

**Health problems after the accident  
of Fukushima Daiichi Nuclear  
Power Plant  
Outbreak of childhood thyroid  
cancer in Fukushima**

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# Purpose

➤ Study: Are 74 thyroid cancer cases in Fukushima Prefecture the outbreak of thyroid cancer or not?

➤ Background:

In Fukushima, so far, the number of thyroid cancer has admittedly risen to as many as 74 cases. Still, the Japanese government and Fukushima Prefectural authority adamantly deny the fact of its out-break. Besides, they squarely refuse to admit the existence and occurrence of any other health hazards.

What is worse, radioactive contamination is not limited within Fukushima prefecture, and cancer is not the only radiation induced health hazard. We should see this situation as a symbolic phenomenon of various health hazards that are waiting to appear from now on.

# Professor SUZUKI Shinichi said

Department of Thyroid and Endocrinology  
at Fukushima Medical University

- Concerning the discovered thyroid cancer, that it is more likely that the discovered cases of thyroid cancer are those that used to be found in later years, but that, due to the development of high accuracy medical checkups by ultrasonic devices, have been found prematurely, so to speak, and they have been formed irrespective of exposure to radiation.
- He added that the data that have been obtained by the thyroid medical checkups will form the frequency base line for the thyroid cancer of Fukushima children.

On the occasion of the 56th annual conference of Japan Thyroid Association held on November 15th, 2013,

# Patients and Study Methods

- 1. Analysis of Incidence Rate Ratio  
comparative subjects: Thyroid cancer incidence rate: National Reserch Institute of Cancer
- 2. Analysis of Prevalence Odds Ratio and 95% confident interval (Comparison of Prevalence rate in areas and zones in Fukushima Prefecture)
- 3. Comparison of Prevalence rate in Fukushima Prefecture and in Chernobyl Accident
- 1, 2 studies: cited studied data by Prof. Toshihide Tsuda (Okayama University)

# Examination of Thyroid Cancer in Fukushima Prefecture (<18 years of age)

- 1st screening: all persons < 18 years of age , 2011 year
  - Thyroid echo examination
    - Positive
    - Nodule >5.0mm or Cyst>20.0mm
    - 2nd screening
- 2nd screening: 1st screening positive
  - Thyroid echo observation、
  - Risk factor(+) → Fine needle aspiration
- Fine needle aspiration positive :
  - Observation、 some case Operation
  - Operated case and Cancer detected =Confirmed Case

# Thyroid cancer examination : 74 cases

Year	Popuration <18 years of age	1 <sup>st</sup> scleening Examined No.	1 <sup>st</sup> scleening (+)=2 <sup>nd</sup> scleening No.	2 <sup>nd</sup> scleening Determined No.	Cancer case (operation case)
2011	47,766	41,561 (87.0%)	218 (0.52%)	187 (85.8%)	14 (10)
2012	163,264	139,239 (85.3%)	986 (0.70%)	826 (83.8%)	50 (22)
2013	122,373	88,554 (72.4f%)	591 (0.64%)	329 (55.7%)	10 (1)
合計	333,403	269,354 (80.8%)	1,795 (0.67%)	1,342 (74.8%)	74(33)

2014/2/7published (collected to 2013/12/31)

