - Part 1: Looking back upon the Immediate Confusion
  - Part 2: Regarding Children's Safety
  - Part 3: Day to Day Life
  - Part 4: Living in Fukushima Prefecture
- **Scientific basis of radiation protection**
  - Part 5: Radiation Exposure and Health Effects
  - Part 6: Countering Public Distrust of Specialists
- **Who did post questions?**
- **Glossary**
- **All titles of 1,870 questions**
- **Index of keywords**
- **Afterword**

All titles of 80 questions are shown in the following slides.



Part 1: Looking back upon the Immediate Confusion

1. What was the exposure to a 3-year old child on 15 March 2011 in the Tokyo Metropolitan Area?
2. What will happen if I ate food exposed to the radioactive air?
3. I am worried because I passed through the radioactive plume during take off.
4. I am concerned about the health effects to my child who got wet in the rain.
5. Please explain about the cancer risks for an infant.
6. Health effects for an infant drinking tap water.
7. Internal and external exposures of an infant from radioiodine.
8. My child drank water from the waterspout.
9. My child ate sand from the sandbox in the park.
10. My child frequently had severe nosebleeds. Is this from radiation?
11. Dose rate from rain water in drainpipes.
12. I live 60 km away from the nuclear power plant, and I'm afraid that the dose rate is higher than the sheltering area (20-30 km from the power plant).
13. Your responses are always saying that it is safe, but I still think there is risk.

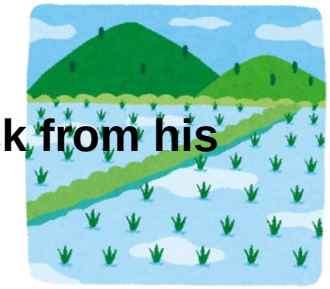
Part 2: Regarding Children's Safety

14. Should I have inspections for thyroid cancer and leukemia for my child in the Tokyo area?
15. Radioiodine and infant cancer incidence rate.
16. Fetal exposure.
17. Should I have a medical inspection of my breast milk?
18. I am worried about infant exposure.
19. Is it safe for my children to swim in an outdoor swimming pool?
20. I am worried about exposure from scrapes at the schoolyard.
21. Is it possible for the milk solids to become concentrated during milk pasteurization?
22. Should I be concerned about exposure to my infant from airborne ash from the wood stove?
23. I live in a house with 24-hour ventilation, and I'm afraid of exposure to my infant.
24. I am afraid of exposure to my child at nursery school.
25. Is there any difference in radio-sensitivity for those who have a chromosomal abnormality?
26. Children's cancer risk from CT examinations.

Part 3: Day to Day Life

27. Please explain the reasons for saying that it is safe on TV, if true.
28. Health effects of exposure to rain.
29. Please tell me about the dose of exposure from cesium in the tea.
30. Is there a possibility that plutonium was scattered around the Tokyo Metropolitan Area?
31. I am worried about large scale burning of dead grass for farming.
32. Radioactive materials were found in waste in vacuum cleaner. How much health effect can it cause?
33. Are there health effects from inhaling radioactive pollen?
34. I'm hesitant to put my contaminated clothes into my closet and dresser.
35. Radioactive materials might remain in the water purification system in the kitchen.
36. Provisional regulation value for drinking water.
37. Internal exposure and blood transfusions.
38. Please tell the difference from atomic bombing in Hiroshima.

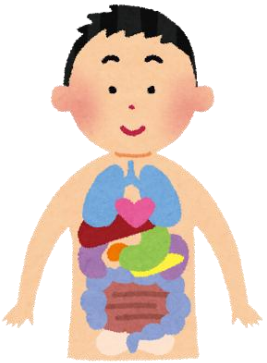
Part 4: Living in Fukushima Prefecture



39. Can I have a healthy baby if I continue to live in Iitate Village?
40. I live in Koriyama City. Should I choose to voluntarily evacuate?
41. Should I take special precautions when my husband comes back from his workplace near the Fukushima Daiichi nuclear power plant?
42. Can relocation reduce my family's exposure?
43. I am planning to volunteer to help decontaminate the city. Is this dangerous and how should I prepare for it?
44. Please tell me about the effect of cesium to the spermatozoa.
45. Meals for pregnant women and the radiation effects for fetus.
46. Please explain a method to convert results from the whole body counter to Sievert.
47. About the news broadcast about an increase of child diabetes in Sukagawa City.
48. Please tell me about the thyroid screening examination.
49. About the results from the medical thyroid inspection by the Fukushima Health Management Survey.
50. Am I at greater risk if I previously had a thyroid disease?
51. Please explain about the lifetime cumulative dose of 100 mSv.

