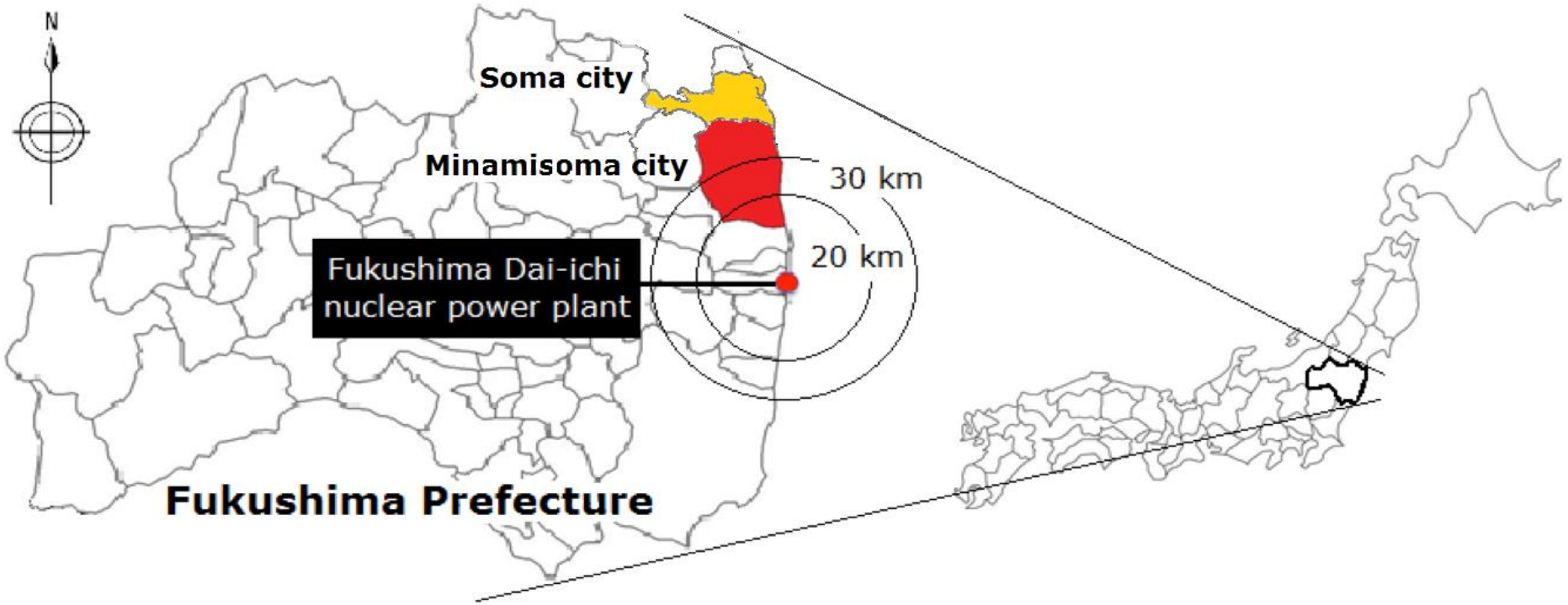
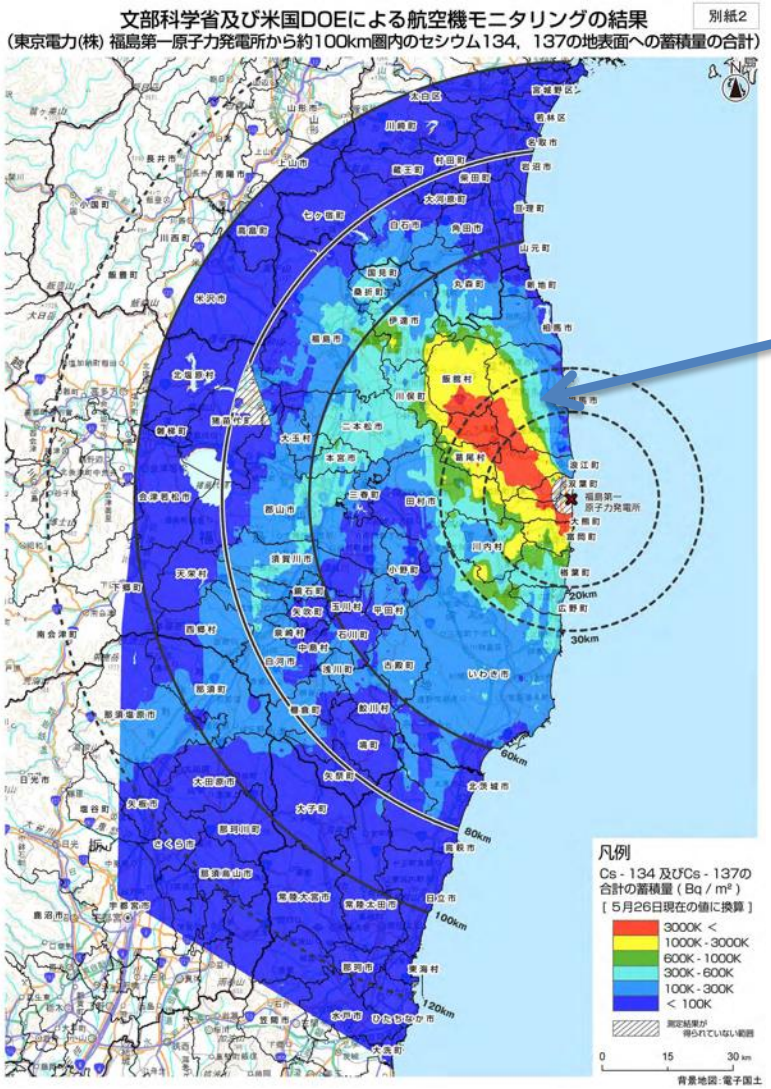
The current situation of the radiation exposure screening program in Hama-dori and the future tasks

The University of Tokyo, The Institute of Medicine
Minamisoma Municipal General Hospital,
Department of Internal Medicine
Dr. Masaharu Tsubokura

Multi-faceted disaster of Earthquake, Tsunami and…



Minamisoma Municipal General Hospital



Minamisoma Municipal General Hospital

- Distance from the plant: 23km
- Number of beds: 230
- Average airborne radiation level: 0.2-0.3 μSV/h

Minamisoma city

- Population: 70,000→10,000→50,000

Source: Ministry of Health, Labour Welfare (http://www.mhlw.go.jp/english/)


2011.3.11
15:37
Haramachi region, Minamisoma


2011.3.11
15:52
Haramachi region, Minamisoma


2011.3.11
Haramachi region, Minamisoma
Death tall: 638 (approx. 1% of the population)


2011.3.11
Nursing home
Number of residents before the disaster: 136
Total deaths:36

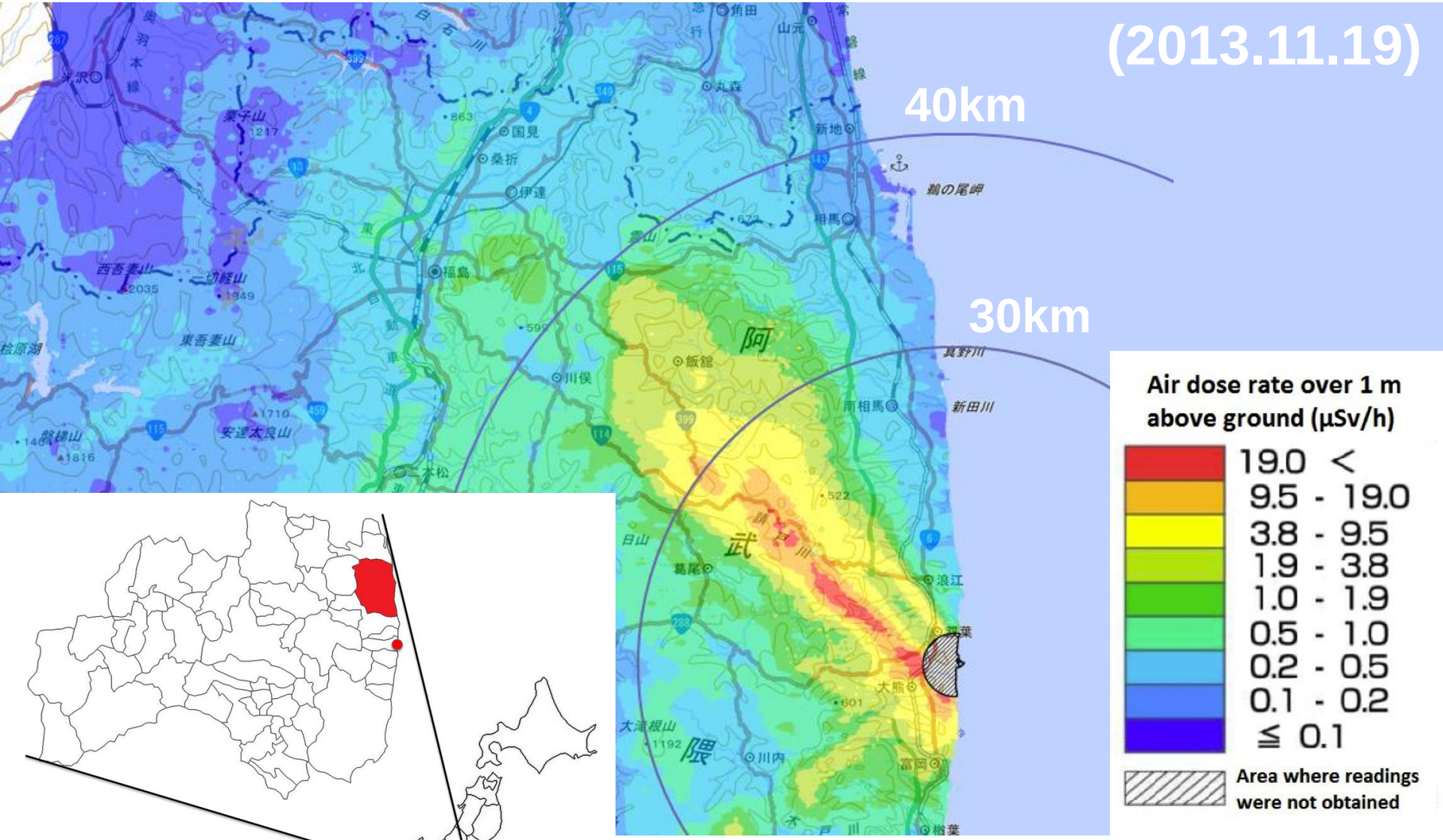

外来診療
2011.3.11
18:33
Minamisoma Municipal General Hospital

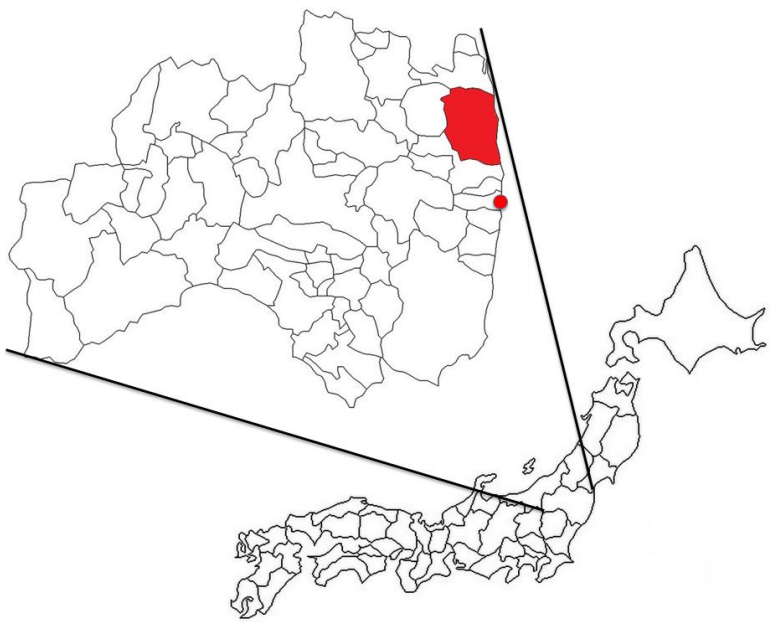

EVホール→
2011.3.11
18:33
Minamisoma Municipal General Hospital

2011.3.12 15:36
First hydrogen explosion
at the Fukushima Daiich Nuclear Plant (Unit 1)

2011.3.14 11:01
Second hydrogen explosion
at the Fukushima Daiich Nuclear Plant (Unit 3)

