ATTACHMENT A-4

JAPAN-SPECIFIC DATA

UNSCEAR 2020/2021 Report, annex B, Levels and effects of radiation exposure due to the accident at the Fukushima Daiichi Nuclear Power Station: implications of information published since the UNSCEAR 2013 Report

Contents

This attachment provides Japan-specific data relevant to the estimation of internal and external exposure of the Japanese population as a result of the accident at the Fukushima Daiichi Nuclear Power Station (FDNPS). Firstly, dose coefficients for intake of radioiodine (in different physical/chemical forms) and radiotellurium by inhalation or ingestion are presented. The dose coefficients have been derived using the methodology set out in section IV of attachment A-2 and should be regarded as indicative for Japanese people with differing diet, age and sex. Secondly, information is presented on the occupancy of Japanese people (of differing age-social groupings) inside buildings (e.g., at home, work, leisure). Based on this latter information, improved estimates have been made of occupancy factors to be used when updating the dose estimates in the UNSCEAR 2013 Report [UNSCEAR, 2014].

Notes

For consistency, doses and other quantities in this attachment are quoted, in general, to two significant figures. This should not be interpreted as an indication of their precision that may often be much less.

This attachment has not been formally edited.

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I. JAPAN-SPECIFIC INDICATIVE DOSE COEFFICIENTS FOR INTAKES OF RADIOIODINE AND RADIOTELLURIUM

A. Japan-specific indicative dose coefficients for ^{131}I

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	Adult male, absorbed dose to thyroid per exposure	*Adult female, absorbed dose to thyroid per exposure*	*Adult, effective dose per exposure*	*10-year-old, absorbed dose to thyroid per exposure*	*10-year-old, effective dose per exposure*
Inhalation, aerosols Type F, 1 µm, dietary intake of stable iodine					
Western pattern diet	3.9E-11	3.8E-11	1.8E-12	6.9E-11	2.9E-12
Typical	**2.1E-11**	**2.0E-11**	**9.6E-13**	**3.7E-11**	**1.6E-12**
Kelp-rich diet	7.2E-12	6.9E-12	3.4E-13	1.3E-11	5.9E-13
Inhalation, methyl iodide, dietary intake of stable iodine					
Western pattern diet	6.6E-11	6.4E-11	3.0E-12	1.1E-10	4.4E-12
Typical	**3.6E-11**	**3.4E-11**	**1.6E-12**	**5.8E-11**	**2.4E-12**
Kelp-rich diet	1.2E-11	1.2E-11	5.6E-13	2.0E-11	8.2E-13
Inhalation, elemental iodine, dietary intake of stable iodine					
Western pattern diet	9.4E-11	9.1E-11	4.2E-12	1.5E-10	6.6E-12
Typical	**5.1E-11**	**4.9E-11**	**2.3E-12**	**8.3E-11**	**3.7E-12**
Kelp-rich diet	1.7E-11	1.7E-11	8.2E-13	2.8E-11	1.5E-12

Table A-4.2. Japan-specific indicative dose coefficients for inhalation of ^{131}I by members of the public (1-year-old and fetus 35 weeks) with various levels of dietary intake of stable iodine: thyroid absorbed dose per exposure, Gy per (Bq s/m^3), and effective dose per exposure, Sv per (Bq s/m^3)

	1-year-old, absorbed dose to thyroid per exposure	*1-year-old, effective dose per exposure*	*Fetus 35 weeks, absorbed dose to thyroid per maternal exposure*	*Fetus 35 weeks, effective dose per maternal exposure*
Inhalation, aerosols Type F, 1 µm, dietary intake of stable iodine				
Western pattern diet	9.1E-11	3.8E-12	7.7E-11	3.8E-12
Typical	**4.8E-11**	**2.0E-12**	**2.9E-11**	**1.4E-12**
Kelp-rich diet	1.6E-11	7.4E-13		
Inhalation, methyl iodide, dietary intake of stable iodine				
Western pattern diet	1.3E-10	5.1E-12	1.6E-10	7.9E-12
Typical	**6.7E-11**	**2.7E-12**	**5.9E-11**	**3.0E-12**
Kelp-rich diet	2.2E-11	9.2E-13		

	1-year-old, absorbed dose to thyroid per exposure	*1-year-old, effective dose per exposure*	*Fetus 35 weeks, absorbed dose to thyroid per maternal exposure*	*Fetus 35 weeks, effective dose per maternal exposure*
Inhalation, elemental iodine, dietary intake of stable iodine				
Western pattern diet	1.8E-10	7.5E-12	2.0E-10	1.0E-11
Typical	**9.5E-11**	**4.1E-12**	**7.6E-11**	**3.8E-12**
Kelp-rich diet	3.2E-11	1.5E-12		

Table A-4.3. Japan-specific indicative dose coefficients for inhalation of ^{131}I by adult members of the public with the typical level of dietary intake of stable iodine: organ absorbed dose per exposure, Gy per (Bq s/m^3)

	Adult male, absorbed dose to red bone marrow per exposure	*Adult female, absorbed dose to red bone marrow per exposure*	*Adult male, absorbed dose to colon per exposure*	*Adult female, absorbed dose to colon per exposure*	*Adult male, absorbed dose to breast per exposure*	*Adult female, absorbed dose to breast per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine						
Typical	1.4E-14	1.4E-14	6.0E-15	4.9E-15	5.0E-15	7.8E-15
Inhalation, methyl iodide, dietary intake of stable iodine						
Typical	2.3E-14	2.2E-14	9.4E-15	7.8E-15	7.8E-15	1.2E-14
Inhalation, elemental iodine, dietary intake of stable iodine						
Typical	3.3E-14	3.2E-14	1.4E-14	1.2E-14	1.1E-14	1.8E-14

Table A-4.4. Japan-specific indicative dose coefficients for inhalation of ^{131}I by children with the typical level of dietary intake of stable iodine: organ absorbed dose per exposure, Gy per (Bq s/m^3)