Part 5: Radiation Exposure and Health Effects

52. About external and internal exposures, and natural and artificial radiation.
53. Are there any differences between artificial and natural radiation?
54. With regard to the stochastic effects of radiation, please explain the non-cancer health effects.
55. Is it enough to only measure the gamma-rays? What about the beta-rays?
56. I often hear the word “becquerel”, but I do not know what it means.
57. About the effective doses of iodine and cesium.
58. Does accumulated radioiodine continue to accumulate, or is it excreted?
59. Please explain about the biological half-life of cesium.
60. Effective dose coefficient and biological half-life.
61. Basis behind the dose limit of 1 mSv, and the duration for 100 mSv.
62. How does reactive oxygen cause DNA damage?
63. Relationship between attained age and cancer risk.
64. With so little incidence of leukemia after Chernobyl, is it possible to explain the relationship between radiation exposure and leukemia risk?
65. Relationship between radiation exposure and heart attack.
66. Please explain the minimum dose that can cause harmful effects.
67. About exposure to 1 mSv and 100 mSv.



Part 6: Countering Public Distrust of Specialists

68. Please disclose the names and affiliations of responders.
69. Do you have any conflicts of interest?
70. About the logic behind the ICRP recommendations.
71. Why is the approach of the ECRR precluded?
72. Please explain about the TV program about the ICRP broadcasted by NHK.
73. About the TV program by NHK (Part 2 of a series about the contaminated area after the Chernobyl accident: Complaints from the Ukraine).
74. Is the article entitled “Das leise Sterben (The Quiet Death)” correct?
75. Please explain about Bura Bura Disease (Radiation Fatigue).
76. Cause of death of the chief radio operator of Daigo Fukuryu Maru.
77. What does it mean when saying “1 mSv is a standard”?
78. Please explain about accumulation of cesium in the body and its effects.
79. Don’t say that something is safe if the effects are not completely known.
80. Please explain about the differences of opinions among specialists.

Example Question (No.1)

- **Female, 30s, Tokyo**

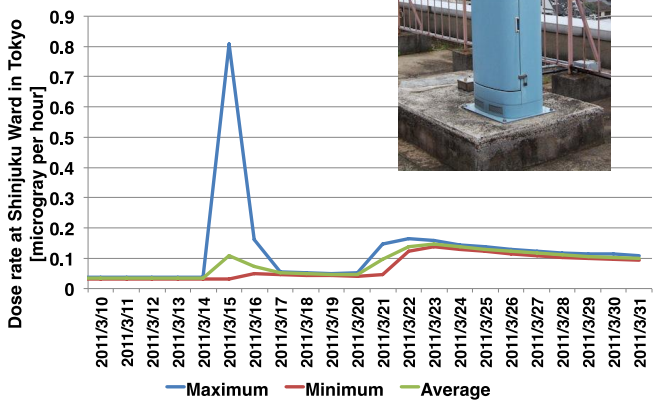
- I live in Shibuya Ward in Tokyo. I was outside with my 3-year old child for 2 hours from 10 am on 15 March 2011. Since we had been staying inside my house after the earthquake, we went to play at the park for a change of pace. On 21 March, we also had to go out due to an urgent business, and went out in the rain for 1 hour with a raincoat.

- Later, I found that the radiation doses were the highest at these days, and I am filled with regret. As a result, I became nervous about foodstuffs. From now on, how cautious should I be?

Our Response

Let us roughly calculate your external and internal exposure in the 2 hours between 10 am and 12 pm on 15 March 2011. In the calculation, we need two pieces of information. One is where you were and how long you stayed there, and the other is the amount of radiation dose per unit time at that location. As for the latter, we use the measurement results published by the Tokyo Metropolitan prefectural government.