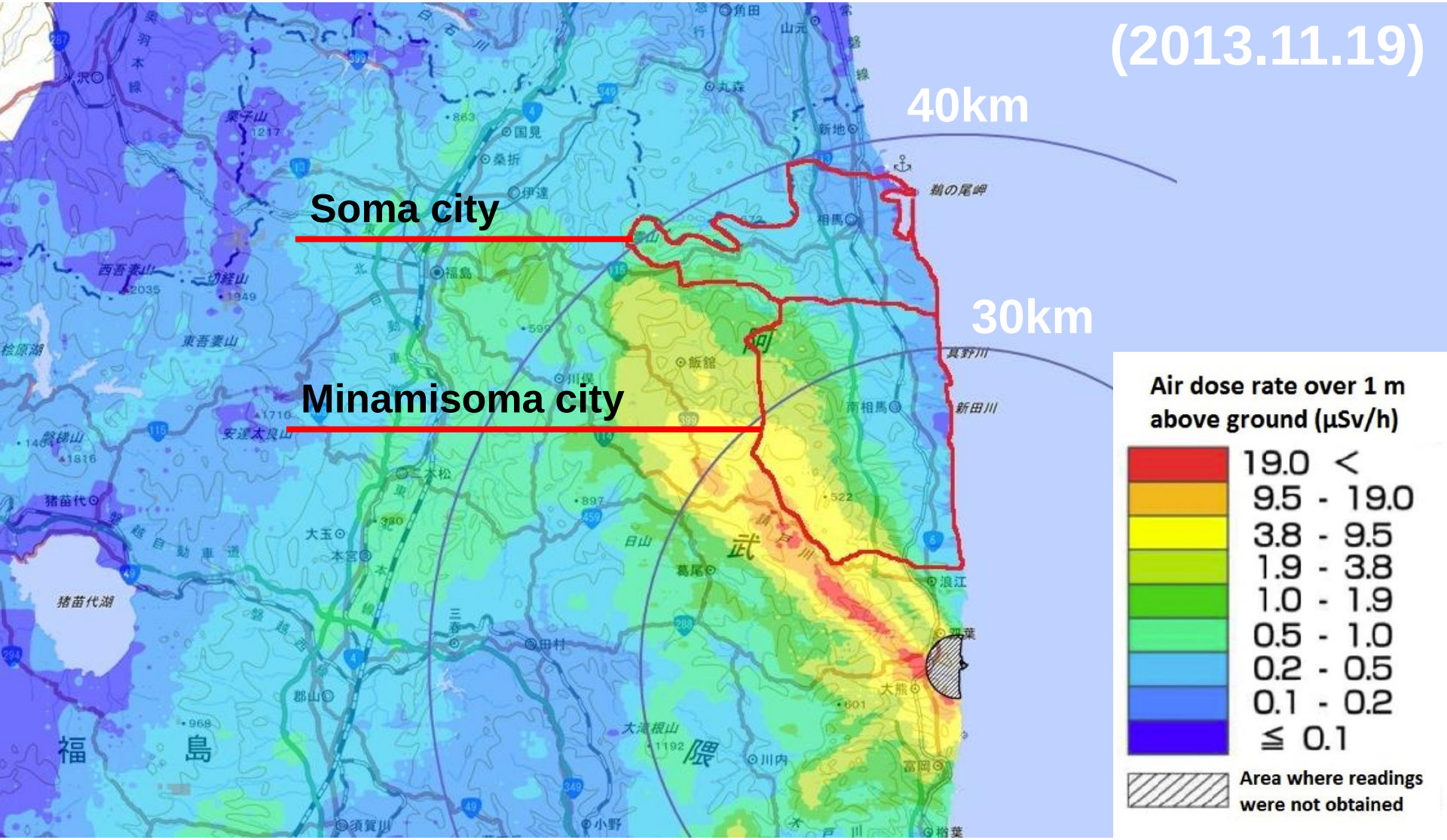
Air-Contamination Trends





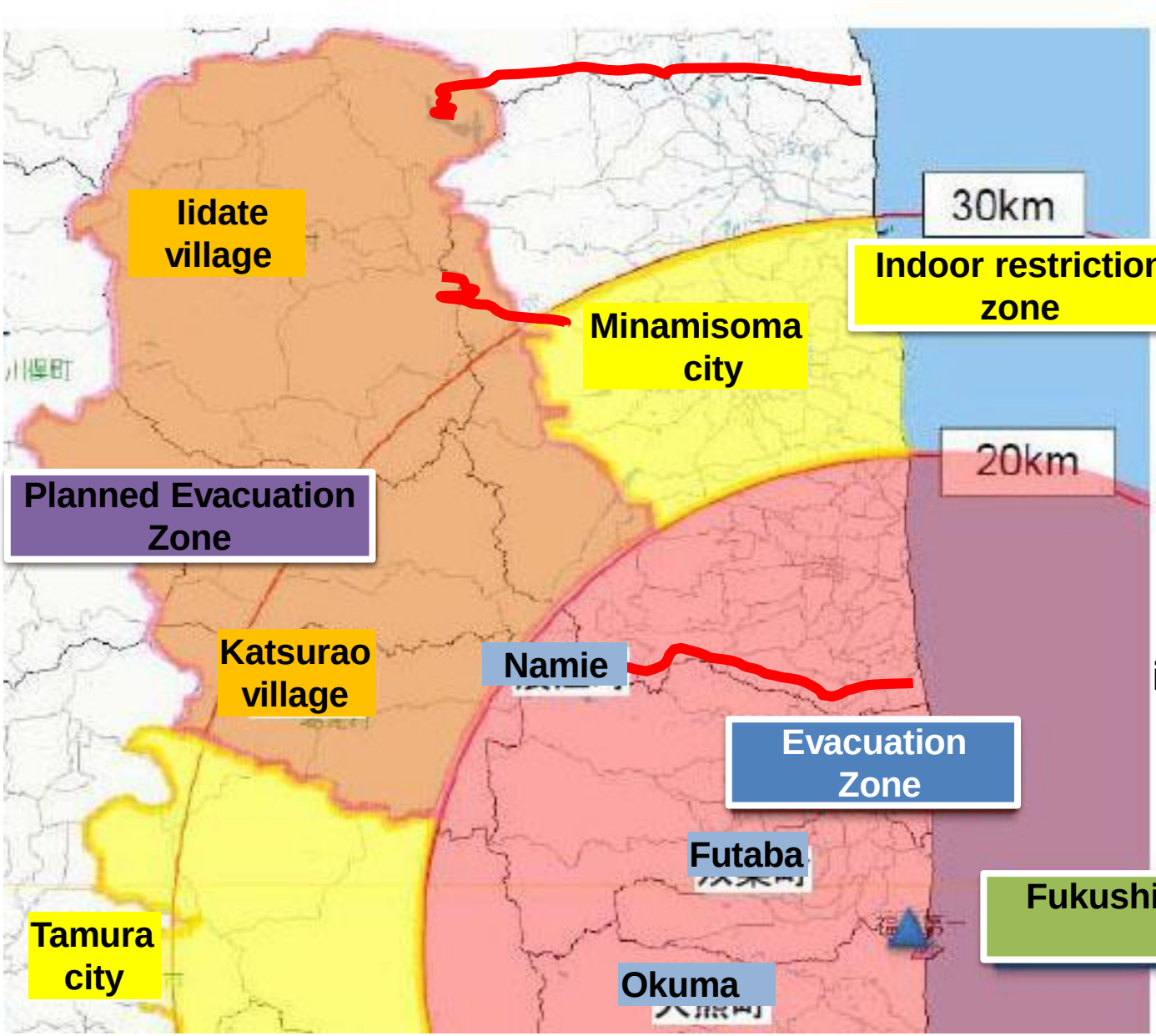
Education, Culture, Sports, Science and Technology)

Air-Contamination Trends



(Source: Ministry of Education, Culture, Sports, Science and Technology)

Evacuation and indoor restriction orders had substantial effects on the flow of goods and people (labor)



20-30km radius zone
Hospitals continued to operate

20km radius zone
Hospitals were immediately closed

Contents

Evacuation

Evacuation procedure is IMPORTANT
not only because evacuation will reduce the level of radiation exposure,
but also because this will have the big impact on long-term counter-measures.

15 March – 18 March 2011: Mandatory evacuation using a coach

2011.3.12
2:21
Minamisoma Municipal General Hospital

Patient Transportation by the Self Defense Force

92 patients were transferred to

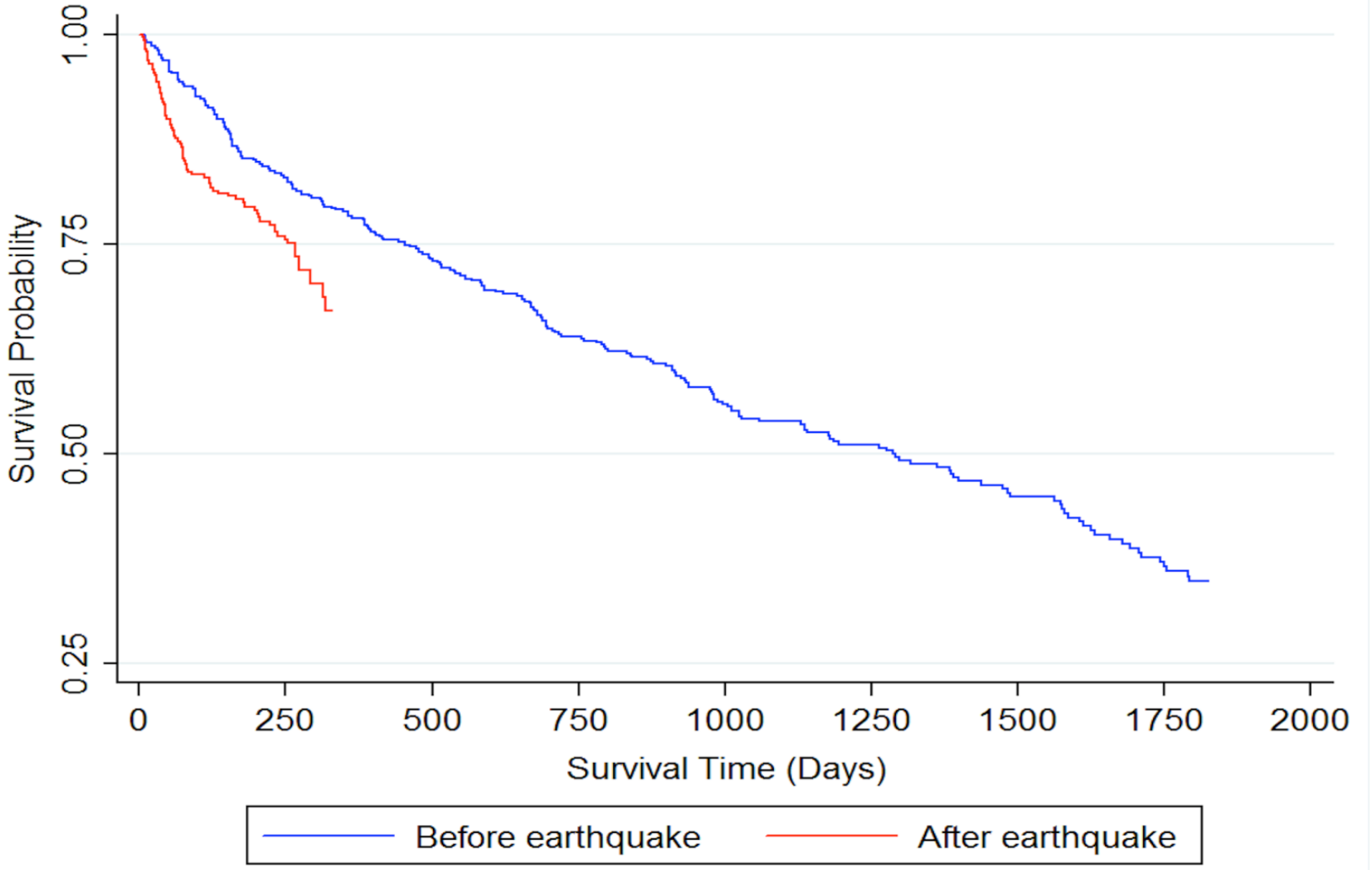
Nigata prefecture (150 km away)

20 March 2011 9:00 There were no patients left at the hospital

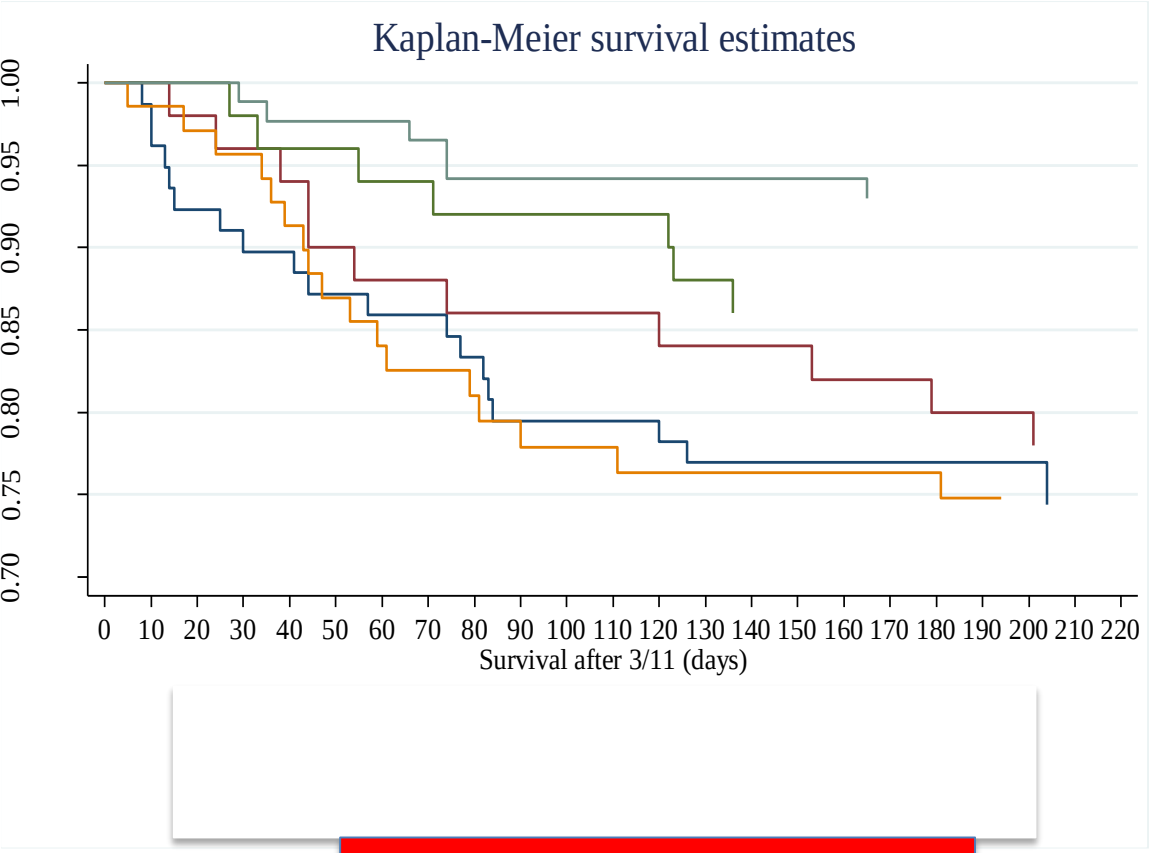
15 March 2011: 11:00am
The 20-30km radius from the nuclear plant became the indoor restriction zone after the second explosion
274 → 90

(Kodama, Tsubokura *et al.*. 2014)

Estimated pre- and post-disaster survival (Minamisoma)



(Nomura, Tsubokura *et al.* PLOS ONE. 2013)



IS evacuation the best?

The Risk from Nursing-Home Evacuation
after the Fukushima Accident
was much higher than
the Radiation Risk.

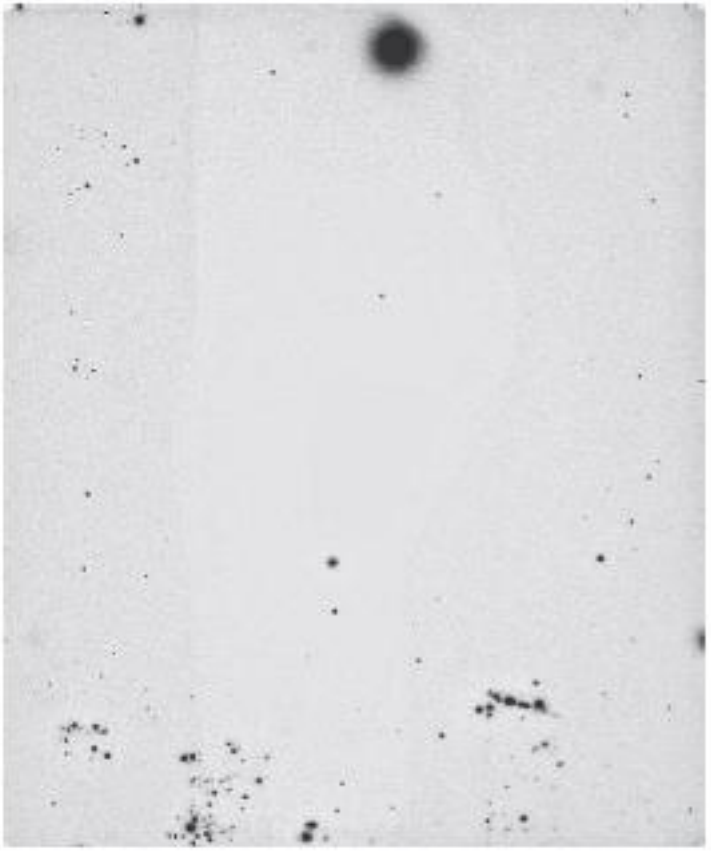
Nomura, Tsubokura et al. 2013
Murakami, Tsubokura et al. 2015

	Rapid evacuation	-day delayed evacuation	20-mSv exposure	100-mSv exposure
Evacuation-related				
Nursing home residents	11000 (10000–13000)[880 (730–1200)][A]	Unknown	-	-
Nursing home staff	Not observed	Unknown	-	-
Radiation-related				
Nursing home residents	0.01	1.7	100	530
Nursing home staff	0.1	26	1000	5300
Total	11000+ (10000+–13000+)	27+	1100	5800

[A] LLEs due to non-evacu on-related effects (e.g. disaster-shock), as estim d from the data from Nursing home group B.

doi:10.1371/journal.pone.0137905.t005

At first, there was no device (dosimeter) to measure the level of airborne radiation



Picture 2.

Tsubokura et al. Internal medicine 2012

Control of Radiation Exposure

Internal Radiation Exposure Control (Whole Body Counter: WBC)

The program started in
July 2011 at
Minamisoma Munical General Hospital

Whole Body Counter (Fastscan) used today

Detection limit: 250 Bq/body

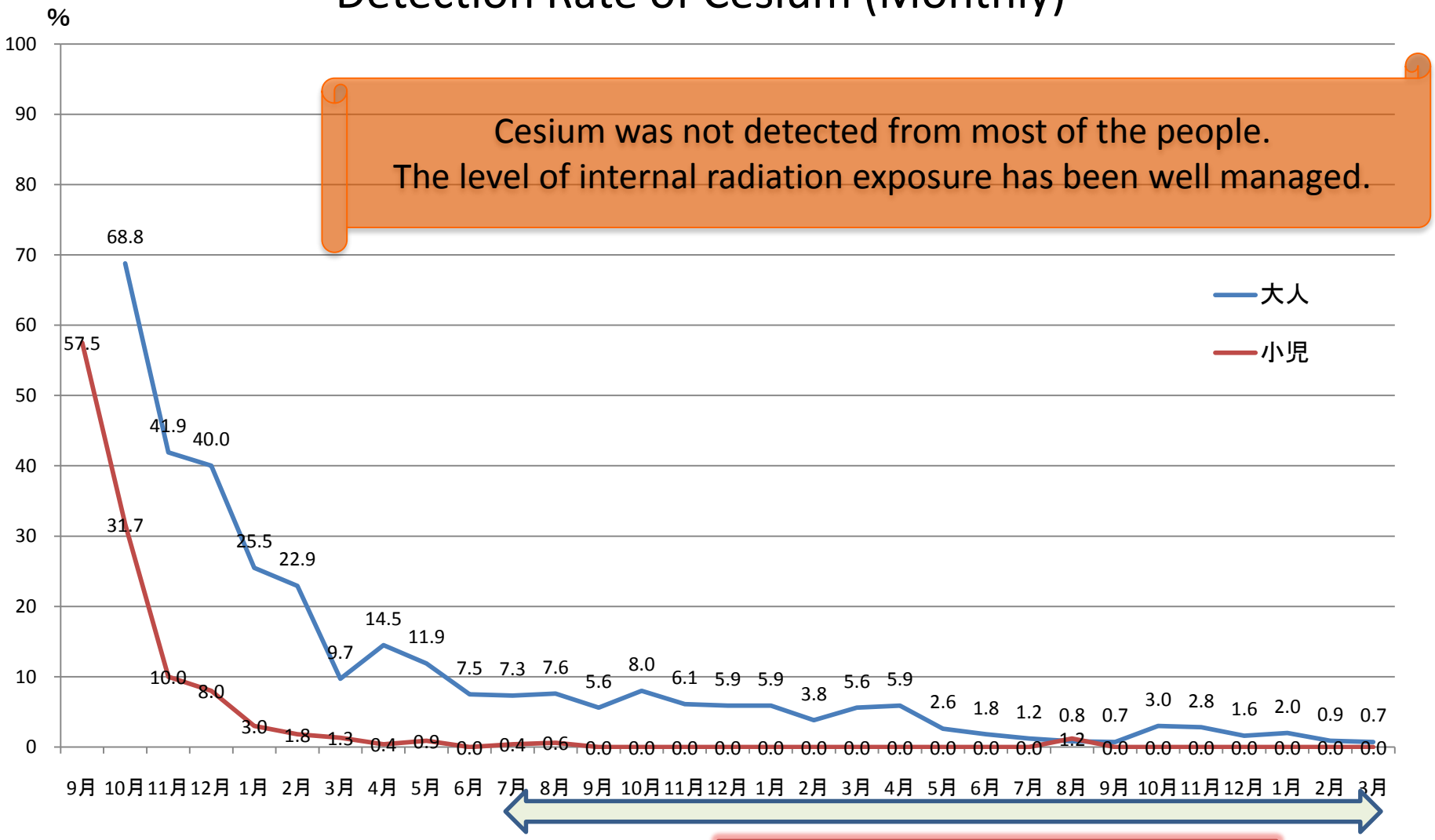
- Continuous monitoring of the internal radiation exposure level since the disaster.
- The program is now mandatory for all the students in Minamisoma and Soma cities.