	10-year-old, absorbed dose to red bone marrow per exposure	*10-year-old, absorbed dose to colon per exposure*	*10-year-old, absorbed dose to breast per exposure*	*1-year-old, absorbed dose to red bone marrow per exposure*	*1-year-old, absorbed dose to colon per exposure*	*1-year-old, absorbed dose to breast per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine						
Typical	1.3E-14	8.3E-15	6.8E-15	1.6E-14	1.1E-14	8.2E-15
Inhalation, methyl iodide, dietary intake of stable iodine						
Typical	2.0E-14	1.2E-14	9.7E-15	2.0E-14	1.4E-14	1.0E-14
Inhalation, elemental iodine, dietary intake of stable iodine						
Typical	2.8E-14	1.8E-14	1.4E-14	2.9E-14	2.1E-14	1.5E-14

Table A-4.5. Japan-specific indicative dose coefficients for ingestion of ^{131}I by members of the public (adult and 10-year-old) with various levels of dietary intake of stable iodine: thyroid absorbed dose per intake, Gy /Bq, and effective dose per intake, Sv/Bq

	Adult male, absorbed dose to thyroid per intake	*Adult female, absorbed dose to thyroid per intake*	*Adult, effective dose per intake*	*10-year-old, absorbed dose to thyroid per intake*	*10-year-old, effective dose per intake*
Western pattern diet	3.6E-07	4.4E-07	1.6E-08	8.7E-07	3.5E-08
Typical	**2.0E-07**	**2.3E-07**	**8.8E-09**	**4.6E-07**	**1.9E-08**
Kelp-rich diet	6.7E-08	8.0E-08	3.1E-09	1.6E-07	6.6E-09

Table A-4.6. Japan-specific indicative dose coefficients for ingestion of ^{131}I by members of the public (1-year-old and fetus 35 weeks) with various levels of dietary intake of stable iodine: thyroid absorbed dose per intake, Gy/Bq, and effective dose per intake, Sv/Bq

	1-year-old, absorbed dose to thyroid per intake	*1-year-old, effective dose per intake*	*Fetus 35 weeks, absorbed dose to thyroid per maternal intake*	*Fetus 35 weeks, effective dose per maternal intake*
Western pattern diet	3.0E-06	1.2E-07	1.1E-06	5.5E-08
Typical	**1.6E-06**	**6.4E-08**	**4.1E-07**	**2.0E-08**
Kelp-rich diet	5.3E-07	2.2E-08		

Table A-4.7. Japan-specific indicative dose coefficients for ingestion of ^{131}I by adult members of the public with the typical level of dietary intake of stable iodine: organ absorbed dose per intake, Gy/Bq

	Adult male, absorbed dose to red bone marrow per intake	*Adult female, absorbed dose to red bone marrow per intake*	*Adult male, absorbed dose to colon per intake*	*Adult female, absorbed dose to colon per intake*	*Adult male, absorbed dose to breast per intake*	*Adult female, absorbed dose to breast per intake*
Typical	1.3E-10	1.5E-10	6.4E-11	6.3E-11	4.6E-11	8.6E-11

Table A-4.8. Japan-specific indicative dose coefficients for ingestion of ^{131}I by children with the typical level of dietary intake of stable iodine: organ absorbed dose per intake, Gy/Bq

	10-year-old, absorbed dose to red bone marrow per intake	*10-year-old, absorbed dose to colon per intake*	*10-year-old, absorbed dose to breast per intake*	*1-year-old, absorbed dose to red bone marrow per intake*	*1-year-old, absorbed dose to colon per intake*	*1-year-old, absorbed dose to breast per intake*
Typical	1.6E-10	1.2E-10	8.0E-11	4.8E-10	3.7E-10	2.5E-10

B. Japan-specific indicative dose coefficients for ^{132}I

Table A-4.9. Japan-specific indicative dose coefficients for inhalation of ^{132}I by members of the public (adult and 10-year-old) with various levels of dietary intake of stable iodine: thyroid absorbed dose per exposure, Gy per (Bq s/m^3), and effective dose per exposure, Sv per (Bq s/m^3)

	Adult male, absorbed dose to thyroid per exposure	*Adult female, absorbed dose to thyroid per exposure*	*Adult, effective dose per exposure*	*10-year-old, absorbed dose to thyroid per exposure*	*10-year-old, effective dose per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine					
Western pattern diet	2.8E-13	2.7E-13	2.2E-14	4.7E-13	8.1E-14
Typical	**1.3E-13**	**1.3E-13**	**1.5E-14**	**2.3E-13**	**7.2E-14**
Kelp-rich diet	4.4E-14	4.3E-14	1.2E-14	7.4E-14	6.6E-14
Inhalation, methyl iodide, dietary intake of stable iodine					
Western pattern diet	7.3E-13	7.0E-13	4.6E-14	1.2E-12	6.5E-14
Typical	**3.5E-13**	**3.4E-13**	**2.9E-14**	**5.9E-13**	**4.0E-14**
Kelp-rich diet	1.1E-13	1.1E-13	1.9E-14	1.9E-13	2.5E-14

	Adult male, absorbed dose to thyroid per exposure	*Adult female, absorbed dose to thyroid per exposure*	*Adult, effective dose per exposure*	*10-year-old, absorbed dose to thyroid per exposure*	*10-year-old, effective dose per exposure*
Inhalation, elemental iodine, dietary intake of stable iodine					
Western pattern diet	9.2E-13	8.9E-13	8.5E-14	1.5E-12	7.1E-13
Typical	**4.4E-13**	**4.3E-13**	**6.4E-14**	**7.4E-13**	**6.8E-13**
Kelp-rich diet	1.4E-13	1.4E-13	5.1E-14	2.4E-13	6.6E-13

Table A-4.10. Japan-specific indicative dose coefficients for inhalation of ^{132}I by members of the public (1-year-old and fetus 35 weeks) with various levels of dietary intake of stable iodine: thyroid absorbed dose per exposure, Gy per (Bq s/m^3), and effective dose per exposure, Sv per (Bq s/m^3)