First, external exposure. The monitoring post installed in Shinjuku Ward in Tokyo is measuring the radiation dose. According to the measurement data, the average dose rate in the hour between 10 am and 11 am was 0.496 microsievert per hour, and that between 11 am and 12 pm was 0.106 microsievert per hour. In this case, the external dose during those 2 hours totaled about 0.6 microsievert.



Our Response (Continued)

Next, internal exposure. Internal exposure occurs by inhalation and ingestion of radioactive materials. The radioactive concentration in the air is being measured in Setagaya Ward, Tokyo. Table 1 shows the radioactive concentration in the air in the hours between 10 am and 12 pm on 15 March 2011.

By using this measurement data, let us calculate the internal dose received through inhalation. For this, we need the breathing rate (m^3/h) and the effective dose coefficient (Sv/Bq). The breathing rates, assuming light exercise, are set as 0.57 m^3/h and 1.5 m^3/h for a child and an adult, respectively. The effective dose coefficient is a conversion factor of the amount of radioactive materials inhaled (Bq) to the amount of effective dose of exposure to radiation (Sv). This coefficient depends on the type of radionuclide as shown in Table 2.

Table 1. Radioactive concentration in air measured in Tokyo on 15 March 2011

Radioisotope	Radioactive concentration in air (Bq/m^3)	
	10-11 am	11-12 am
Iodine-131	240	83
Iodine-132	280	100
Iodine-133	30	9.7
Cesium-134	64	24
Cesium-136	11	4.2
Cesium-137	60	23
Tellurium-129	51	18
Tellurium-129m	63	25
Tellurium-131m	13	4.7
Tellurium-132	390	150
Molybdenum-99	Not detected	Not detected
Technetium-99m	3.6	Not detected

Our Response (Continued)

Table 2. Effective dose coefficient for inhaled radionuclides

Radionuclide		Effective dose coefficient (μSv/Bq)	
		Children (5 years representing 2-7 years)	Adult (more than 17 years)
Iodine-131	particulate aerosol *	0.037	0.0074
	elemental iodine vapor	0.094	0.020
	methyl iodine	0.074	0.015
Iodine-132	particulate aerosol *	0.00045	0.00011
	elemental iodine vapor	0.0013	0.00031
	methyl iodine	0.00095	0.00019
Iodine-133	particulate aerosol *	0.0083	0.0015
	elemental iodine vapor	0.021	0.0040
	methyl iodine	0.017	0.0031
Cesium-134		0.041	0.020
Cesium-136		0.0060	0.0029
Cesium-137		0.070	0.039
Tellurium-129		0.000099	0.000039
Tellurium-129m		0.017	0.0079
Tellurium-131m		0.0039	0.00094
Tellurium-132		0.0085	0.0020
Technetium-99m		0.000052	0.000020

* Inhalation of particulate aerosol: AMAD=1 μm, absorption type=F (the maximum among type F, M, S)

ICRP, Database of Dose Coefficients: Workers and Members of the Public, ICRP CD1 (http://www.icrp.org/publication.asp?id=ICRP%20CD1)

Our Response (Continued)

The internal dose (μSv) can be calculated as follows, where μSv is 1/1,000 of 1 mSv and 1/1,000,000 of 1 Sv.

Concentration in air (Bq/m^3) x breathing rate (m^3/h) x time duration (h) x effective dose coefficient (μSv/Bq)

As shown in Table 1, the radioactive concentration in air is given for each hour. For example, the internal dose from inhaling radioiodine-131 (particulate aerosol) during 10 am to 12 pm is calculated for a 5 year-old child as follows.

(240 + 83) Bq/m^3 x 0.57 m^3/h x 1 h x 0.037 μSv/Bq = 6.8 μSv

As for radioiodine, in addition to the particulate aerosol, there are gas forms. The gas forms of radioiodine pass through a normal filter, and thus are not included in the measurement result shown in Table 1.

So, let us assume that the amount of the gas forms of radioiodine is 2.507 times higher than the particulate aerosols, and 1/3 of the gas forms is the elemental iodine vapor and 2/3 of the gas forms is the methyl iodine, in accordance with a report by the US Defense Threat Reduction Agency*.