Whole Body Counter (Babyscan) used today

Detection limit: 50 Bq/body

General Public + Students

Detection Rate of Cesium (Monthly)



Including the data from Watanabe hospital

※Detected is defined as if either Cesium 134 or Cesium 137, or both were detected above the detection limit.
※Adults is defined as older than middle school, and children is defined as younger than middle school students.

Tsubokura et al. 2013

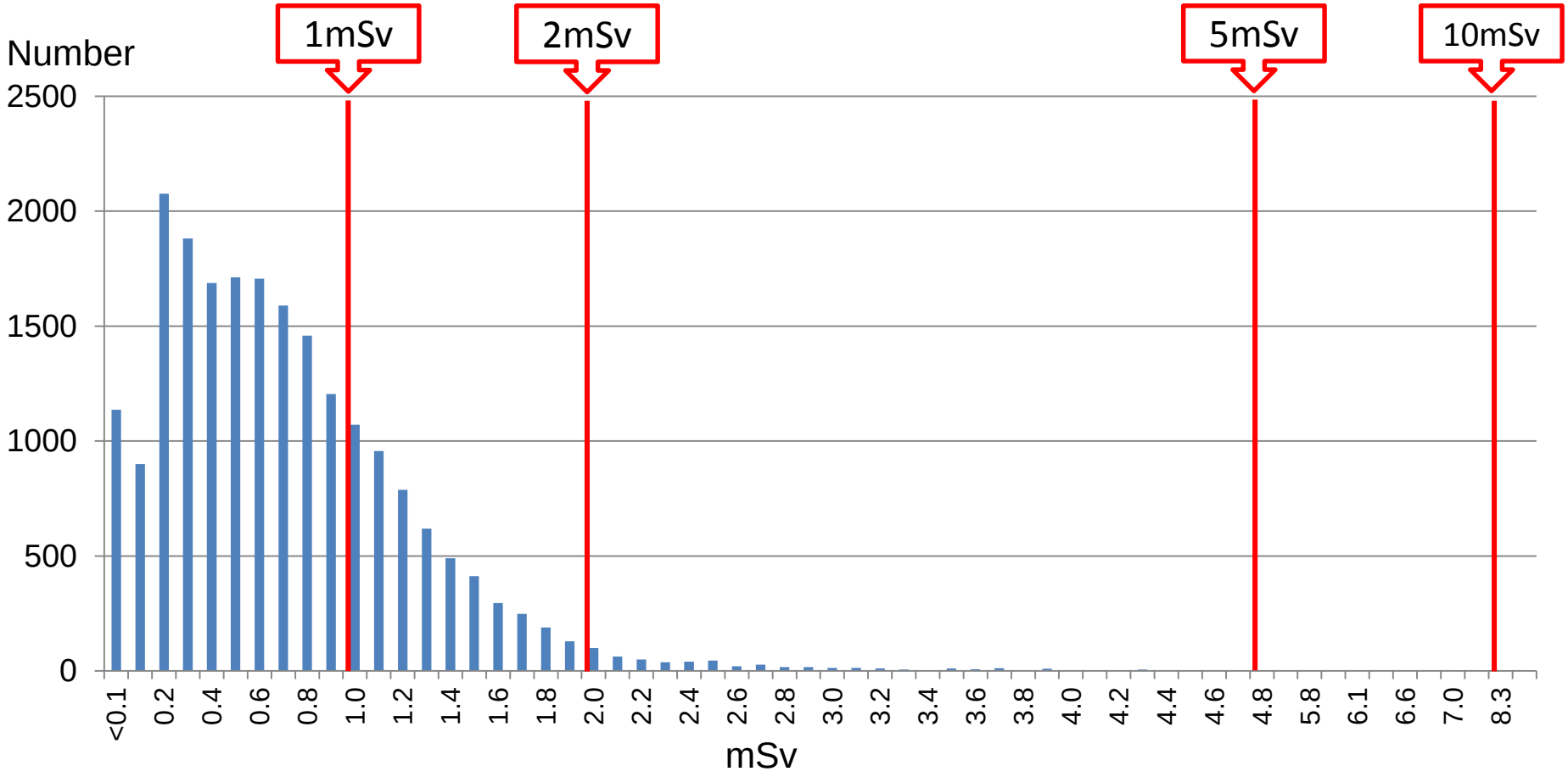
High levels of internal conatmination

Table 1. Results of repeated measurement among residents with internal Cs-137 burden of more than 50 Bq/kg

				1st	Cs-134		Cs-137		2nd	Cs-134		Cs-137		3rd	Cs-134		Cs-137	
Pt No	Age	Sex	Family	Measure-ment	Bq/body	Bq/kg	Bq/body	Bq/kg	Measure-ment	Bq/body	Bq/kg	Bq/body	Bq/kg	Measure-ment	Bq/body	Bq/kg	Bq/body	Bq/kg
1	70	M	Family 1	Jul, 2012	4160	66.0	7032	111.6	Nov, 2012	1313	20.9	2547	40.6	Feb, 2013	631	10.0	1069	16.9
2	66	F	Family 1	Jul, 2012	2471	40.0	4300	69.6	Nov, 2012	695	11.2	1485	23.9	Feb, 2013	ND*	ND	585	9.4
3	71	M	-	Jul, 2012	6713	88.3	10730	141.2	Nov, 2012	3288	43.8	5556	74.1	Apr, 2013	1717	21.2	3445	42.5
4	64	M	-	Sep, 2012	9114	123.8	15918	216.3	Dec, 2012	4122	56.0	7670	104.2	-	-	-	-	-
5	74	M	Family 2	Aug, 2012	7237	108.3	12270	183.7	Nov, 2012	3204	47.7	6177	91.9	Feb, 2013	1679	25.0	3600	53.7
6	74	F	Family 2	Aug, 2012	2894	41.6	4830	69.4	Nov, 2012	1133	16.0	2139	30.3	Feb, 2013	418	5.8	919	12.8
7	60	M	-	Apr, 2012	2203	42.6	3190	61.7	-	-	-	-	-	-	-	-	-	-
8	73	M	Family 3	May, 2012	2090	36.7	3230	56.7	Aug, 2012	1043	18.3	1695	29.7	Feb, 2013	ND	ND	582	10.2
9	69	F	Family 3	May, 2012	1442	34.3	2130	50.7	Aug, 2012	466	11.1	711	16.9	Feb, 2013	ND	ND	ND	ND

The Fukushima Health Management Survey:

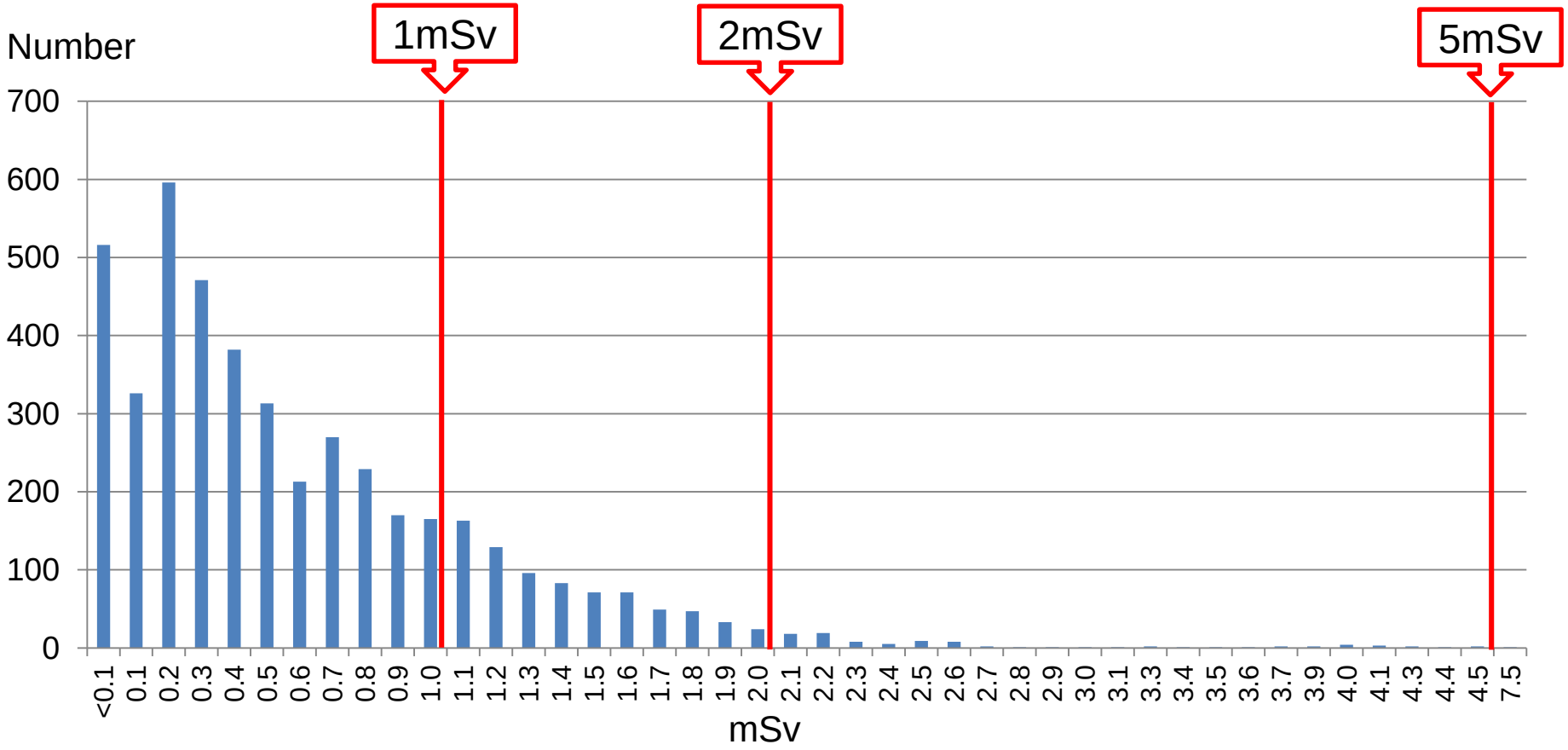
estimated external doses to residents in Minamisoma City
for the first 4 months after the Fukushima nuclear incident
(Adults aged over 16: N=21,084)



mSv	-1.0)	[1.0-2.0)	[2.0-3.0)	[3.0-4.0)	[4.0-5.0)	[5.0-10.0)	[10.0-
Number	16,421	4,226	326	78	19	13	1
%	77.9	20.0	1.5	0.4	0.1	0.1	0.0

The Fukushima Health Management Survey:

estimated external doses to residents in Minamisoma City
for the first 4 months after the Fukushima nuclear incident
(Children aged under 15: N=4,512)