	1-year-old, absorbed dose to thyroid per exposure	*1-year-old, effective dose per exposure*	*Fetus 35 weeks, absorbed dose to thyroid per maternal exposure*	*Fetus 35 weeks, effective dose per maternal exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine				
Western pattern diet	7.0E-13	8.6E-14	8.5E-13	4.5E-14
Typical	**3.4E-13**	**7.2E-14**	**2.3E-13**	**1.4E-14**
Kelp-rich diet	1.1E-13	6.3E-14		
Inhalation, methyl iodide, dietary intake of stable iodine				
Western pattern diet	1.6E-12	8.0E-14	1.9E-12	1.0E-13
Typical	**7.9E-13**	**4.6E-14**	**5.1E-13**	**3.1E-14**
Kelp-rich diet	2.5E-13	2.4E-14	–	–
Inhalation, elemental iodine, dietary intake of stable iodine				
Western pattern diet	2.1E-12	5.1E-13	2.2E-12	1.2E-13
Typical	**1.0E-12**	**4.7E-13**	**6.1E-13**	**3.7E-14**
Kelp-rich diet	3.2E-13	4.4E-13		

Table A-4.11. Japan-specific indicative dose coefficients for inhalation of ^{132}I by adult members of the public with the typical level of dietary intake of stable iodine: organ absorbed dose per exposure, Gy per (Bq s/m^3)

	Adult male, absorbed dose to red bone marrow per exposure	*Adult female, absorbed dose to red bone marrow per exposure*	*Adult male, absorbed dose to colon per exposure*	*Adult female, absorbed dose to colon per exposure*	*Adult male, absorbed dose to breast per exposure*	*Adult female, absorbed dose to breast per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine						
Typical	3.5E-15	3.8E-15	3.1E-15	2.3E-15	2.1E-15	2.1E-15
Inhalation, methyl iodide, dietary intake of stable iodine						
Typical	7.3E-15	7.7E-15	6.7E-15	5.7E-15	3.7E-15	3.3E-15
Inhalation, elemental iodine, dietary intake of stable iodine						
Typical	1.0E-14	1.1E-14	1.0E-14	7.7E-15	6.0E-15	4.9E-15

Table A-4.12. Japan-specific indicative dose coefficients for inhalation of ^{132}I by children with the typical level of dietary intake of stable iodine: organ absorbed dose per exposure, Gy per (Bq s/m^3)

	10-year-old, absorbed dose to red bone marrow per exposure	*10-year-old, absorbed dose to colon per exposure*	*10-year-old, absorbed dose to breast per exposure*	*1-year-old, absorbed dose to red bone marrow per exposure*	*1-year-old, absorbed dose to colon per exposure*	*1-year-old, absorbed dose to breast per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine						
Typical	4.3E-15	3.6E-15	2.6E-15	4.6E-15	3.6E-15	2.6E-15
Inhalation, methyl iodide, dietary intake of stable iodine						
Typical	8.1E-15	8.0E-15	4.1E-15	7.0E-15	7.3E-15	3.8E-15
Inhalation, elemental iodine, dietary intake of stable iodine						
Typical	1.1E-14	1.2E-14	5.9E-15	9.6E-15	1.0E-14	5.4E-15

Table A-4.13. Japan-specific indicative dose coefficients for ingestion of ^{132}I by members of the public (adult and 10-year-old) with various levels of dietary intake of stable iodine: thyroid absorbed dose per intake, Gy/Bq, and effective dose per intake, Sv/Bq

	Adult male, absorbed dose to thyroid per intake	*Adult female, absorbed dose to thyroid per intake*	*Adult, effective dose per intake*	*10-year-old, absorbed dose to thyroid per intake*	*10-year-old, effective dose per intake*
Western pattern diet	2.9E-09	3.5E-09	2.8E-10	7.1E-09	5.8E-10
Typical	**1.4E-09**	**1.7E-09**	**2.1E-10**	**3.4E-09**	**4.3E-10**
Kelp-rich diet	4.5E-10	5.5E-10	1.7E-10	1.1E-09	3.4E-10

Table A-4.14. Japan-specific indicative dose coefficients for ingestion of ^{132}I by members of the public (1-year-old and fetus 35 weeks) with various levels of dietary intake of stable Iodine: thyroid absorbed dose per intake, Gy/Bq, and effective dose per intake, Sv/Bq

	1-year-old, absorbed dose to thyroid per intake	*1-year-old, effective dose per intake*	*Fetus 35 weeks, absorbed dose to thyroid per maternal intake*	*Fetus 35 weeks, effective dose per maternal intake*
Western pattern diet	2.8E-08	1.7E-09	1.2E-08	6.2E-10
Typical	**1.4E-08**	**1.1E-09**	**3.2E-09**	**2.0E-10**
Kelp-rich diet	4.4E-09	7.6E-10		

Table A-4.15. Japan-specific indicative dose coefficients for ingestion of ^{132}I by adult members of the public with the typical level of dietary intake of stable Iodine: organ absorbed dose per intake, Gy/Bq

	Adult male, absorbed dose to red bone marrow per intake	*Adult female, absorbed dose to red bone marrow per intake*	*Adult male, absorbed dose to colon per intake*	*Adult female, absorbed dose to colon per intake*	*Adult male, absorbed dose to breast per intake*	*Adult female, absorbed dose to breast per intake*
Typical	3.6E-11	4.8E-11	5.0E-11	3.9E-11	2.8E-11	2.5E-11

Table A-4.16. Japan-specific indicative dose coefficients for ingestion of ^{132}I by children with the typical level of dietary intake of stable Iodine: organ absorbed dose per intake, Gy/Bq

	10-year-old, absorbed dose to red bone marrow per intake	*10-year-old, absorbed dose to colon per intake*	*10-year-old, absorbed dose to breast per intake*	*1-year-old, absorbed dose to red bone marrow per intake*	*1-year-old, absorbed dose to colon per intake*	*1-year-old, absorbed dose to breast per intake*
Typical	5.5E-11	7.8E-11	3.6E-11	1.4E-10	1.9E-10	9.5E-11

C. Japan-specific indicative dose coefficients for ^{133}I

Table A-4.17. Japan-specific indicative dose coefficients for inhalation of ^{133}I by members of the public (adult and 10-year-old) with various level of dietary intake of stable iodine: thyroid absorbed dose per exposure, Gy per (Bq s/m^3), and effective dose per exposure, Sv per (Bq s/m^3)