* Radiation Dose Assessment for Shore-based Individuals in Operation Tomodachi, Revision 1, December 2012

Our Response (Continued)

Then, the exposure dose for a child from inhaling the elemental iodine vapor is calculated as,

$$(240 + 83)\ Bq/m^3 \times 2.507 \times 1/3 \times 0.57\ m^3/h \times 1\ h \times 0.094\ \mu Sv/Bq = 14.5\ \mu Sv$$

and the exposure dose from inhaling the methyl iodine is calculated as,

$$(240 + 83)\ Bq/m^3 \times 2.507 \times 2/3 \times 0.57\ m^3/h \times 1\ h \times 0.074\ \mu Sv/Bq = 22.8\ \mu Sv$$

By performing the similar calculation for all radionuclides, and summing up the dose, the internal doses are calculated to be 55 μSv for a child and 35 μSv for an adult.

The exposure dose can be similarly calculated for 21 March. The external exposure dose was 0.083 μSv, and the internal exposure doses were 2.7 μSv and 1.8 μSv for a 5-year old child and an adult, respectively.

Our Response (Continued)

According to the above calculation, the exposure doses during going outside on 15 and 21 March 2011 in Tokyo were assessed, in consideration of both external and internal exposures, as approximately 58 μSv (0.058 mSv) for a child and 37 μSv (0.037 mSv) for an adult.

Of course, unnecessary exposures should be avoided, but these doses were smaller than the variation of natural background radiation among the prefectures of Japan (0.38 mSv). So we can consider the dose to not be at a level of health concern.

Moreover, you are worried about ingesting the contaminated food, but the concentration of radiocesium in the food distributed in the market is low. According to the measurement data of foodstuffs conducted until 31 August 2011, the annual effective doses were 0.135 mSv for a child (1-6 years) and 0.099 mSv for all other ages. We can expect that it will decrease in the future*. So, it can be considered that special precautions for food selection in the market are not necessary.

* It was confirmed by an additional survey by Ministry of Health, Labor and Welfare (MHLW) from March to May 2012 that the exposure doses did decrease (e.g., less than 0.003 mSv/y for a child). Available at: http://www.mhlw.go.jp/stf/houdou/2r9852000002wyf2.html (in Japanese)

Feedback

■ Positive

- Responders are honest and reliable
- Each answer is provided in plain language, based on plenty of knowledge and expertise
- Quantitative answers sound reasonable, not just saying "Don't worry"

□ Negative

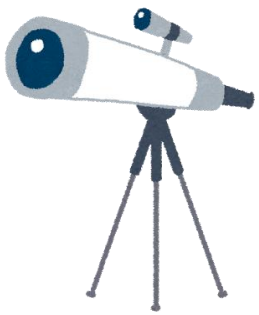
- All opinions saying "Don't worry" stir up more anxiety
- Dose assessments are not reliable because the government might hide some important information
- Which is true? Different opinions are provided by other sources, so there is no consensus about the risks of exposure to low-dose radiation

H. Ogino, Jpn. J. Health Phys., 47(1), 37-43 (2011)
Available at: https://www.jstage.jst.go.jp/article/jhps/47/1/47_37/_pdf

Future perspectives

- **Radiation protection is a practical science**
  - Relevant to day to day life
    - Especially for existing exposure situations in Fukushima
    - Now and for decades to come
  - What is the purpose of the research, and for whom?

- **Broad knowledge is needed**
  - Deeper understanding of one's own specialty
  - Cooperation with specialists in other fields



Future perspectives

- **Stance of specialists**
  - **Impartiality**
    - Separating personal biases from the research
    - Avoiding conflicts of interest
  - **Scientifically-based explanations**
    - Importance of scientific papers with broad consensus in academic circles
    - Insight to recognize sound science
    - Balance between contradicting new evidence and established consensus