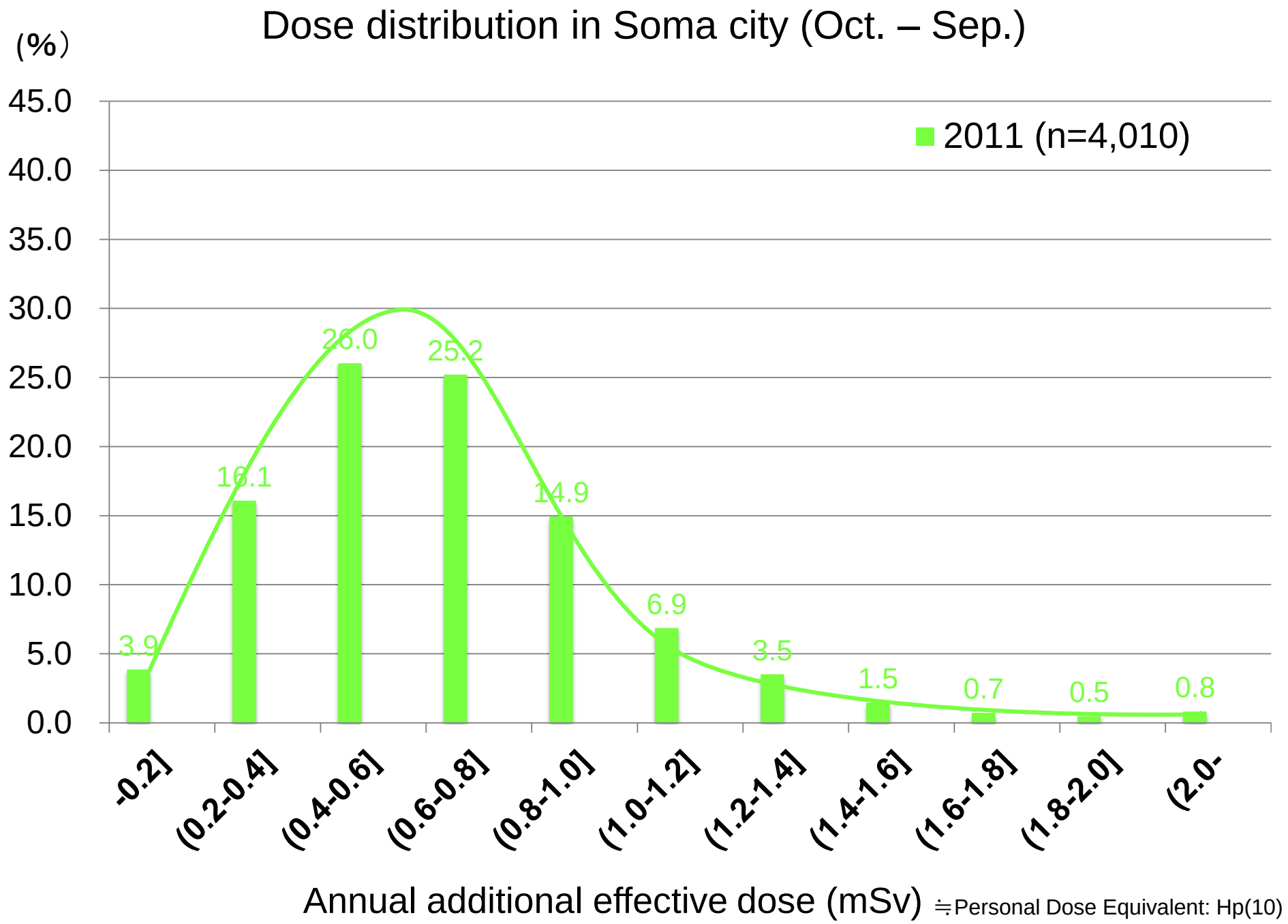


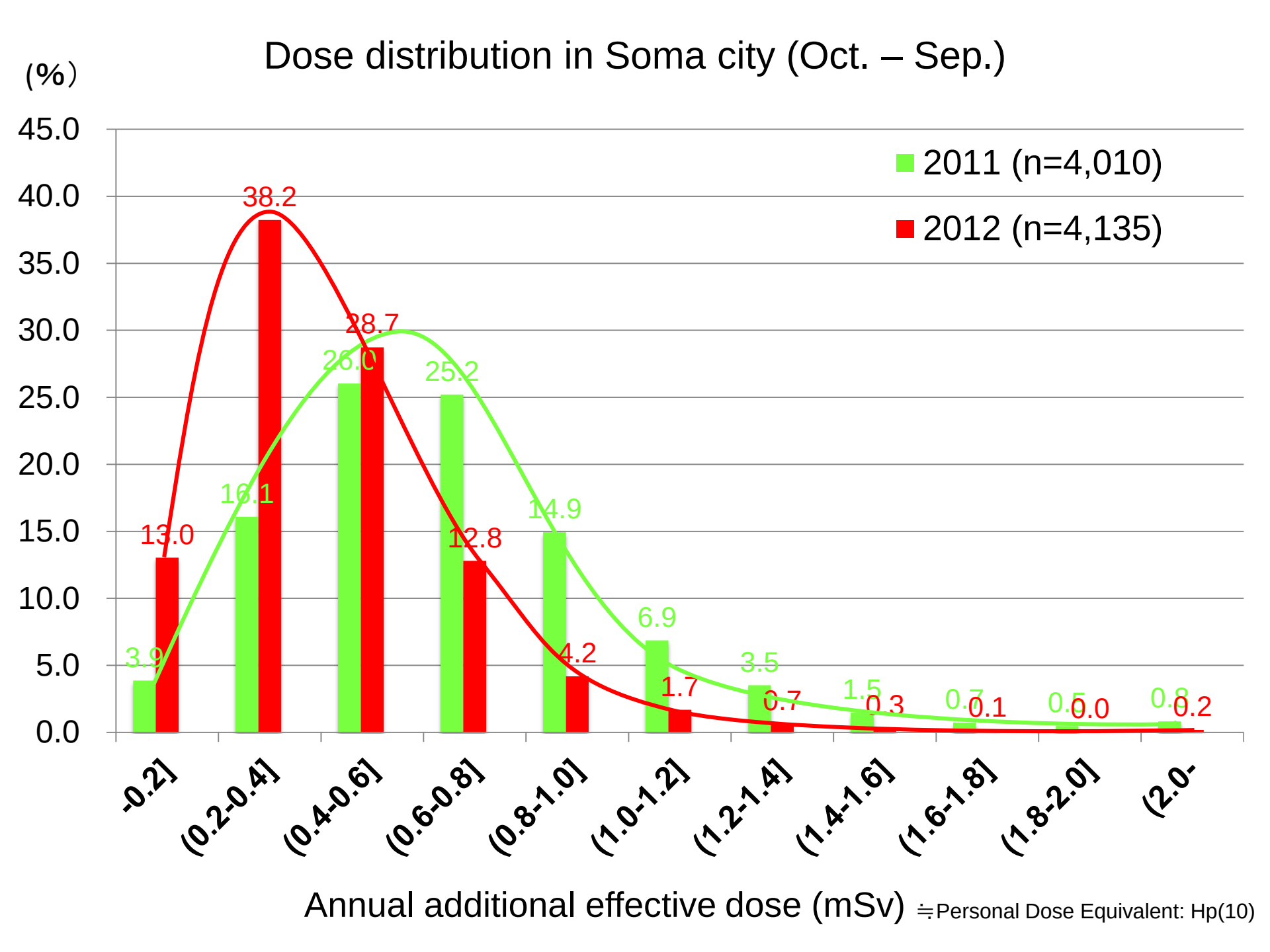
mSv	-1.0)	[1.0-2.0)	[2.0-3.0)	[3.0-4.0)	[4.0-5.0)	[5.0-)
Number	3,651	766	72	14	8	1
%	80.9	17.0	1.6	0.3	0.2	0.0

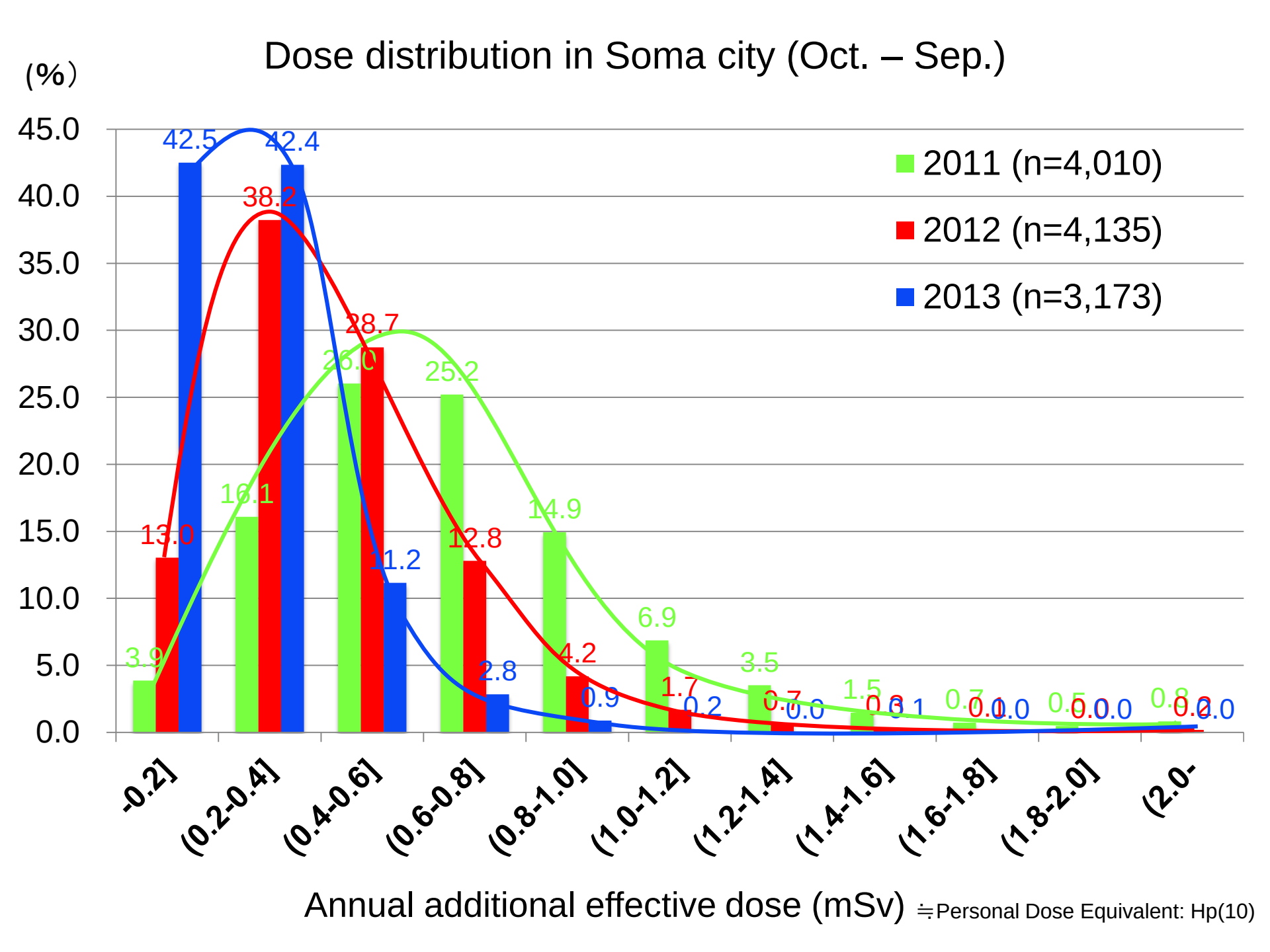
External Radiation Exposure Control (Glass badges)

Measures the periodic average level of external exposure

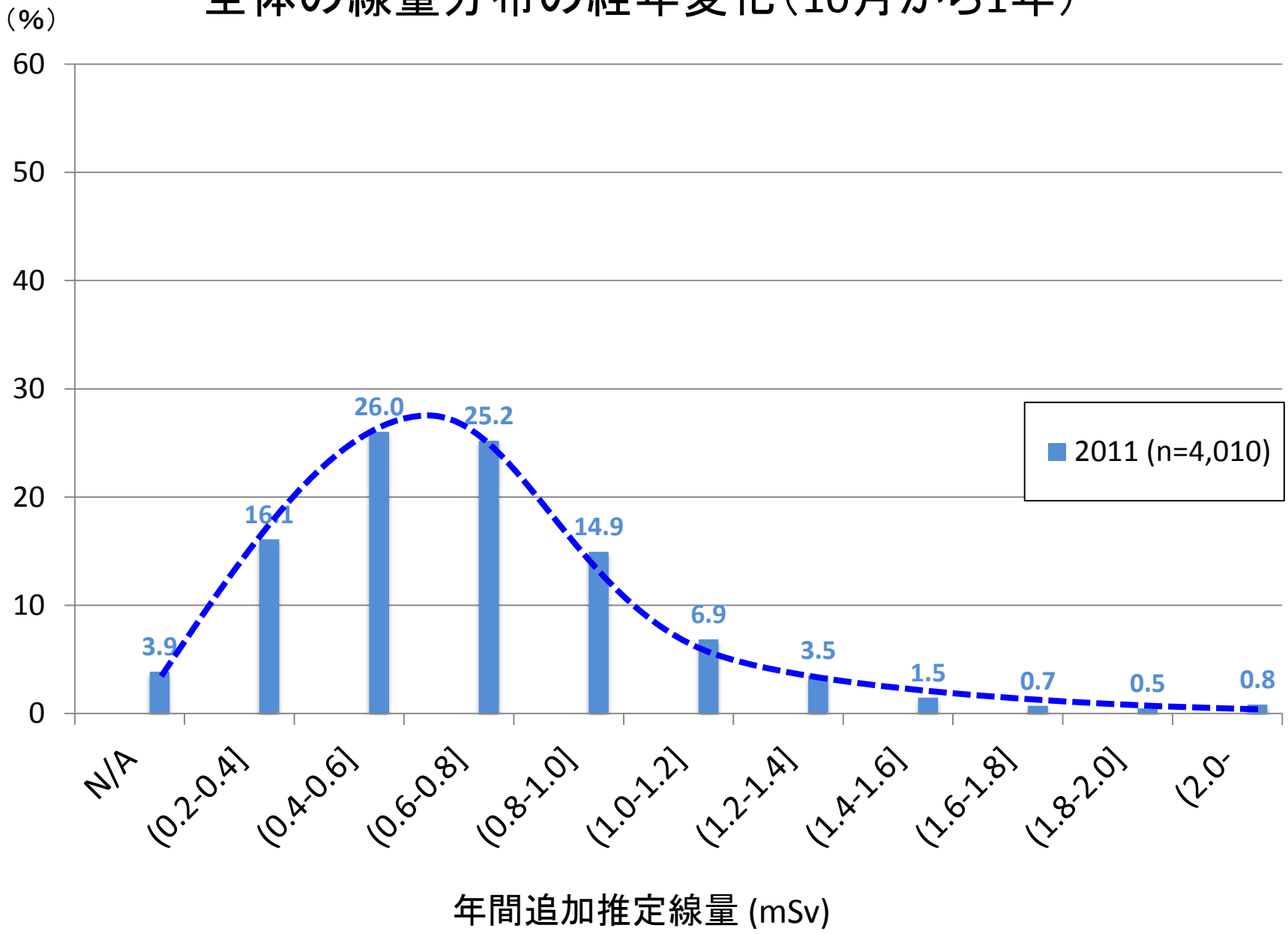
Measures the hourly average level of external radiation exposure

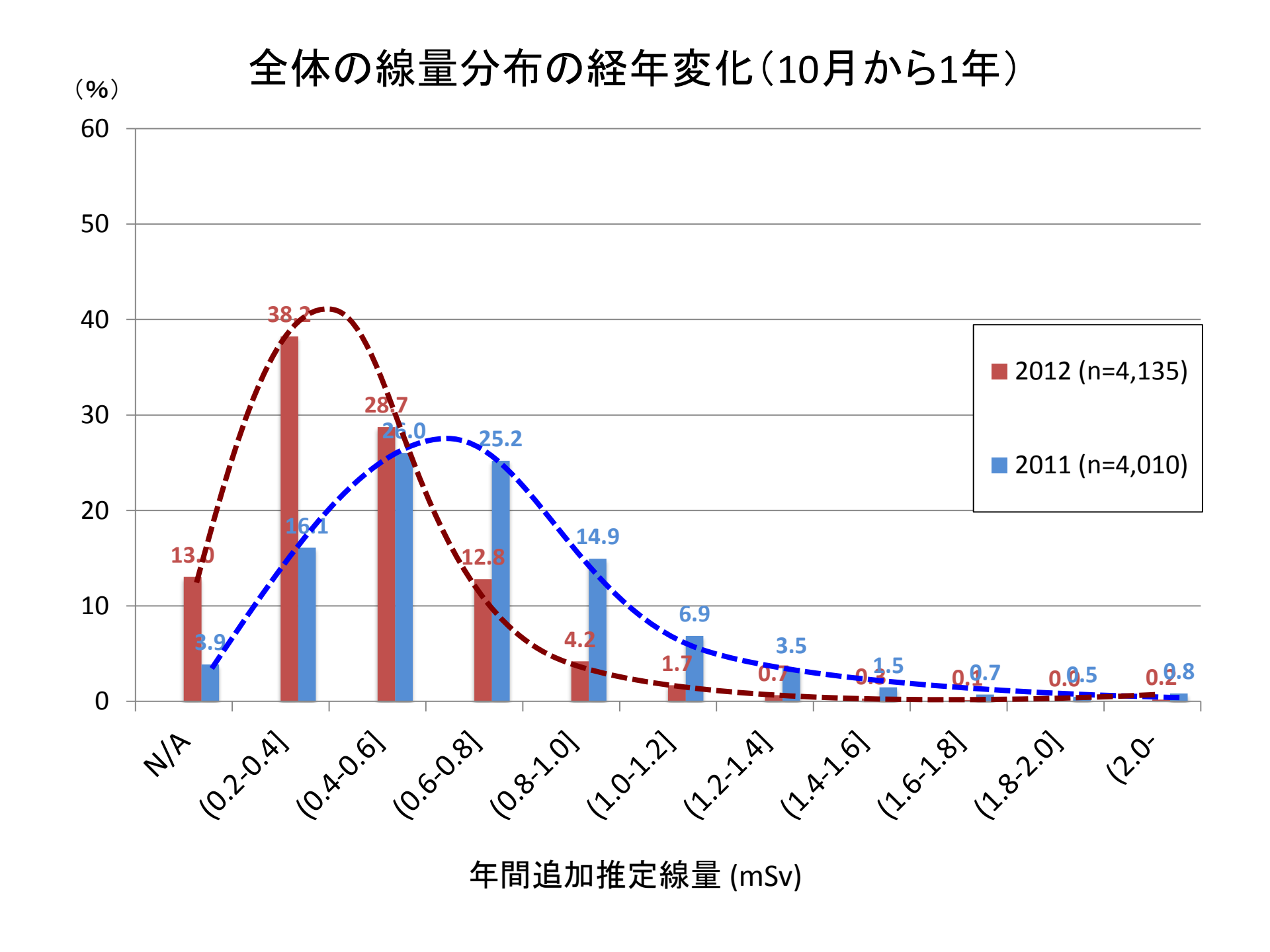

Dose distribution in Soma city (Oct. – Sep.)
(%)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2011 (n=4,010)
3.9
16.1
26.0
25.2
14.9
6.9
3.5
1.5
0.7
0.5
0.8
-0.2]
(0.2-0.4]
(0.4-0.6]
(0.6-0.8]
(0.8-1.0]
(1.0-1.2]
(1.2-1.4]
(1.4-1.6]
(1.6-1.8]
(1.8-2.0]
(2.0-
Annual additional effective dose (mSv) ≒Personal Dose Equivalent: Hp(10)