	Adult male, absorbed dose to thyroid per exposure	*Adult female, absorbed dose to thyroid per exposure*	*Adult, effective dose per exposure*	*10-year-old, absorbed dose to thyroid per exposure*	*10-year-old, effective dose per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine					
Western pattern diet	6.6E-12	6.4E-12	3.1E-13	1.2E-11	6.0E-13
Typical	**3.5E-12**	**3.3E-12**	**1.7E-13**	**6.3E-12**	**3.7E-13**
Kelp-rich diet	1.2E-12	1.1E-12	7.2E-14	2.1E-12	2.0E-13
Inhalation, methyl iodide, dietary intake of stable iodine					
Western pattern diet	1.2E-11	1.2E-11	5.8E-13	2.1E-11	8.9E-13
Typical	**6.5E-12**	**6.3E-12**	**3.2E-13**	**1.1E-11**	**4.9E-13**
Kelp-rich diet	2.2E-12	2.1E-12	1.2E-13	3.7E-12	1.9E-13
Inhalation, elemental iodine, dietary intake of stable iodine					
Western pattern diet	1.7E-11	1.7E-11	8.4E-13	3.0E-11	1.8E-12
Typical	**9.2E-12**	**8.8E-12**	**4.7E-13**	**1.6E-11**	**1.2E-12**
Kelp-rich diet	3.1E-12	2.9E-12	2.0E-13	5.3E-12	8.3E-13

Table A-4.18. Japan-specific indicative dose coefficients for inhalation of ^{133}I by members of the public (1-year-old and fetus 35 weeks) with various level of dietary intake of stable iodine: thyroid absorbed dose per exposure, Gy per (Bq s/m^3), and effective dose per exposure, Sv per (Bq s/m^3)

	1-year-old, absorbed dose to thyroid per exposure	*1-year-old, effective dose per exposure*	*Fetus 35 weeks, absorbed dose to thyroid per maternal exposure*	*Fetus 35 weeks, effective dose per maternal exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine				
Western pattern diet	1.9E-11	8.6E-13	1.8E-11	9.0E-13
Typical	**9.8E-12**	**5.0E-13**	**6.3E-12**	**3.2E-13**
Kelp-rich diet	3.3E-12	2.4E-13		
Inhalation, methyl iodide, dietary intake of stable iodine				
Western pattern diet	2.9E-11	1.2E-12	3.7E-11	1.9E-12
Typical	**1.5E-11**	**6.4E-13**	**1.3E-11**	**6.6E-13**
Kelp-rich diet	5.1E-12	2.4E-13		

	1-year-old, absorbed dose to thyroid per exposure	*1-year-old, effective dose per exposure*	*Fetus 35 weeks, absorbed dose to thyroid per maternal exposure*	*Fetus 35 weeks, effective dose per maternal exposure*
Inhalation, elemental iodine, dietary intake of stable iodine				
Western pattern diet	4.1E-11	2.1E-12	4.7E-11	2.4E-12
Typical	**2.1E-11**	**1.3E-12**	**1.7E-11**	**8.4E-13**
Kelp-rich diet	7.2E-12	7.1E-13	-	-

Table A-4.19. Japan-specific indicative dose coefficients for inhalation of ^{133}I by adult members of the public with the typical level of dietary intake of stable iodine: organ absorbed dose per exposure, Gy per (Bq s/m^3)

	Adult male, absorbed dose to red bone marrow per exposure	*Adult female, absorbed dose to red bone marrow per exposure*	*Adult male, absorbed dose to colon per exposure*	*Adult female, absorbed dose to colon per exposure*	*Adult male, absorbed dose to breast per exposure*	*Adult female, absorbed dose to breast per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine						
Typical	6.4E-15	6.4E-15	5.8E-15	5.0E-15	3.4E-15	3.6E-15
Inhalation, methyl iodide, dietary intake of stable iodine						
Typical	1.1E-14	1.1E-14	9.8E-15	8.6E-15	5.5E-15	5.6E-15
Inhalation, elemental iodine, dietary intake of stable iodine						
Typical	1.6E-14	1.6E-14	1.5E-14	1.3E-14	8.2E-15	8.2E-15

Table A-4.20. Japan-specific indicative dose coefficients for inhalation of ^{133}I by children with the typical level of dietary intake of stable iodine: organ absorbed dose per exposure, Gy per (Bq s/m^3)

	10-year-old, absorbed dose to red bone marrow per exposure	*10-year-old, absorbed dose to colon per exposure*	*10-year-old, absorbed dose to breast per exposure*	*1-year-old, absorbed dose to red bone marrow per exposure*	*1-year-old, absorbed dose to colon per exposure*	*1-year-old, absorbed dose to breast per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine						
Typical	7.7E-15	7.6E-15	4.7E-15	9.1E-15	7.8E-15	5.3E-15
Inhalation, methyl iodide, dietary intake of stable iodine						
Typical	1.2E-14	1.2E-14	7.0E-15	1.2E-14	1.1E-14	7.0E-15
Inhalation, elemental iodine, dietary intake of stable iodine						
Typical	1.7E-14	1.8E-14	1.0E-14	1.7E-14	1.7E-14	1.0E-14

Table A-4.21. Japan-specific indicative dose coefficients for ingestion of ^{133}I by members of the public (adult and 10-year-old) with various levels of dietary intake of stable iodine: thyroid absorbed dose per intake, Gy/Bq, and effective dose per intake, Sv/Bq

	Adult male, absorbed dose to thyroid per intake	*Adult female, absorbed dose to thyroid per intake*	*Adult, effective dose per intake*	*10-year-old, absorbed dose to thyroid per intake*	*10-year-old, effective dose per intake*
Western pattern diet	6.6E-08	8.0E-08	3.1E-09	1.6E-07	7.0E-09
Typical	**3.5E-08**	**4.2E-08**	**1.8E-09**	**8.6E-08**	**3.9E-09**
Kelp-rich diet	1.2E-08	1.4E-08	7.4E-10	2.9E-08	1.6E-09

Table A-4.22. Japan-specific indicative dose coefficients for ingestion of ^{133}I by members of the public (1-year-old and fetus 35 weeks) with various levels of dietary intake of stable iodine: thyroid absorbed dose per intake, Gy/Bq, and effective dose per intake, Sv/Bq