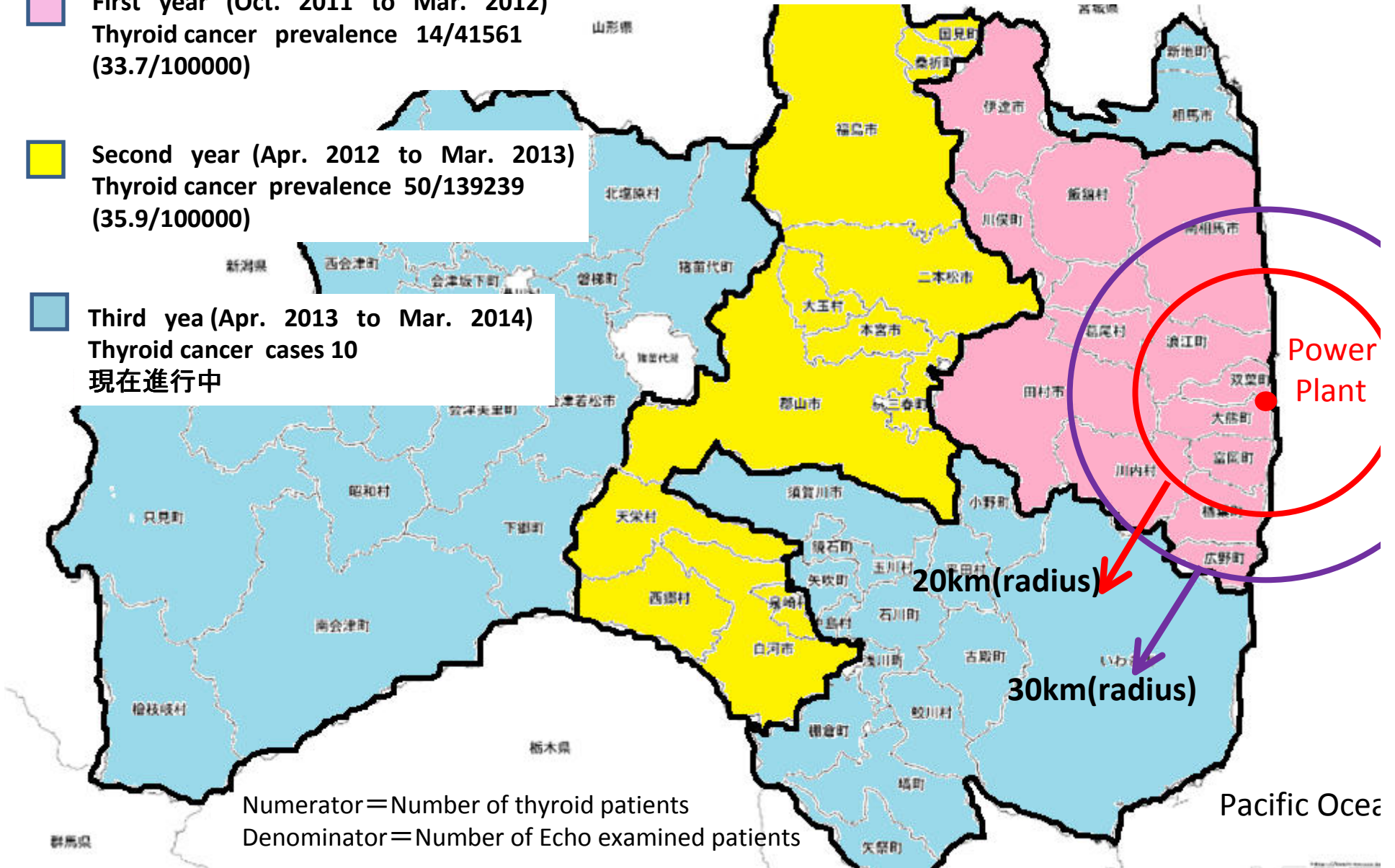
# Thyroid cancer examination in Fukushima

(As of Dec.31 2013)

**First year (Oct. 2011 to Mar. 2012)**  
 Thyroid cancer prevalence 14/41561  
 (33.7/100000)

**Second year (Apr. 2012 to Mar. 2013)**  
 Thyroid cancer prevalence 50/139239  
 (35.9/100000)

**Third year (Apr. 2013 to Mar. 2014)**  
 Thyroid cancer cases 10  
 現在進行中



Numerator = Number of thyroid patients  
 Denominator = Number of Echo examined patients

# <1> Analysis of Incidence Rate Ratio

## Methods : Comparative subjects

- Thyroid cancer incidence rate: National Research Institute of Cancer (1975-2008)
  - Average Thyroid cancer incidence rate in Japan:  
**0.5/100,000** years of age (15-19), year (1975-2008)
  - Average Thyroid cancer incidence rate in Japan:  
**1.1/100,000** years of age (15-24), year (1975-2008)
    - to make a generous estimate,  
Average Thyroid cancer incidence rate in Japan:  
0.2-0.3/100,000 years of age (0-19), year (2003-2007)
    - It doesn't matter much which value to give when the amount of data increases.
- Fukushima prefecture is published the data by every 3 month.
  - This analyses are based on the data made public on Feb.7 2014



# <1> Analysis of Incidence Rate Ratio

## Methods: Adjustment and Estimation

- Prevalence  $\doteq$  Incidence rate  $\times$  Average Duration of the Disease
  - In this study, Average Duration of the Disease:
  - Period from the day when thyroid cancer becomes detectable by medical checkups and FNA to the day when the thyroid cancer becomes detectable by conventional clinical environment without detailed medical checkups.
- Sensitivity analysis: plural prevalence periods (year).
- Estimation of 95% confident interval:  
Poisson distribution