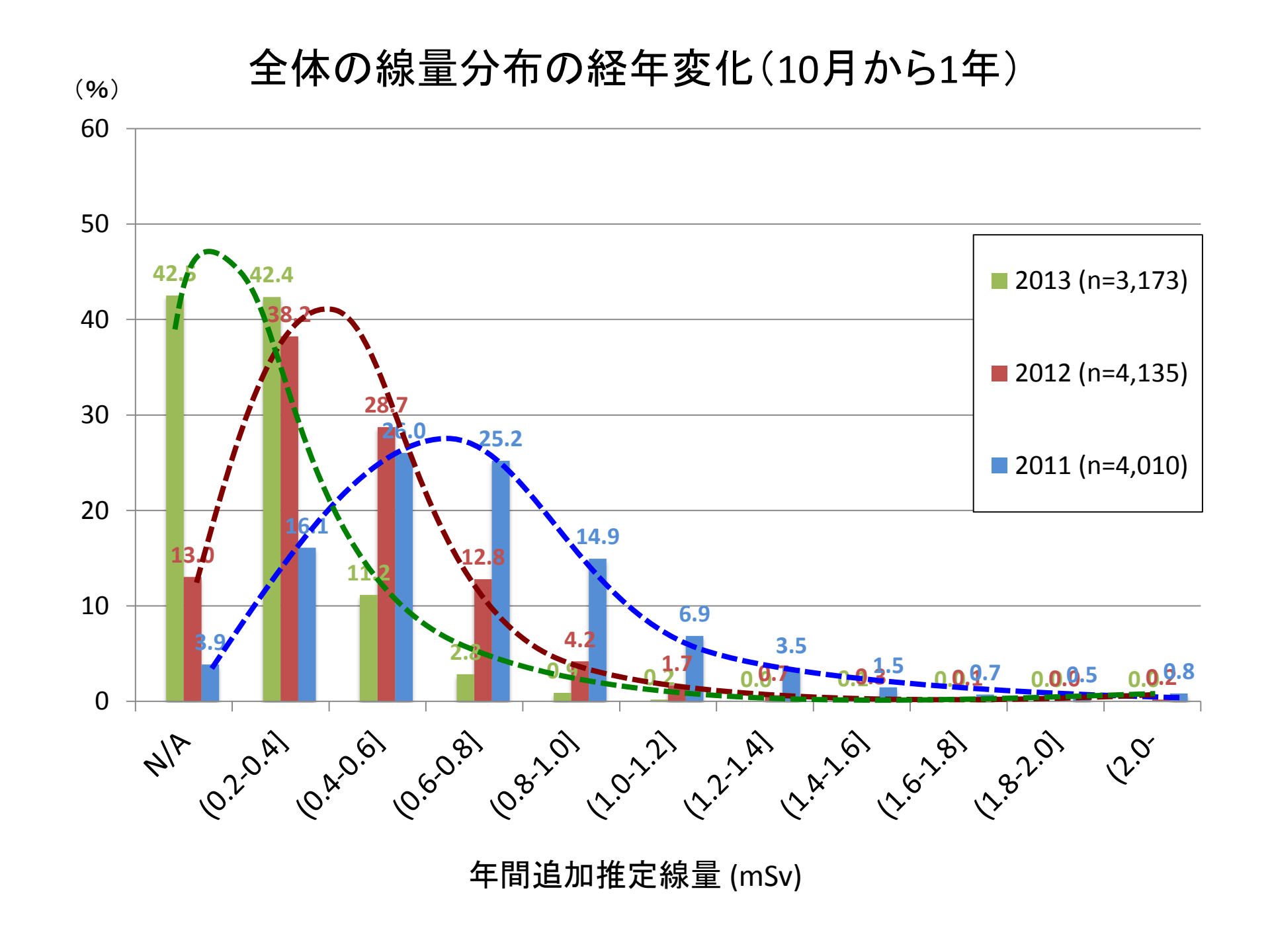

Dose distribution in Soma city (Oct. – Sep.)
(%)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2011 (n=4,010)
2012 (n=4,135)
3.9
13.0
16.1
38.2
26.0
28.7
25.2
12.8
14.9
4.2
6.9
1.7
3.5
0.7
1.5
0.3
0.7
0.1
0.5
0.0
0.8
0.2
-0.2]
(0.2-0.4]
(0.4-0.6]
(0.6-0.8]
(0.8-1.0]
(1.0-1.2]
(1.2-1.4]
(1.4-1.6]
(1.6-1.8]
(1.8-2.0]
(2.0-
Annual additional effective dose (mSv) ≒Personal Dose Equivalent: Hp(10)


Dose distribution in Soma city (Oct. – Sep.)
(%)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2011 (n=4,010)
2012 (n=4,135)
2013 (n=3,173)
42.5
42.4
38.2
28.7
26.0
25.2
16.1
14.9
13.0
12.8
11.2
6.9
4.2
3.9
3.5
2.8
1.7
1.5
0.9
0.7
0.2
0.1
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
-0.2]
(0.2-0.4]
(0.4-0.6]
(0.6-0.8]
(0.8-1.0]
(1.0-1.2]
(1.2-1.4]
(1.4-1.6]
(1.6-1.8]
(1.8-2.0]
(2.0-
Annual additional effective dose (mSv) ≒Personal Dose Equivalent: Hp(10)

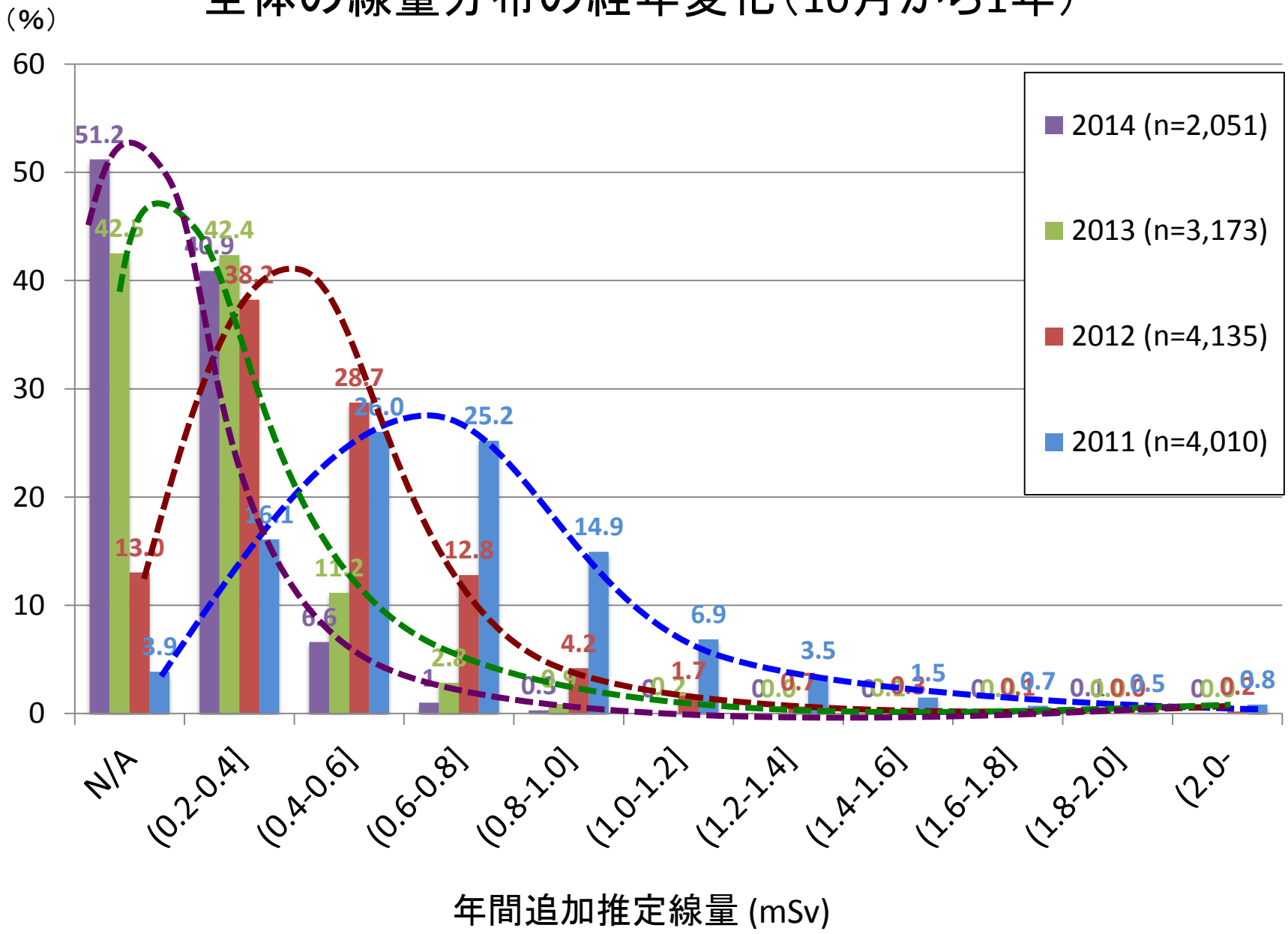
全体の線量分布の経年変化（10月から1年）



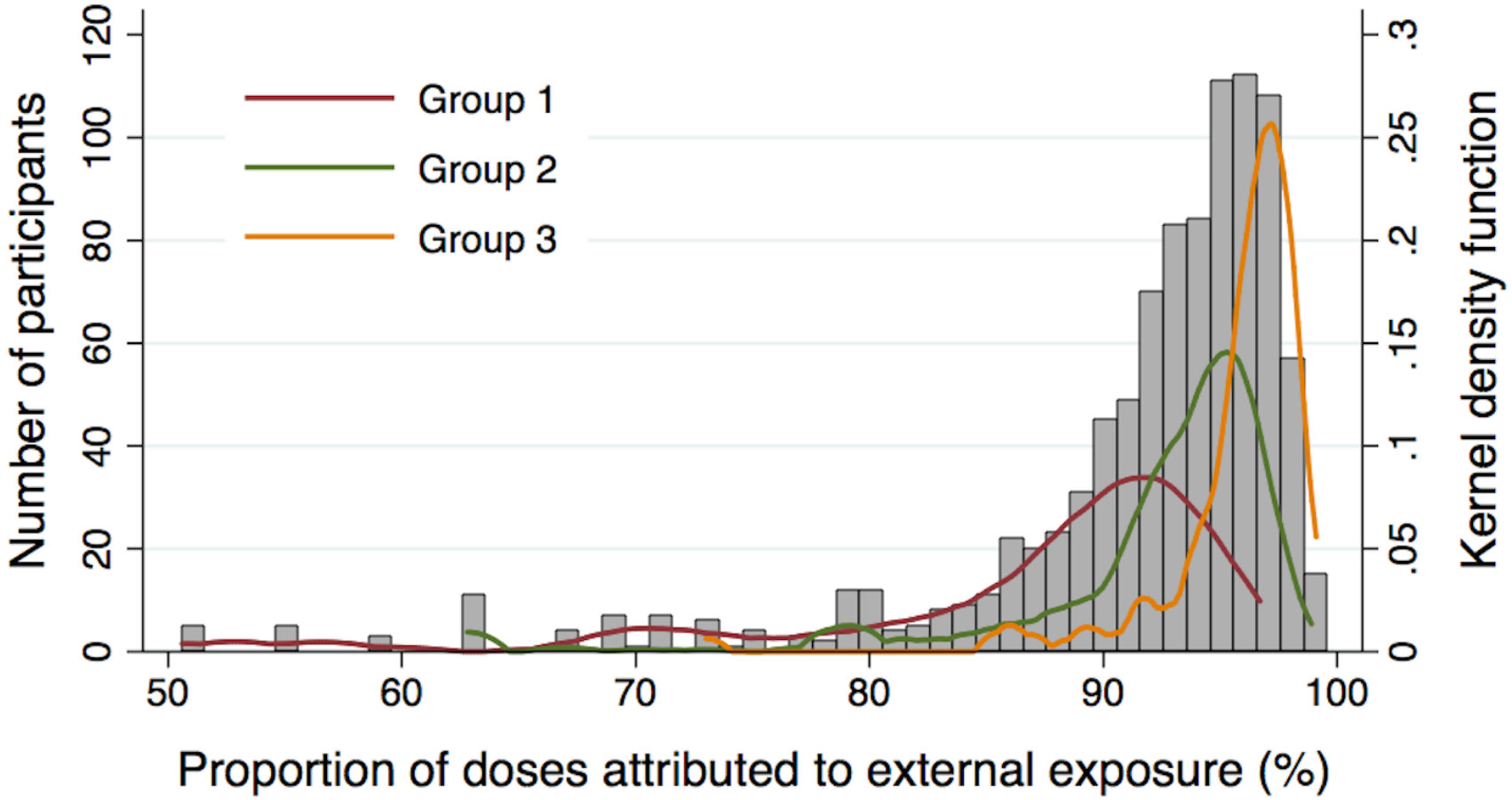

全体の線量分布の経年変化（10月から1年）
（%）
60
50
40
30
20
10
0
38.2
28.7
26.0
25.2
16.1
14.9
13.0
12.8
6.9
4.2
3.9
3.5
1.7
1.5
0.7
0.7
0.5
0.8
0.2
2012 (n=4,135)
2011 (n=4,010)
N/A
(0.2-0.4]
(0.4-0.6]
(0.6-0.8]
(0.8-1.0]
(1.0-1.2]
(1.2-1.4]
(1.4-1.6]
(1.6-1.8]
(1.8-2.0]
(2.0-
年間追加推定線量 (mSv)


全体の線量分布の経年変化（10月から1年）
（%）
60
50
40
30
20
10
0
2013 (n=3,173)
2012 (n=4,135)
2011 (n=4,010)
42.6
42.4
38.2
28.7
26.0
25.2
16.1
14.9
13.0
12.8
11.2
6.9
4.2
3.9
3.5
2.8
1.7
1.5
0.9
0.7
0.2
0.5
0.8
N/A
(0.2-0.4]
(0.4-0.6]
(0.6-0.8]
(0.8-1.0]
(1.0-1.2]
(1.2-1.4]
(1.4-1.6]
(1.6-1.8]
(1.8-2.0]
(2.0-
年間追加推定線量 (mSv)

全体の線量分布の経年変化（10月から1年）



Dose from external radiation exposure accounts for 93.4% of the total effective dose.



Tsubokura et al. 2015

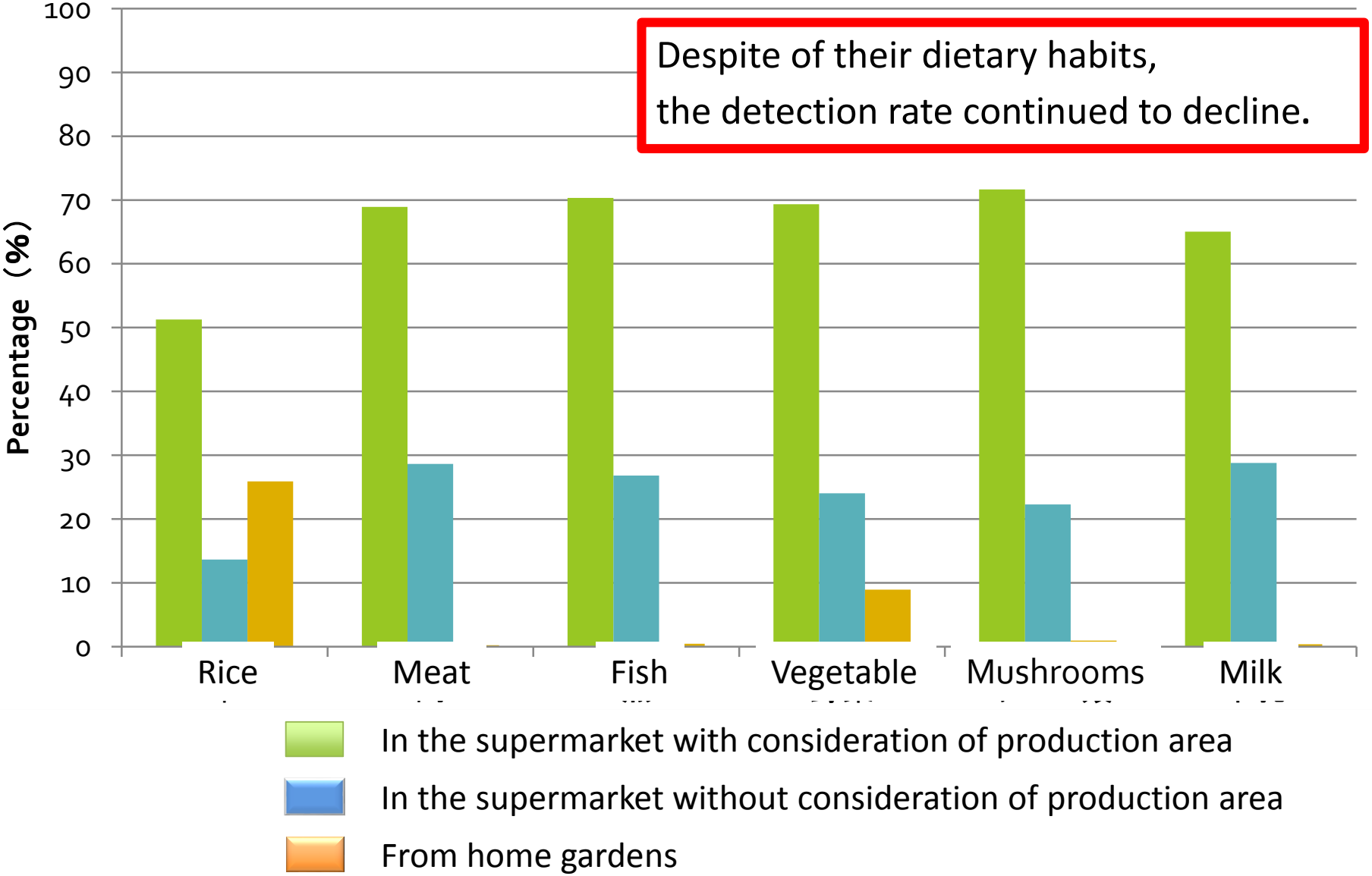
Level of exposure is low, but,,,,

There is still a tendency exist to avoid food products produced in Fukushima prefecture.