	1-year-old, absorbed dose to thyroid per intake	*1-year-old, effective dose per intake*	*Fetus 35 weeks, absorbed dose to thyroid per maternal intake*	*Fetus 35 weeks, effective dose per maternal intake*
Western pattern diet	6.7E-07	2.8E-08	2.5E-07	1.3E-08
Typical	**3.5E-07**	**1.5E-08**	**8.9E-08**	**4.5E-09**
Kelp-rich diet	1.2E-07	5.6E-09		

Table A-4.23. Japan-specific indicative dose coefficients for ingestion of ^{133}I by adult members of the public with the typical level of dietary intake of stable Iodine: organ absorbed dose per intake, Gy/Bq

	Adult male, absorbed dose to red bone marrow per intake	*Adult female, absorbed dose to red bone marrow per intake*	*Adult male, absorbed dose to colon per intake*	*Adult female, absorbed dose to colon per intake*	*Adult male, absorbed dose to breast per intake*	*Adult female, absorbed dose to breast per intake*
Typical	6.0E-11	7.5E-11	7.0E-11	7.2E-11	3.4E-11	4.0E-11

Table A-4.24. Japan-specific indicative dose coefficients for ingestion of ^{133}I by children with the typical level of dietary intake of stable Iodine: organ absorbed dose per intake, Gy/Bq

	10-year-old, absorbed dose to red bone marrow per intake	*10-year-old, absorbed dose to colon per intake*	*10-year-old, absorbed dose to breast per intake*	*1-year-old, absorbed dose to red bone marrow per intake*	*1-year-old, absorbed dose to colon per intake*	*1-year-old, absorbed dose to breast per intake*
Typical	9.6E-11	1.2E-10	5.8E-11	2.9E-10	3.1E-10	1.7E-10

D. Japan-specific indicative dose coefficients for ^{132}Te

Table A-4.25. Japan-specific indicative dose coefficients for inhalation of ^{132}Te by members of the public (adult and 10-year-old) with various level of dietary intake of stable iodine: thyroid absorbed dose per exposure, Gy per (Bq s/m^3), and effective dose per exposure, Sv per (Bq s/m^3)

	Adult male, absorbed dose to thyroid per exposure	*Adult female, absorbed dose to thyroid per exposure*	*Adult, effective dose per exposure*	*10-year-old, absorbed dose to thyroid per exposure*	*10-year-old, effective dose per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine					
Western pattern diet	4.3E-12	4.1E-12	3.1E-13	7.3E-12	5.7E-13
Typical	**2.1E-12**	**2.0E-12**	**2.2E-13**	**3.6E-12**	**4.2E-13**
Kelp-rich diet	7.4E-13	7.2E-13	1.6E-13	1.3E-12	3.3E-13

Table A-4.26. Japan-specific indicative dose coefficients for inhalation of ^{132}Te by members of the public (1-year-old and fetus 35 weeks) with various level of dietary intake of stable iodine: thyroid absorbed dose per exposure, Gy per (Bq s/m^3), and effective dose per exposure, Sv per (Bq s/m^3)

	1-year-old, absorbed dose to thyroid per exposure	*1-year-old, effective dose per exposure*	*Fetus 35 weeks, absorbed dose to thyroid per maternal exposure*	*Fetus 35 weeks, effective dose per maternal exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine				
Western pattern diet	1.1E-11	7.2E-13	2.3E-11	1.2E-12
Typical	**5.4E-12**	**4.9E-13**	**5.9E-12**	**3.7E-13**
Kelp-rich diet	1.9E-12	3.5E-13		

Table A-4.27. Japan-specific indicative dose coefficients for inhalation of ^{132}Te by adult members of the public with the typical level of dietary intake of stable iodine: organ absorbed dose per exposure, Gy per (Bq s/m^3)

	Adult male, absorbed dose to red bone marrow per exposure	*Adult female, absorbed dose to red bone marrow per exposure*	*Adult male, absorbed dose to colon per exposure*	*Adult female, absorbed dose to colon per exposure*	*Adult male, absorbed dose to breast per exposure*	*Adult female, absorbed dose to breast per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine						
Typical	6.5E-14	7.1E-14	1.8E-13	1.7E-13	3.2E-14	2.6E-14

Table A-4.28. Japan-specific indicative dose coefficients for inhalation of ^{132}Te by children with the typical level of dietary intake of stable iodine: organ absorbed dose per exposure, Gy per (Bq s/m^3)

	10-year-old, absorbed dose to red bone marrow per exposure	*10-year-old, absorbed dose to colon per exposure*	*10-year-old, absorbed dose to breast per exposure*	*1-year-old, absorbed dose to red bone marrow per exposure*	*1-year-old, absorbed dose to colon per exposure*	*1-year-old, absorbed dose to breast per exposure*
Inhalation, aerosols Type F, 1 μm, dietary intake of stable iodine						
Typical	7.8E-14	2.5E-13	3.7E-14	8.4E-14	2.0E-13	3.8E-14

Table A-4.29. Japan-specific indicative dose coefficients for ingestion of ^{132}Te by members of the public (adult and 10-year-old) with various levels of dietary intake of stable iodine: thyroid absorbed dose per intake, Gy/Bq, and effective dose per intake, Sv/Bq

	Adult male, absorbed dose to thyroid per intake	*Adult female, absorbed dose to thyroid per intake*	*Adult, effective dose per intake*	*10-year-old, absorbed dose to thyroid per intake*	*10-year-old, effective dose per intake*
Western pattern diet	2.0E-08	2.4E-08	1.9E-09	4.9E-08	3.6E-09
Typical	**9.8E-09**	**1.2E-08**	**1.5E-09**	**2.4E-08**	**2.6E-09**
Kelp-rich diet	3.4E-09	4.1E-09	1.2E-09	8.3E-09	2.0E-09

Table A-4.30. Japan-specific indicative dose coefficients for ingestion of ^{132}Te by members of the public (1-year-old and fetus 35 weeks) with various levels of dietary intake of stable iodine: thyroid absorbed dose per intake, Gy/Bq, and effective dose per intake, Sv/Bq