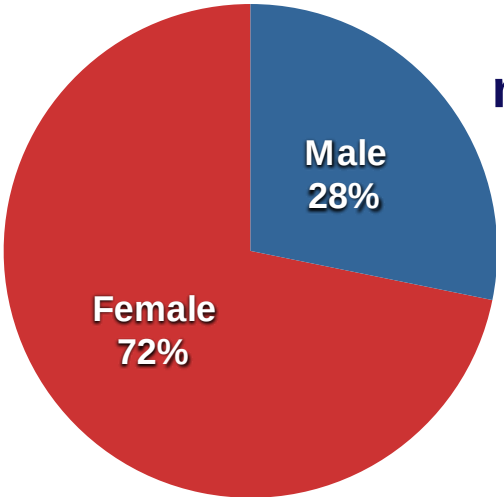
Thank you for your attention

Haruyuki OGINO

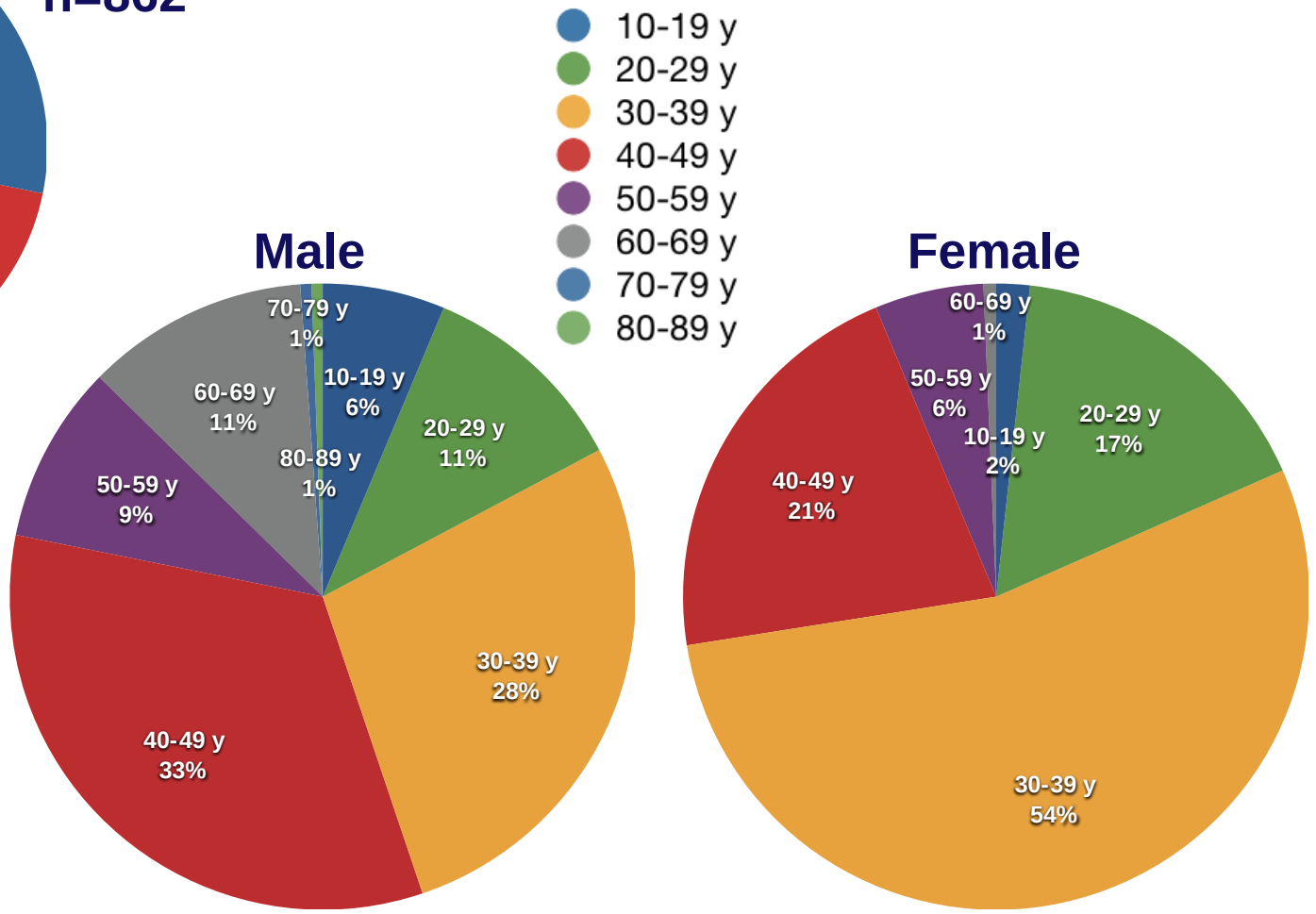
haruyuki@criepi.denken.or.jp

Additional Slides

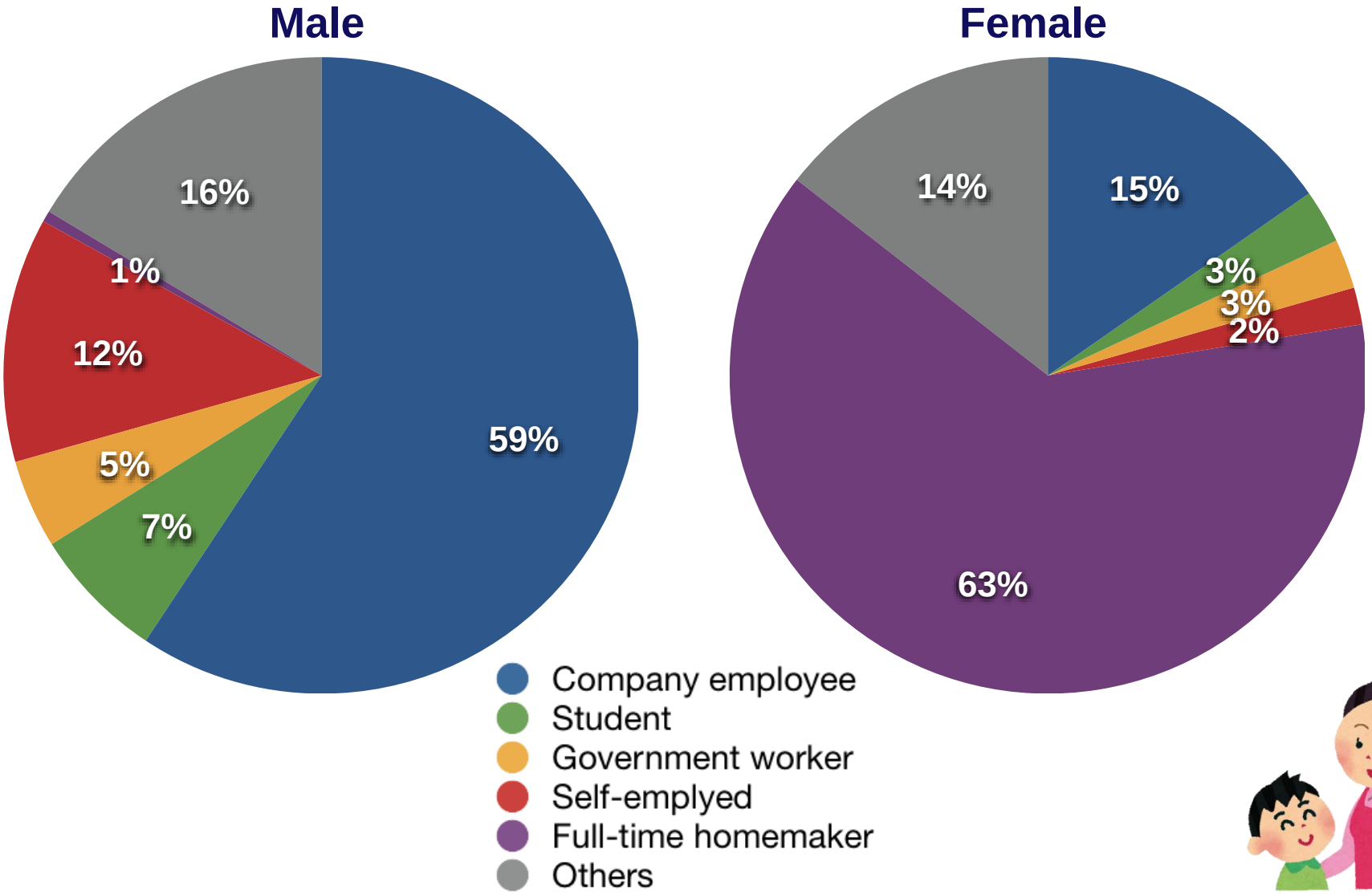
User Profile



n=862



Occupation


Male
16%
1%
12%
5%
7%
59%
Female
14%
15%
3%
3%
2%
63%
Company employee
Student
Government worker
Self-emplyed
Full-time homemaker
Others

Number of Questions