Food intake at Minamisoma City in 2012

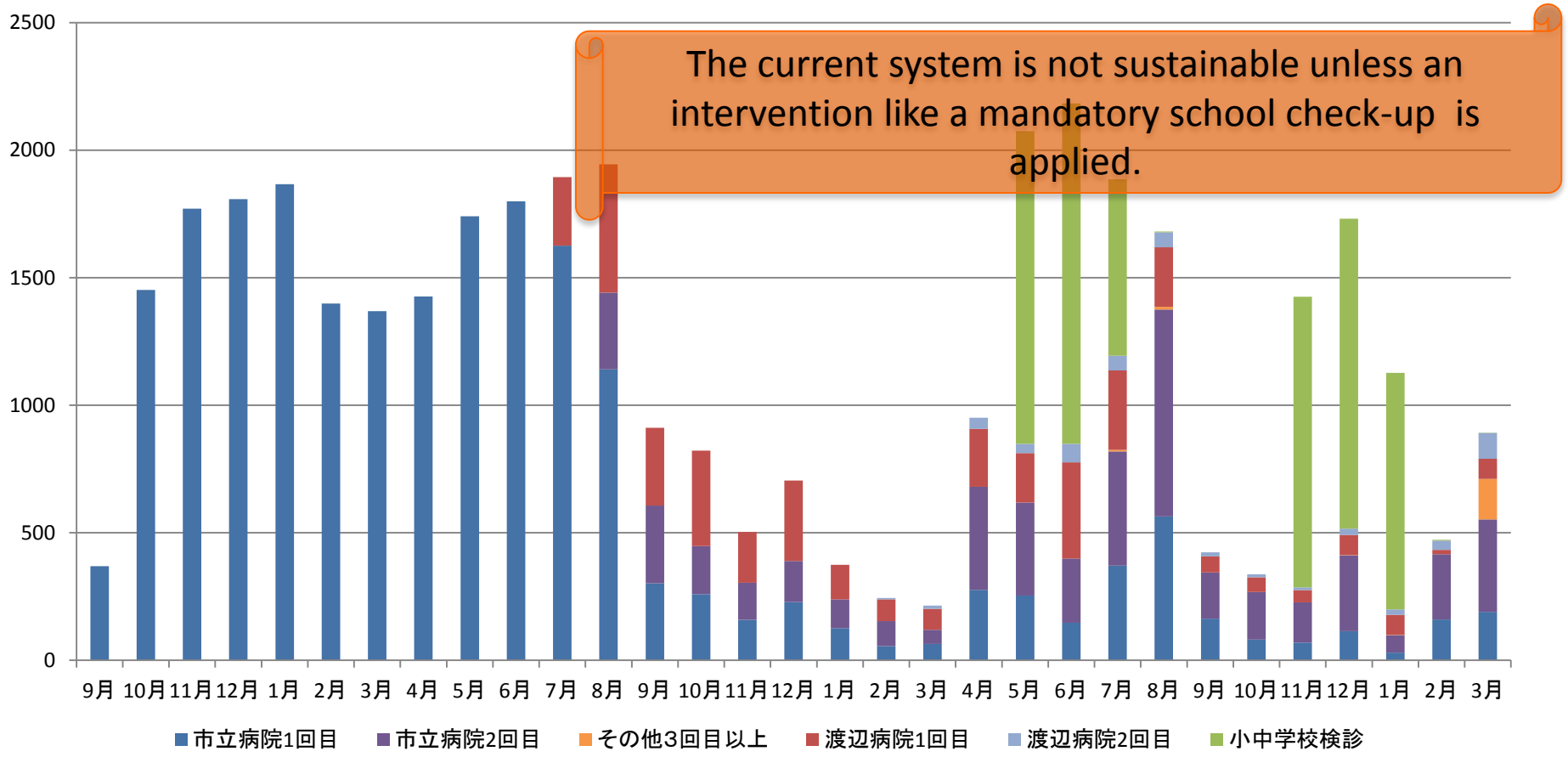
Total Number of Participants: approx.3000

Q. How are you obtaining the following food products (Multiple answers)



General Public + Students

Number of people attended the screening test (Monthly) September 2011 – March 2014



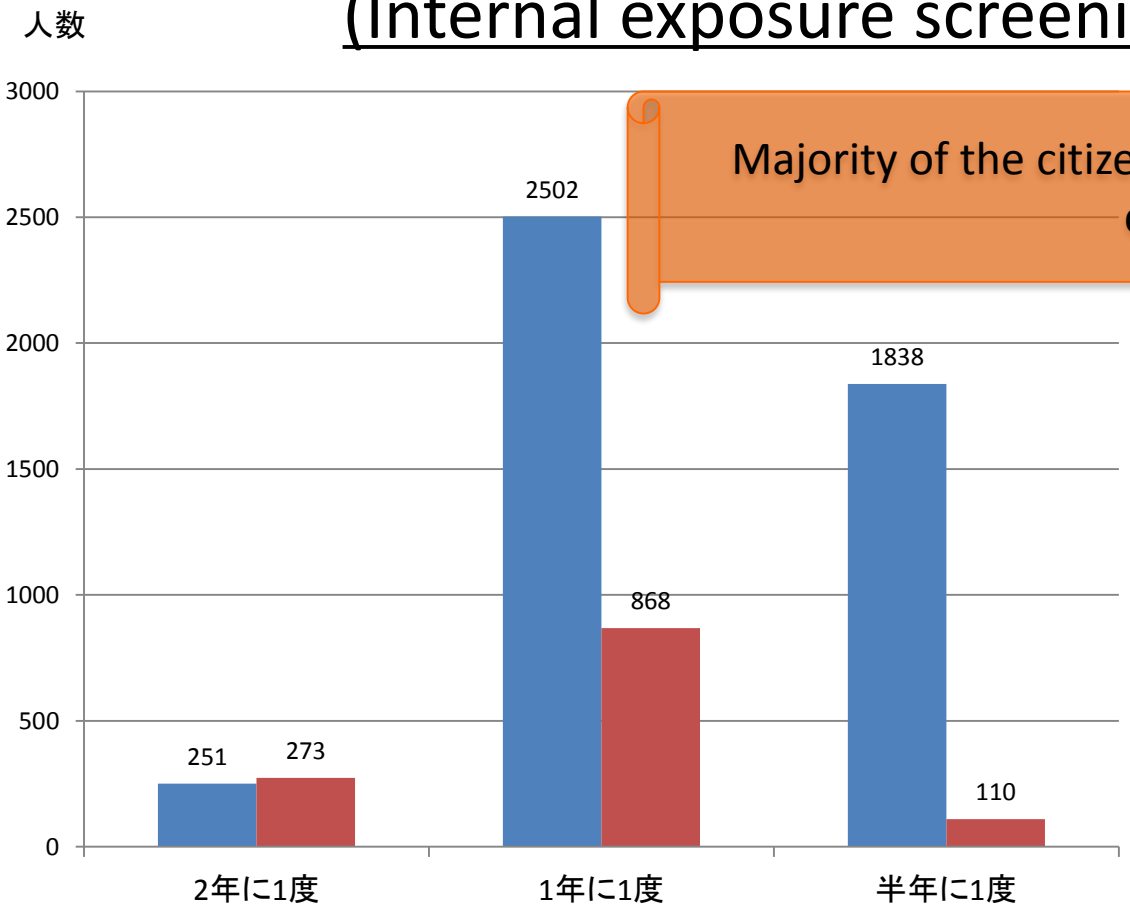
The current system is not sustainable unless an intervention like a mandatory school check-up is applied.

※Others (more than three times) implies students from Fukushima high school and elementary to middle school students living outside the prefecture.

Including the data from Wanatabe hospital

General Public +
Students

About the future WBC test
(Internal exposure screening test)



Majority of the citizens want the screening test to continue.

不要である	回答なし
21	123

Many people were losing their interest to get radiation information year after year.

However,

Many people are fear of potential irradiation.

There are still students with self-destructive comments. (Lack of self-esteem)

Questions asked in the seminar have not changed.

Small sized radiation seminars

Especially for the elderly, mothers and children.

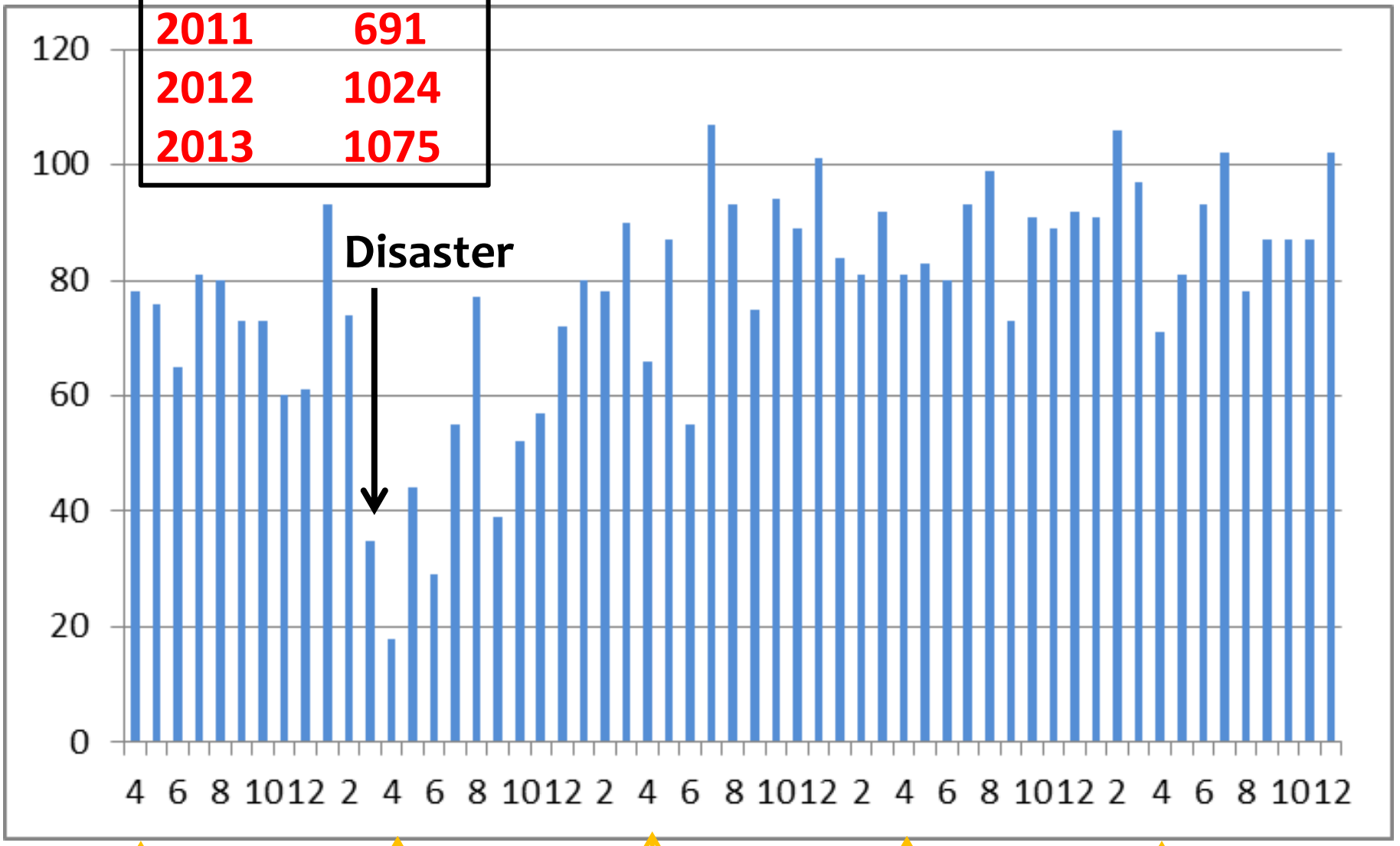
Local information is necessary.

The impacts of the nuclear disaster on health are not limited to that from radiation exposure.

In Fukushima, the biggest impact is not from radiation exposure but from societal change.

The number of ambulance calls by month

Year	No. of pt
2010	849
2011	691
2012	1024
2013	1075



Dog bites!!