	1-year-old, absorbed dose to thyroid per intake	*1-year-old, effective dose per intake*	*Fetus 35 weeks, absorbed dose to thyroid per maternal intake*	*Fetus 35 weeks, effective dose per maternal intake*
Western pattern diet	1.9E-07	1.2E-08	1.3E-07	7.2E-09
Typical	**9.5E-08**	**7.8E-09**	**3.4E-08**	**2.4E-09**
Kelp-rich diet	3.3E-08	5.3E-09		

Table A-4.31. Japan-specific indicative dose coefficients for ingestion of ^{132}Te by adult members of the public with the typical level of dietary intake of stable iodine: organ absorbed dose per intake, Gy/Bq

	Adult male, absorbed dose to red bone marrow per intake	*Adult female, absorbed dose to red bone marrow per intake*	*Adult male, absorbed dose to colon per intake*	*Adult female, absorbed dose to colon per intake*	*Adult male, absorbed dose to breast per intake*	*Adult female, absorbed dose to breast per intake*
Typical	4.2E-10	5.9E-10	3.0E-09	3.6E-09	2.1E-10	1.6E-10

Table A-4.32. Japan-specific indicative dose coefficients for ingestion of ^{132}Te by children with the typical level of dietary intake of stable iodine: organ absorbed dose per intake, Gy/Bq

	10-year-old, absorbed dose to red bone marrow per intake	*10-year-old, absorbed dose to colon per intake*	*10-year-old, absorbed dose to breast per intake*	*1-year-old, absorbed dose to red bone marrow per intake*	*1-year-old, absorbed dose to colon per intake*	*1-year-old, absorbed dose to breast per intake*
Typical	6.7E-10	5.3E-09	2.8E-10	1.7E-09	1.0E-08	7.4E-10

II. JAPAN-SPECIFIC OCCUPANCY FACTORS

1. This review is largely concerned with information on occupancy factors (i.e., the fractions of time spent outdoors and indoors) published since 2013 by Japanese authors in peer-reviewed journals. It first summarizes the annual occupancy factors used in the UNSCEAR 2013 Report [UNSCEAR, 2014]; these were for four age-social groups of Japanese people and were derived from Japanese official demography sources. It then summarizes the findings of six publications that quantify the fractions of time spent indoors and outdoors by different groups of adults and children in the Japanese population. Based on an analysis of the data in these publications, occupancy factors were derived for use in the update of the assessment of doses made in the UNSCEAR 2013 Report.

A. UNSCEAR 2013 Report – occupancy factors for Japan[1]

2. For this study of Japanese populations with their unique national cultural tradition, the occupation factors p_{ij} were derived as fractions of daily time from the national survey data specific for Japan [MIC, 2011]. The results are presented in table A-4.33.

[1] Taken from section II.B.3 of attachment C-12 [UNSCEAR, 2014].

Table A-4.33. Set of annual occupancy factors p_{ij} for Japan used in the UNSCEAR 2013 Report

Type of location	*Occupancy factor, p_{ij} (dimensionless)*			
	1-year-old	*10-year-old*	*Outdoor worker*	*Indoor worker or pensioner*
Indoors	0.80	0.85	0.70	0.90
Outdoors including:	0.20	0.15	0.30	0.10
Paved surfaces	0.10	0.05	0.20	0.05
Unpaved surfaces	0.10	0.10	0.10	0.05

3. The occupancy factors presented in table A-4.33, in combination with location factors (i.e., to take account of shielding effects while inside buildings, etc.), were used in [UNSCEAR, 2014] to characterize 12 social/age groups and dwelling house types. At the time when the UNSCEAR 2013 Report was being prepared, only limited information on time spent by various groups of the Japanese population in various locations had been published. The national survey data used for this purpose did not contain explicit information on the fractions of time spent by people indoors and outdoors; occupancy factors in table A-4.33 had, therefore, to be assessed indirectly.

B. Review of publications by Japanese authors since 2013 relevant for the assessment of occupancy factors

4. Takahara et al. [Takahara et al., 2014b] provided quantitative information on external doses to evacuees. Doses were estimated for indoor workers, outdoor workers, and pensioners on the assumption that they lived in urban areas. It was assumed that indoor workers and pensioners spent all day in areas paved with asphalt. However, it was assumed that outdoor workers spent their working hours in areas classified as “dirt surfaces” in an urban environment.

5. In the survey, time spent indoors and outdoors for the three population groups was measured: indoor workers, outdoor workers, and pensioners. The indoor workers surveyed were from the Fukushima City offices and the outdoor workers were from the Northern Fukushima Affiliate of Contractors Association and Japan Agricultural Cooperatives. Data surveyed for the months of February, March and April 2012 were used in deriving occupancy factors for use in the update of the UNSCEAR 2013 Report [UNSCEAR, 2014].

6. Some quantitative information on time spent indoors and outdoors by adult people engaged in various activities, including statistical parameters that determined the probability distribution functions of time spent outdoors by each population group under consideration, was derived from table 18.3 of Takahara et al. [Takahara et al., 2014a] and included in table A-4.34 below. A limitation of this study was the absence of information on the numbers of people interviewed.

7. Takahara et al. [Takahara et al., 2014a] reported on the development of a probabilistic model for dose assessment based on measurements conducted in early 2012. They studied doses to residents of Fukushima Prefecture from external exposure by measuring ambient dose rates and monthly doses to 500 individuals, as well as behaviour patterns of various population groups, including indoor and outdoor workers, and pensioners.

8. Participants were interviewed in February, March and April 2012. Participants from all groups spent most of their time inside their homes. Those from the Senior Citizens’ Club stayed inside their homes for 21 hours daily, amounting to about 90% of time in a day. The participants

from the three other groups (Fukushima City office workers, the Northern Fukushima Affiliate of Contractors Association, and the Japan Agricultural Cooperatives) stayed inside their homes for about 14–17 hours daily. The daily time spent outside houses was 1.2 hours for the Senior Citizens' Club and 2.2 hours for members of the Japan Agricultural Cooperatives. The participants from Fukushima City office spent 0.2 hours outside their homes, and those from the Contractors' Association spent 0.3 hours outside their homes.