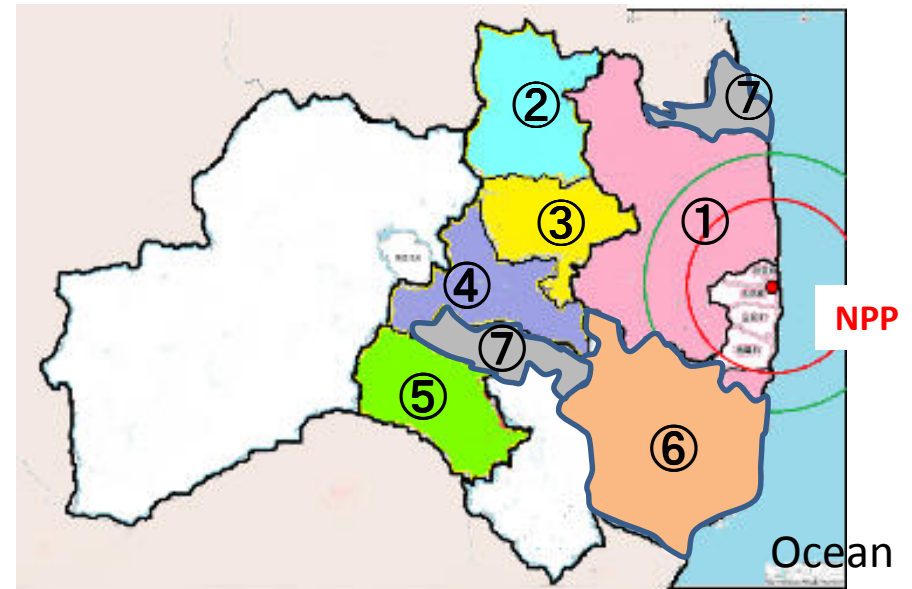
The year 2011 ①  
 The year 2012=  
 4 areas in Central Zone in Fukushima  
 Prefecture

② ③ ④ ⑤

The year 2013  
 = South East and North East area

⑥

⑦ 4 cities and town other than Iwaki,  
 2nd screening examined rate > 80%



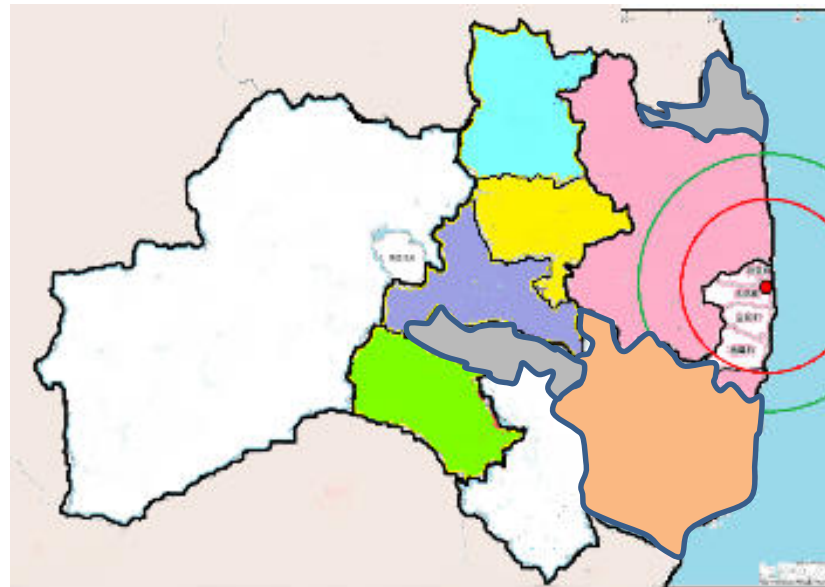
area	Population	1 <sup>st</sup> screening Examinede No.	2 <sup>nd</sup> screening Subject No.	2 <sup>nd</sup> screening Determined No.	Cancer cases
①Near NPP (first year)	47,766	41,561	218	187	14(10)
②North: Fukushima (second year)	57,467	50,246	302	269	12
③Central: Nihonmatsu (second year)	20,889	17,776	105	91	11
④Koriyama (second year)	65,586	54,120	472	374	21
⑤South: Shirakawa (second year)	18,980	16,756	105	90	6
⑥Iwaki (third year)	62,176	46,201	381	221	8
⑦East (other than Iwaki) (third year)	26,775	18,471	136	108	2