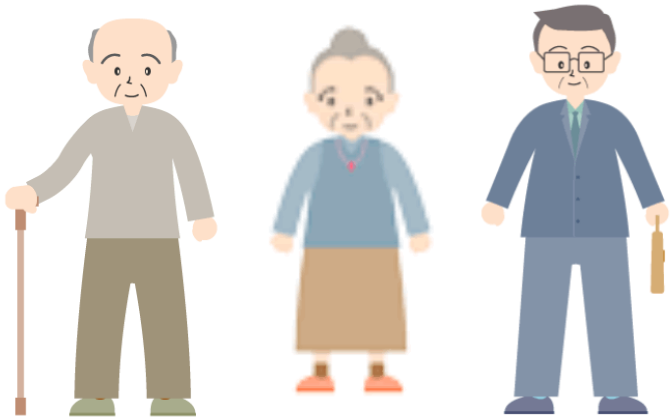
Before **15 cases/y**

After **more than 100 cases/y**

Mori J, Tsubokura M et al. 2013

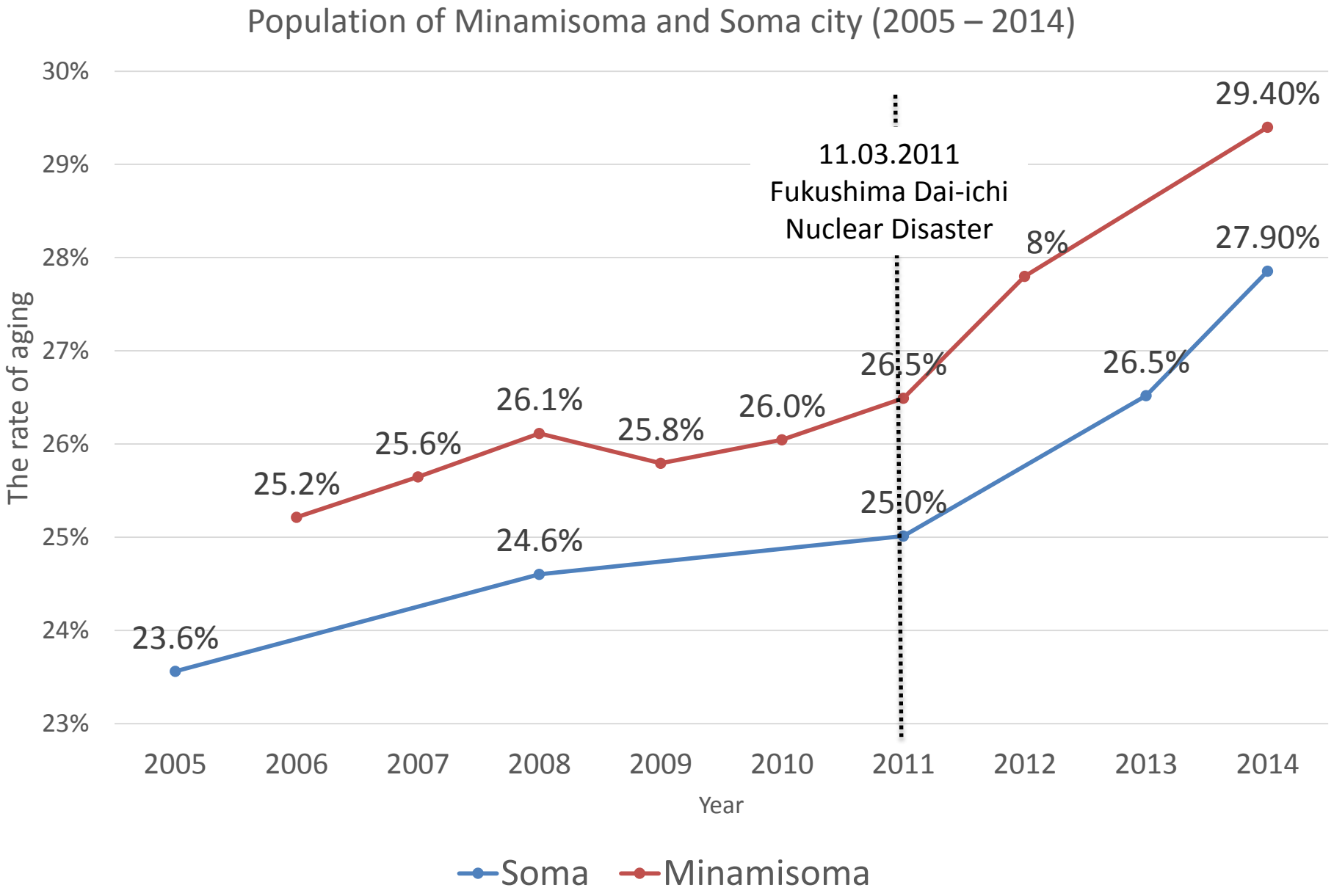
Injuries during the cleanup works

or



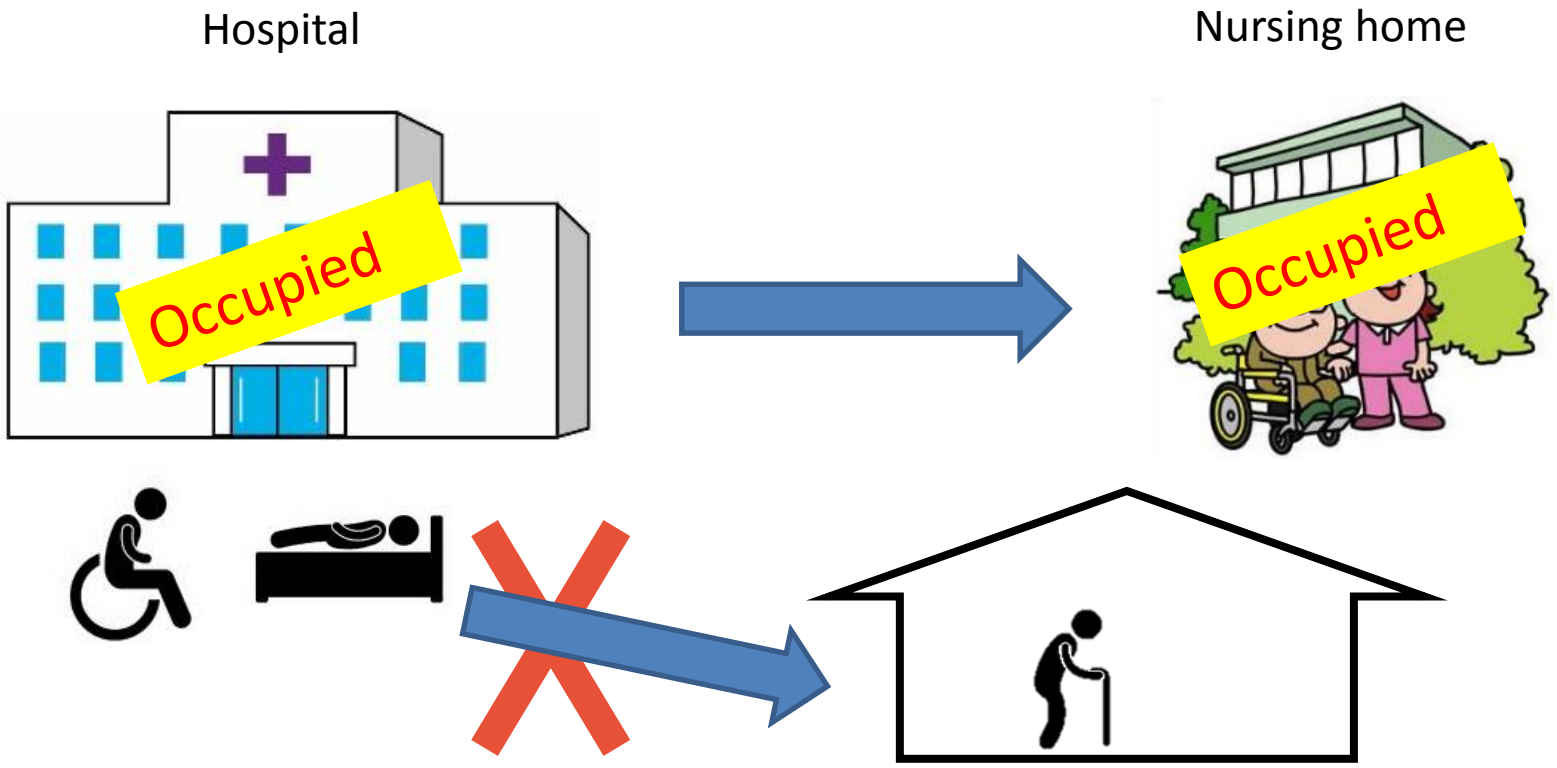
The trend of nuclear families is increasing after the nuclear disaster.

The nuclear accident accelerated aging of the population



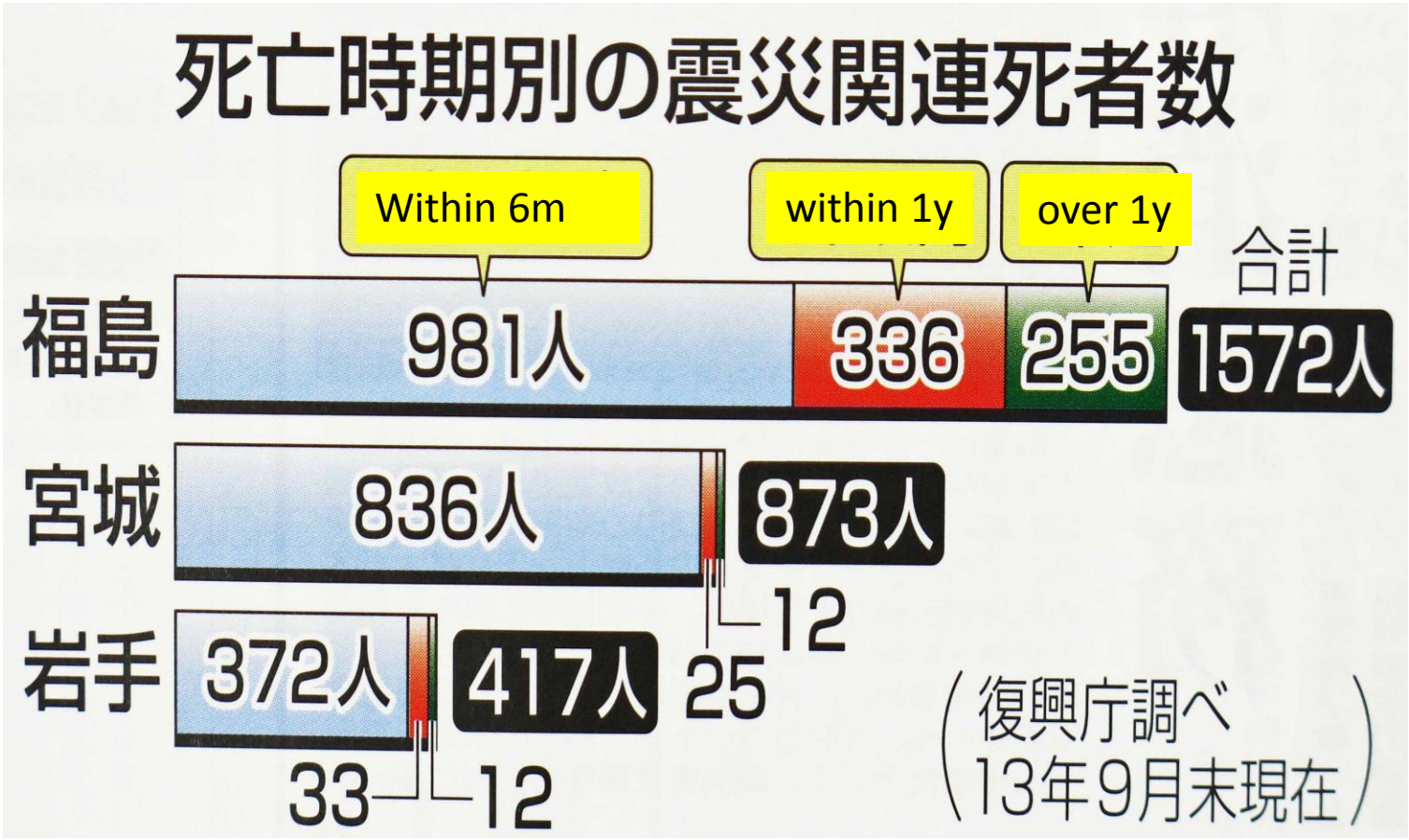
The rapid aging of the population after the disaster caused an extra burden on the local health system

- All of the nursing homes in our cities are fully occupied



Psychiatric Hospital in Minamisoma, Fukushima

Disaster-related Death



Fukushima

Miyagi

Iwate

In Fukushima 255 residents died in disaster-related death
Within a year of the disaster.
The impact of disaster has been continuing in Fukushima now

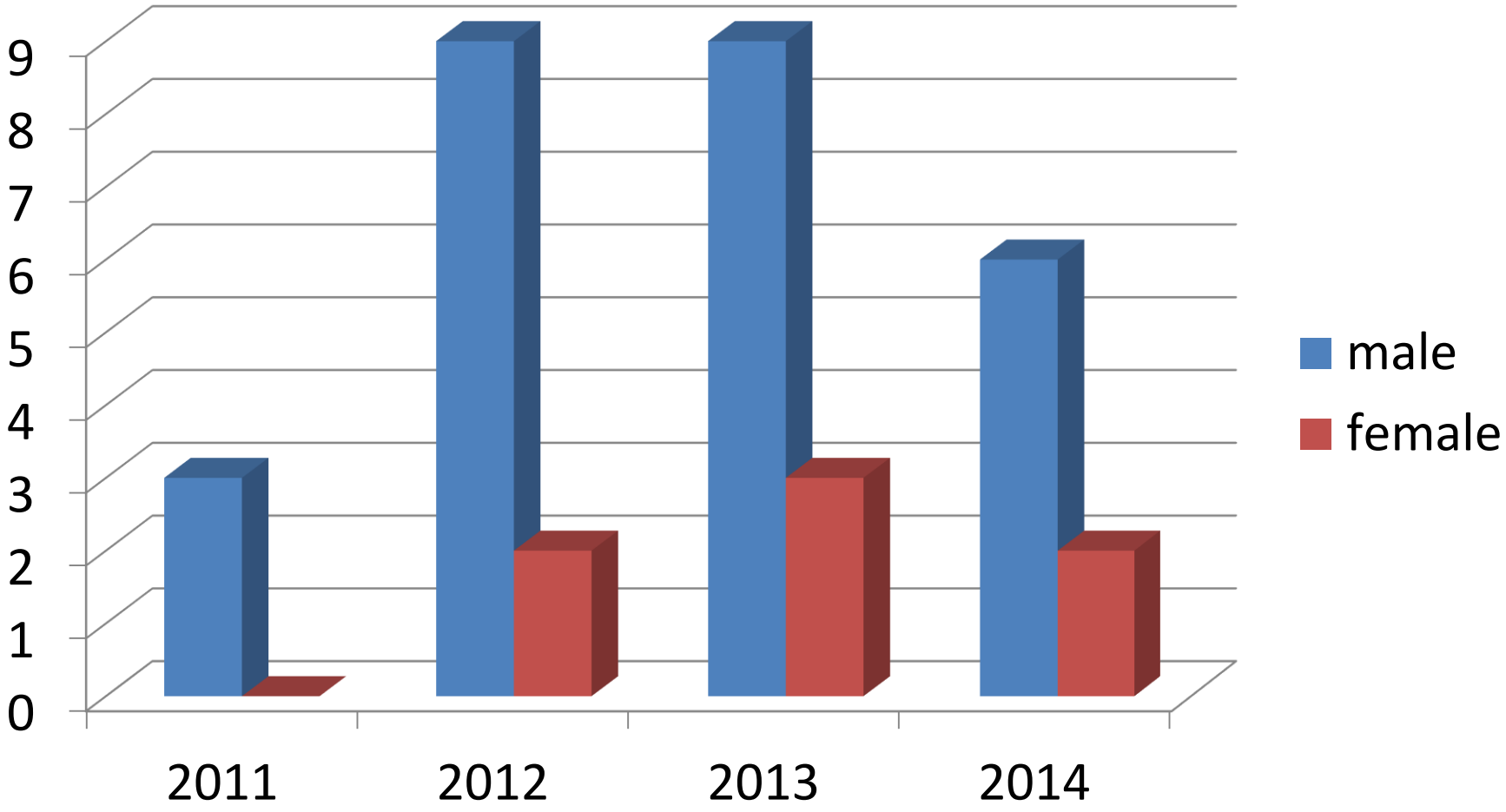
Proportion of disaster-related deaths

（2014/10/04）

	Direct deaths	Deaths registration	Disaster-related deaths	Total
Fukushima prefecture	1603	225	1777	3605
Minamisoma	525	111	458	1094

Disaster-related death can be occurred by various factors
Mass evacuation may be one of the most important factor

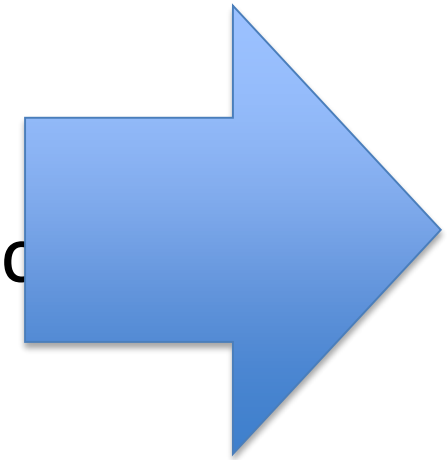
Comparison of men and women on solitary death



Supports for men is more essential

Extra attention is needed for Chronic Diseases

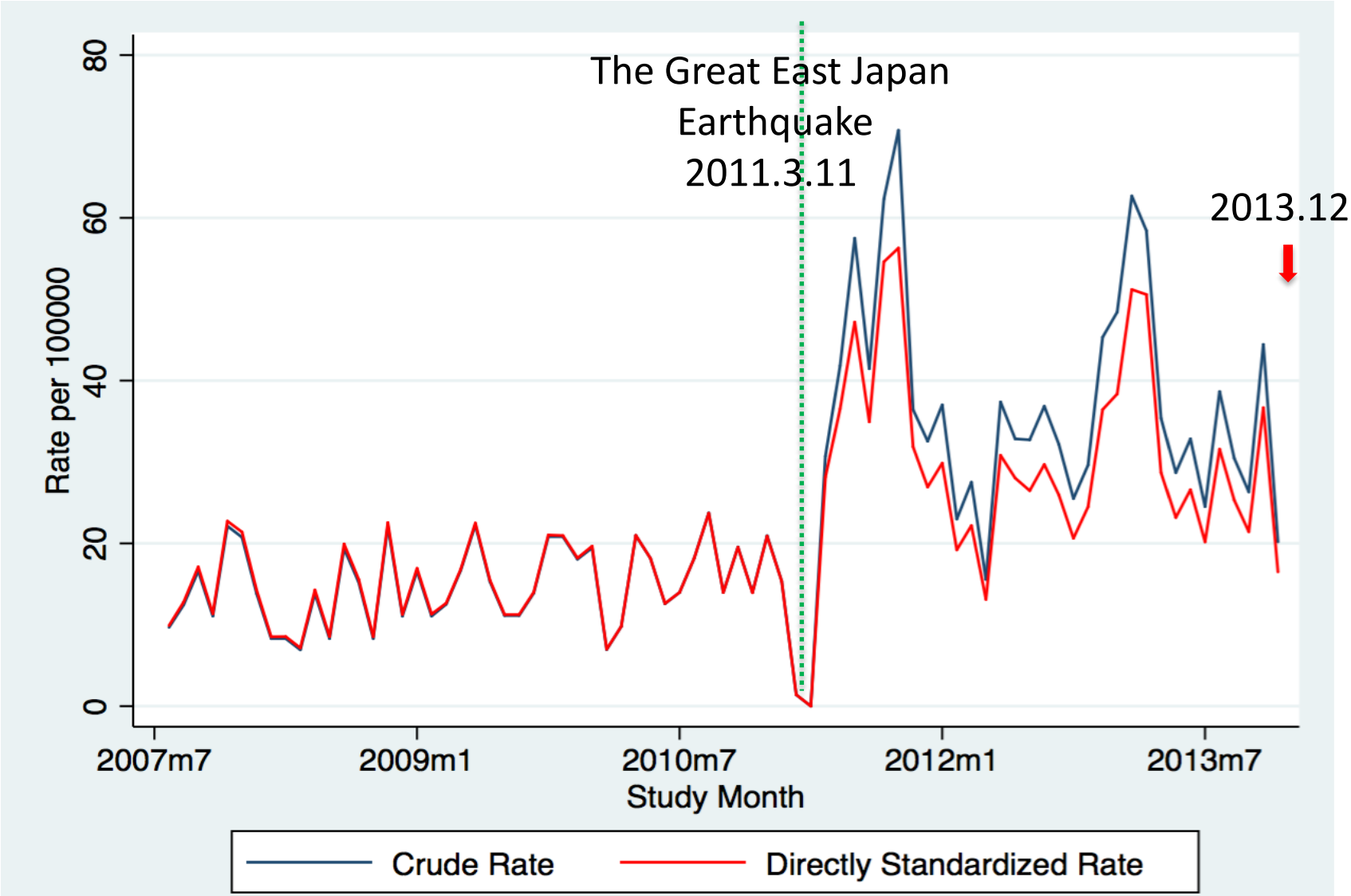
- High Blood Pressure
- Hypercholesteremia
- Diabetes
- Obesity
- Depression
- Alcohol addic