9. A different trend between the population groups was observed with respect to time spent in workplaces. The participants from the Fukushima City office stayed inside office buildings on average for 7.0 hours per day while at work and outside of office buildings for only 0.1 hours. The participants from the Contractors' Association stayed inside buildings for 2.3 hours on average and outside for about 6.2 hours. The participants from the Agricultural Cooperatives stayed outside the house 2.2 hours and spent most of their working hours outside buildings, staying inside for 0.3 hours and outside for 2.4 hours.

10. Clear differences were found between the groups in terms of time spent outdoors and how it varied between individuals. For participants from the Fukushima City office and the Senior Citizens' Club, normality was examined for the logarithmic values of time spent outdoors; significance levels were more than 5% for both groups. When the time spent outdoors daily was expressed as a geometric mean for each month between February and April, it ranged from 0.4–0.8 hours for workers in the Fukushima City office and 1.0–1.7 hours for members of the Senior Citizens' Club. Arithmetic means of the daily time spent outdoors were in the range of 0.7–1.0 hours for those from the Fukushima City office and 1.7–2.6 hours for those from the Senior Citizens' Club.

11. When time spent daily outdoors was expressed as the arithmetic means for each month between February and April, it was in the range of 7.5–7.6 hours for those from the Contractors' Association and 5.2–7.9 hours for those from the Agricultural Cooperatives.

12. Estimates of the time spent indoors and outdoors by adults engaged in various activities have been derived from Takahara et al. [Takahara et al., 2014a] and are presented in table A-4.34.

13. Yajima et al. [Yajima et al., 2015] measured ambient dose rates at many residential and occupational locations throughout a number of study areas in Fukushima Prefecture and also individual doses with personal dosimeters. They also presented data on national occupancy of, and shielding by, buildings. For all locations investigated, the estimated effective dose to outdoor workers was higher than that to indoor workers [Yajima et al., 2015].

14. Individual doses were calculated for lifestyles of the following occupations: farmer, forest worker, office worker, school staff, and home-based individuals (i.e., those who spent most of the day at home). Time allocations for each place of residence or work were created for each occupation by referring to statistical data on Japanese lifestyles [NHK, 2011].

15. From this paper based on recent Japanese demography statistics (see above), it follows, inter alia, that office workers and school staff spend 15.4 hours at home, 7.3 hours in indoor spaces and 1.3 hours outdoors. The latter is one half of the value used in the UNSCEAR 2013 Report (see attachment C-12 in the UNSCEAR 2013 Report [UNSCEAR, 2014]).

16. Nomura et al. [Nomura et al., 2016] analysed the dependence of radiation dose on patterns of behaviour of school children of various grades at a school in Minamisoma City. Information on behaviour was obtained through interviews in autumn 2012 and included time spent in commuting to school and time spent outdoors after school and at weekends [Nomura et

al., 2016]. The Committee has estimated average times spent by schoolchildren in various activities based on the results and these are summarized in table A-4.34.

17. This study was based on the post-accident poll of school children in an affected municipality of Fukushima Prefecture and its outcome may, therefore, have been influenced by advice on safety and behaviour following the accident.

18. Ishikawa et al. [Ishikawa et al., 2016] assessed time spent outdoors for residents of Iitate Village from information collected in the Basic Survey conducted by Fukushima Medical University in Fukushima Prefecture [Ishikawa et al., 2015]. From 3,400 responses to the questionnaire, the authors randomly selected a total of 240 in accordance with the distribution of the original population by age group, and estimated the average time spent outdoors per day. The arithmetic mean for the 170 individuals for whom there was a full four months of data was 2.08 hours (95% CI: 1.64–2.51 hours). This is a much smaller value than commonly assumed in many dose assessments, although a value of 2.4 hours had been adopted for indoor workers in the UNSCEAR 2013 Report [UNSCEAR, 2014].

19. Iitate Village is one of the municipalities most affected by the accident at FDNPS in Fukushima Prefecture and it is likely that the behaviour of residents was influenced by safety advice. Whereas average time spent outdoors was 2.1 hours during the first 4 months after the accident (95% CI: 1.93–2.10 hours with a range of 0–15.5 hours), the median was 0.94 hours. These data can hardly be used for external model validation because the paper does not contain any information about people’s occupancy.

20. Mori et al. [Mori et al., 2017] assessed annual effective doses of indoor workers, outdoor workers, and pensioners in Fukushima Prefecture taking account of variability in behavioural patterns and ^{137}Cs surface-activity levels. Behavioural patterns were obtained from surveys of inhabitants of Fukushima Prefecture (10 people from the Fukushima City office, 8 people from the Building Contractors’ Society, 24 people from the Japan Agricultural Cooperatives, and 25 people from a Senior Citizens’ Club). Averages and standard deviations for the time periods spent indoors and outdoors by the respective groups were estimated by the authors and are summarized in table A-4.34.

21. Tsubokura et al. [Tsubokura et al., 2018] estimated doses from external exposure in Minamisoma City and compared them with doses for three other cities in other prefectures. In these four cities, external dose was measured every hour for two weeks using an individual electronic dosimeter D-shuttle. The locations of participants were recorded every hour for comparison with doses from external exposure. The time spent at home and in the workplace accounted for most of the time and was also the major contributor to the total dose from external exposure.

22. The measurements were made of city employees in four municipalities in Japan (Fukuyama City in Hiroshima Prefecture, Minamisoma City in Fukushima Prefecture, Nanto City in Toyama Prefecture and Tajimi City in Aichi Prefecture). Twenty-five city employees participated in the study from each municipality and the total number of employees measured was 100. The measurements were made over a two-week period, from 29 May to 11 June 2017.

23. Each employee recorded their activities every 30 minutes in a questionnaire under one of five categories: home, workplace, inside the city other than at home or work, during transit to and from work, and outside the city.

24. The proportion of time spent in each category over the two-week period differed slightly with municipality (chi-squared p<0.001). While there were differences between municipalities, time spent at home and in the workplace (57% and 24%, respectively) accounted for most of the time in all four municipalities. Doses received in the workplace and at home were the major contributors to the overall exposures in all four municipalities.

C. Discussion

25. Although the published studies of human behaviour, based on interview and self-recording, are limited both in number and scope, useful data can be extracted from them in terms of the average time spent daily (hours) by five groups of Japanese people (indoor workers, outdoor workers, pensioners, 10-year-old children and 1-year-old infants) in various types of location. These are summarized in table A-4.34.

Table A-4.34. Average time[a] (in hours) spent per day by different groups of the Japanese population in various types of location

Reference	*Indoor home*	*Indoor work, etc.*	*Outdoors*	*Other*	*Comments*
Adult indoor worker					
[UNSCEAR, 2014]	21.6		2.4		Deterministic estimate from Japanese official demography sources
[Takahara et al., 2014b]			1.2 ± 2.1 [0.57 ± 3.3]		Fukushima City office workers. Number interviewed not specified
[Takahara et al., 2014a]	15.1	8.0	0.9		60 Fukushima City office workers
[Yajima et al., 2015]	15.4	7.3	0.5	0.8 (commuting)	Office workers and school staff, NHK Research Institute
[Mori et al., 2017]		6.3 ± 2.5 [5.9 ± 1.5]		1.3 ± 1.0	10 Fukushima City office workers
[Tsubokura et al., 2018]	13.7	7.3	1.1	1.8 (in transit)	100 city officer workers in four cities
[MIC, 2011]	15.8–20.6	1.9–6.5	1.4–1.7		Deterministic range estimated from Japanese official demography sources
Values used in deriving occupancy factors (see table A-4.35)	15	7	1	1 (commuting)	
Adult outdoor worker					
[UNSCEAR, 2014]	16.8		7.2		Deterministic estimate from Japanese official demography sources
[Takahara et al., 2014b]			7.0 ± 2.9		Contractors Association and Japan Agricultural Cooperatives. Number interviewed not specified
[Takahara et al., 2014a]	15.2	2.2	6.6		53 members of Contractors Association and 60 members of Japan Agricultural Cooperatives

Reference	*Indoor home*	*Indoor work, etc.*	*Outdoors*	*Other*	*Comments*
[Yajima et al., 2015]	17.5	0	6.3	0.2 (commuting)	Farmer and forest worker NHK, Research Institute
[Mori et al., 2017]			7.3 ± 5.6		8 people from the Building Contractors' Society, 24 people from the Japan Agricultural Cooperatives
[MIC, 2011] as analysed by S. Kinase	14.4–17.8	0.2	6.0–9.4		Deterministic range estimated from Japanese official demography sources
Values used in deriving occupancy factors (see table A-4.35)	16	1	7	0	
Pensioner					
[UNSCEAR, 2014]	21.6		2.4		Deterministic estimate from Japanese official demography sources
[Takahara et al., 2014b]			2.7±4.9 [1.3 ± 3.4]		Number interviewed not specified
[Takahara et al., 2014a]	20.9	1.3	1.8		65 senior citizens from Fukushima City
[Yajima et al., 2015]	22.9	0	1.1	0	Home-based individuals, NHK Research Institute
[Mori et al., 2017]				1.9 ± 2.2	25 people from a Senior Citizens' Club
[MIC, 2011]	22.3–22.6		1.4–1.7		Deterministic estimate from Japanese official demography sources
Values used in deriving occupancy factors (see table A-4.35)	22	0.5	1.5	0	
10-year-old					
[UNSCEAR, 2014]	14.4	6.0	3.6		Deterministic estimate from Japanese official demography sources
[Nomura et al., 2016]			~1	~0.5 (commuting)	Students of primary and secondary school in Minamisoma City, 2012
[MIC, 2011]	17.5	4.8	1.7		Deterministic range estimated from Japanese official demography sources
Values used in deriving occupancy factors (see table A-4.35)	16	5.5	2	~0.5 (commuting)	

Reference	*Indoor home*	*Indoor work, etc.*	*Outdoors*	*Other*	*Comments*
1-year-old					
[UNSCEAR, 2014]	14.4	4.8	4.8		Deterministic estimate from Japanese official demography sources
[MIC, 2011]	17.5	4.8	1.7		Deterministic range estimated from Japanese official demography sources
Values used in deriving occupancy factors (see table A-4.35)	17	5	2		

[a] Times (in hours) given in the table are arithmetic means ± standard deviation apart from those in [square parenthesis] which are geometric mean values and geometric standard deviations.

26. The data, presented in table A-4.34 are mostly applicable to Fukushima Prefecture and do not contradict national statistical data available at the following reference [SBJ, 2020]. Unfortunately, data presented by the Statistics Bureau of Japan does not contain explicit values of time duration spent by various groups of people indoors and outdoors. However, those could be estimated indirectly from the data presented.

27. The data in table A-4.34 on the amounts of time spent daily indoors and outdoors while at home and work have been converted to dimensionless occupancy factors, p_{ij} by dividing by 24 hours and rounding to one significant figure. The resulting occupancy factors are presented in table A-4.35 and they are the values the Committee has used in updating its assessment of doses in the UNSCEAR 2013 Report [UNSCEAR, 2014].

28. There are differences for some of the population groups in the amounts of time assumed to be spent outdoors compared with what was assumed in the UNSCEAR 2013 Report [UNSCEAR, 2014]. For outdoor workers, indoor workers and pensioners, the differences are either non-existent or not significant; however, for children, the time spent outdoors assumed in the UNSCEAR 2013 Report was a factor of about two greater than that indicated in table A-4.35.

Table A-4.35. Occupancy factors derived from data in table A-4.34

Location	*Occupancy factor, p_{ij} (dimensionless)*				
	1-year-old	*10-year-old*	*Outdoor worker*	*Indoor worker*	*Pensioner*[a]
Indoors including:	0.9	0.9	0.7	0.9	0.9
At home and others	0.7	0.7	0.7	0.6	0.9
At work, school, kindergarten, etc.	0.2	0.2		0.3	
Outdoors including:	0.1	0.1	0.3	0.1	0.1
Areas with paved surfaces	0.1	0.1	0.2	0.1	0.1
Areas with unpaved surfaces			0.1		

[a] Occupancy factors for pensioners are broadly comparable with those for indoor workers.

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