Cardiac Infarction
Stroke
Cancer

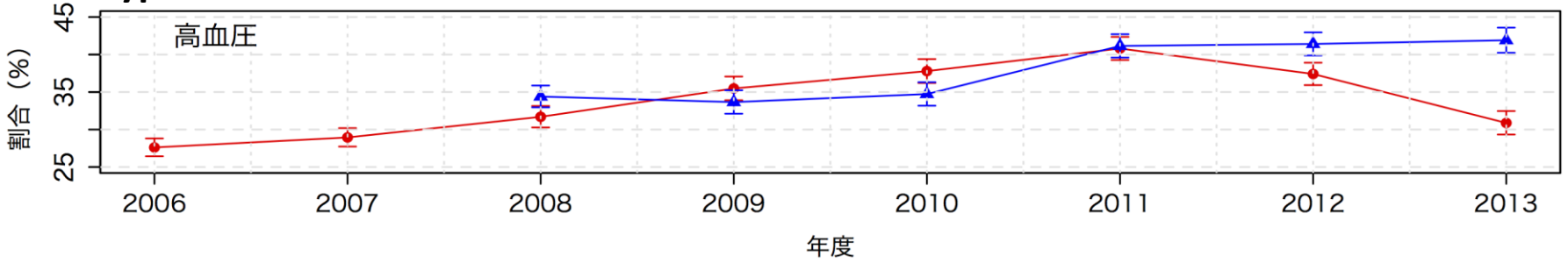
Tsubokura et al. BMC Public health, 2013

Monthly incidence of Stroke Patients per 100,000
(population/age-quota adjusted)

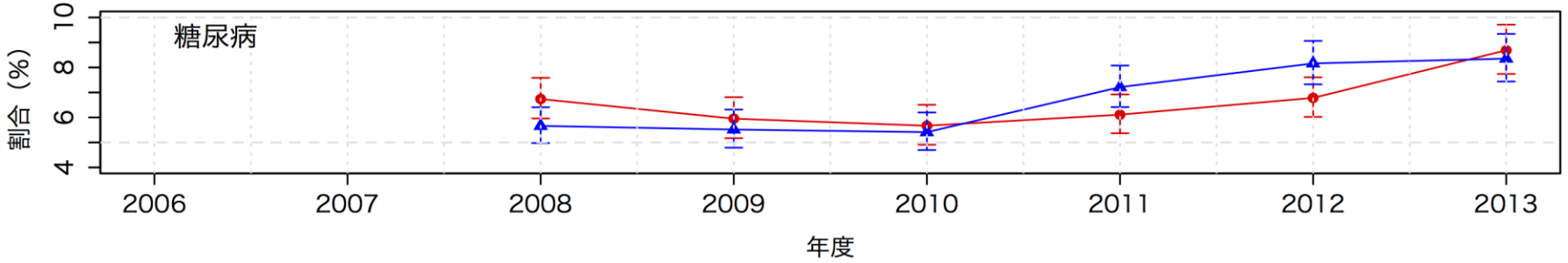


Trends in the prevalence of chronic diseases in Soma-region

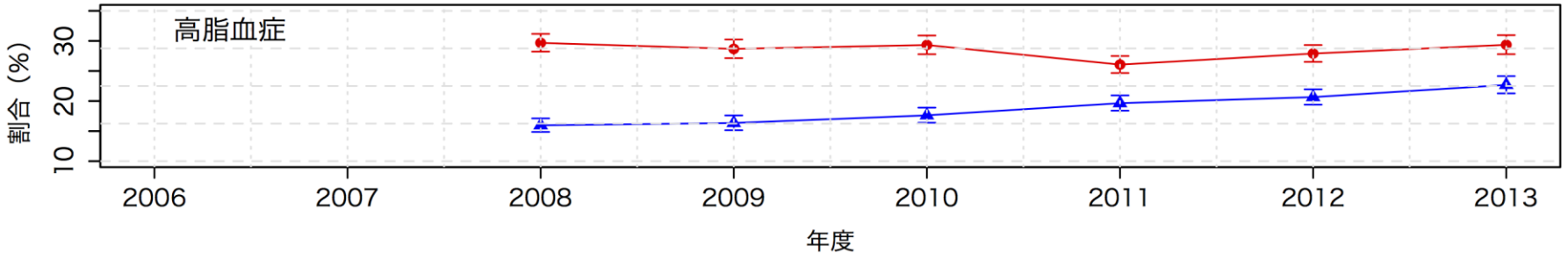
Hypertension



Diabetes



Hyperlipidemia



Prevalence (Red) Oral administration rate (Blue)

Decontamination Cost: Approx. £ 5 billion

Decontamination workers

- More than 5,000-6,000 workers in Minamisoma
- Population of Minamisoma is 50,000.

- Most of them are men, migrant workers (no family, sometimes no insurance!!)

Soma High School &
Fukushima High School

Q. Things I would like to know about radiation

We no longer discuss about radiation issues, but there are still students with self-destructive comments.

Contents	#
Future health effects	16
Water & seafood safety	6
How long will it take until we can live without worrying about radiation?	5
The amount of radiation we are currently exposed to	4
The actual contamination level	3
Things we need to be careful of	3
Differences between internal and external exposure	2
Vegetables/food products safety	2
Methods on how to get rid of radiation	2
Issues on decontamination & release of the No Entry Zone	2
Differences between Chernobyl and Hiroshima	2
Safety of areas around my house	1
Differences between artificial and naturally occurring radiation	1
Methods on how to get rid of radiation from our body	1
Ways to read radiation level in units.	1
Differences between radiation in Japan and abroad	1

Other comments:

- I am not interested. I do not see a point in discussing about something that had happened more than two years ago.
- I am not interested. How the knowledge on radiation would help us get rid of the radiation we have been already exposed to?
- I do not really know about it, but I think I would probably die of cancer.
- I do not know if we will be healthy in ten years.

The purpose of information sharing

① To prevent loss of self-confidence

（For them to continue their normal daily life)

② To prevent isolation

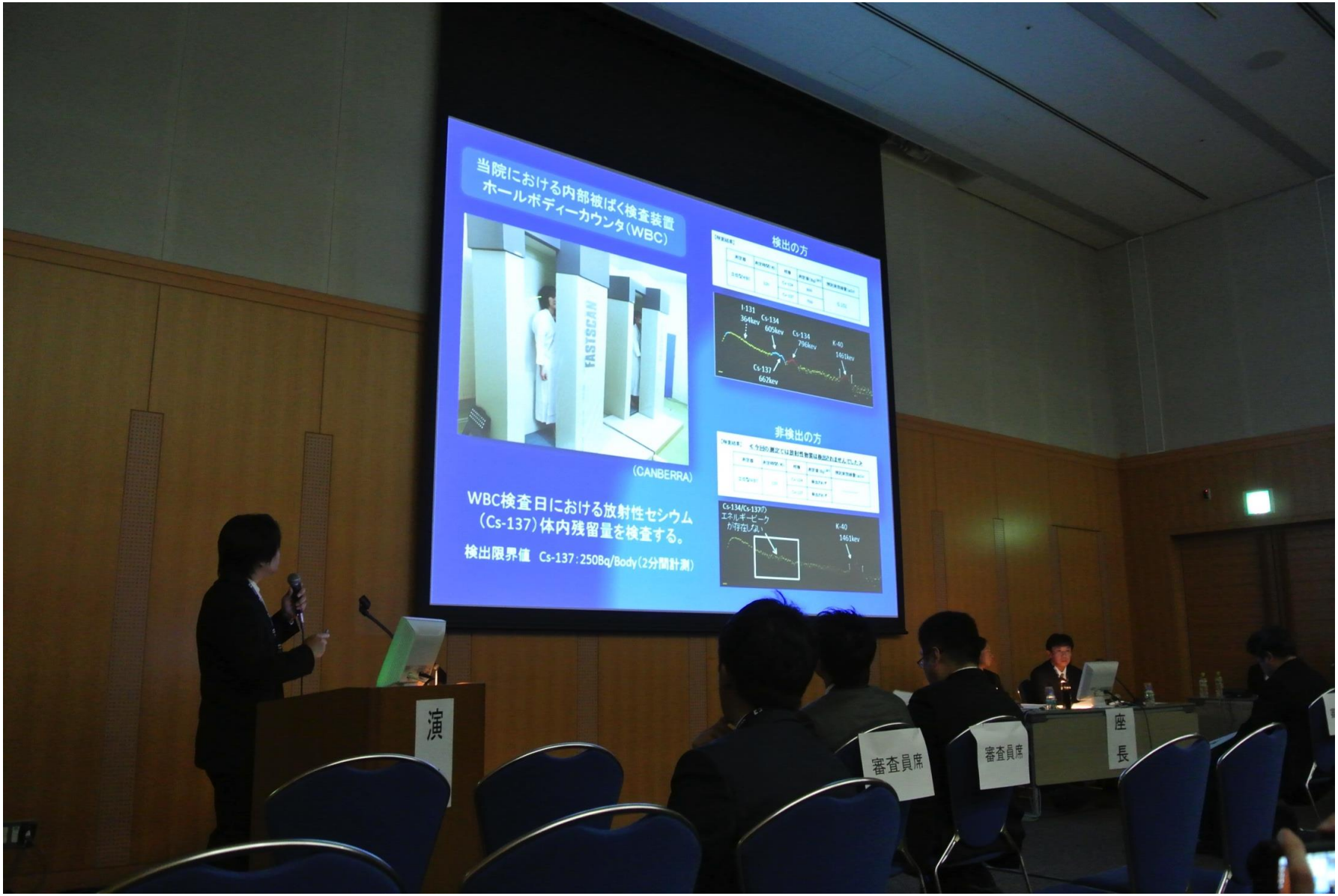
（Socially, Economically, Physically, Physiologically etc…)

It is important to share the information (e.g., the result on screening test), and to provide additional support/service.

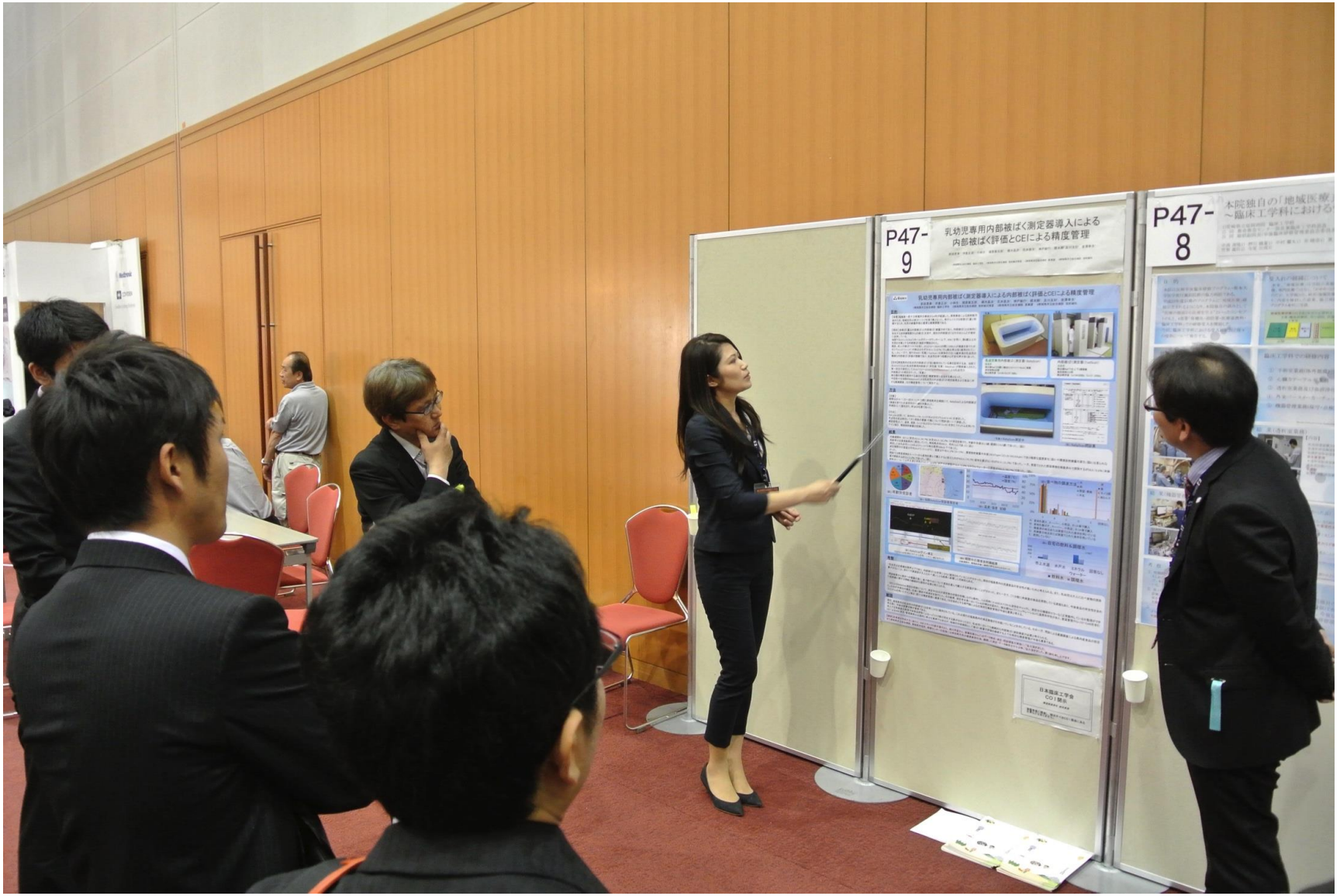
The impacts of the nuclear disaster on health are not limited to that from radiation exposure.

In Fukushima, the biggest impact is not from radiation exposure but from societal change.

スタッフによる学会発表

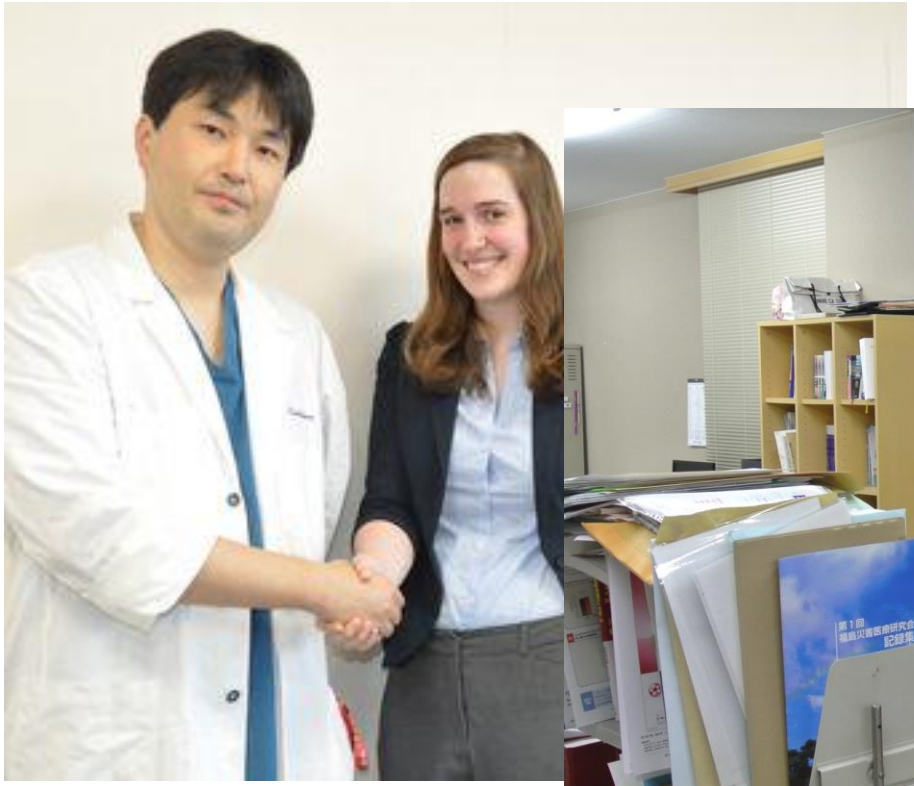


スタッフによる学会発表



初期研修医、後期研修医

南相馬に医学留学
（イギリス・エジンバラから）



中国フッタン大学とのコラボレーション

Thank you