# Analysis of Incidence

## Rate Ratio

(Average Duration of the Disease : 2 years)

\*IRR (Incidence Rate Ratio)  
(95% confident interval)



Comparative subjects: Average Thyroid cancer incidence rate in Japan

area	0.5/100,000		1.1/100,000	
	IRR*	(95% C.I.) *	IRR*	(95% C.I.) *
①Near NPP (first year)	33.69	(19.49-56.19)	15.31	(8.86-25.54)
②North: Fukushima (second year)	23.88	(13.31-41.49)	10.86	(6.05-18.86)
③Central: Nihonmatsu (second year)	61.88	(32.38-111.46)	28.13	(14.72-50.67)
④Koriyama ( second year)	38.80	(24.55-59.71)	17.64	(11.16-27.14)
⑤South: Shirakawa (second year)	35.81	(15.59-79.29)	16.28	(7.09-36.04)
⑥Iwaki (third year)	17.32	(8.15-34.24)	7.87	(3.70-15.56)
⑦East (other than Iwaki) (third year)**	10.83	(1.92-39.49)	4.92	(0.87-17.95)

\*\*2nd scleening examined rate > 80%

partial reversion of data analysed by Dr.Tsuda

# Analysis of Incidence Rate Ratio

(Average Duration of the Disease : 4 years)

\*IRR (Incidence Rate Ratio)  
(95% confident interval)



Comparative subjects: Average Thyroid cancer incidence rate in Japan

area	0.5/100,000		1.1/100,000	
	IRR*	(95% C.I.) *	IRR*	(95% C.I.) *
①Near NPP (first year)	16.84	(9.75-28.09)	7.66	(4.43-12.77)
②North: Fukushima (second year)	11.94	(6.65-20.75)	5.43	(3.02-9.43)
③Central: Nihonmatsu (second year)	30.94	(16.19-55.73)	14.06	(7.36-25.33)
④Koriyama ( second year)	19.40	(12.27-29.85)	8.82	(5.58-13.57)
⑤South: Shirakawa (second year)	17.90	(7.80-39.65)	8.14	(3.54-18.02)
⑥Iwaki (third year)	8.66	(4.07-17.12)	3.94	(1.85-7.78)
⑦East (other than Iwaki) (third year)**	5.41	(0.96-19.75)	2.46	(0.44-8.98)

\*\*2nd screening examined rate > 80%

partial reversion of data analysed by Dr.Tsuda

# Analysis of Incidence Rate

## Ratio

(Average Duration of the Disease : 6 years)

\*IRR (Incidence Rate Ratio)  
(95% confident interval)



Comparative subjects: Average Thyroid cancer incidence rate in Japan

area	0.5/100,000		1.1/100,000	
	IRR*	(95% C.I.) *	IRR*	(95% C.I.) *
①Near NPP (first year)	11.23	(6.50-18.73)	5.10	(2.95-8.51)
②North: Fukushima (second year)	7.96	(4.44-13.83)	3.62	(2.02-6.29)
③Central: Nihonmatsu (second year)	20.63	(10.79-37.15)	9.38	(4.91-16.89)
④Koriyama ( second year)	12.93	(8.18-19.90)	5.88	(3.72-9.05)
⑤South: Shirakawa (second year)	11.94	(5.20-26.43)	5.43	(2.36-12.01)
⑥Iwaki (third year)	5.77	(2.72-11.41)	2.62	(1.23-5.19)
⑦East (other than Iwaki) (third year)**	3.61	(0.64-13.16)	1.64	(0.29-5.98)

\*\*2nd scleening examined rate > 80%

partial reversion of data analysed by Dr.Tsuda

# Analysis of Incidence Rate Result

- Incidence rate is clearly high !
- In 2012, Nihonmatsu City, Motomiya city –Central area in Central Zone(Nakadoori) >>  
In 2011, City and Town, Village near NPP
- Koriyama City, South area of Central Zone >>  
In 2011, City and Town, Village near NPP
- continued、  
2011 year area > Central Zone North area、  
Iwaki City、  
2013 year area other than Iwaki City  
2nd screening determined Subject > 80%

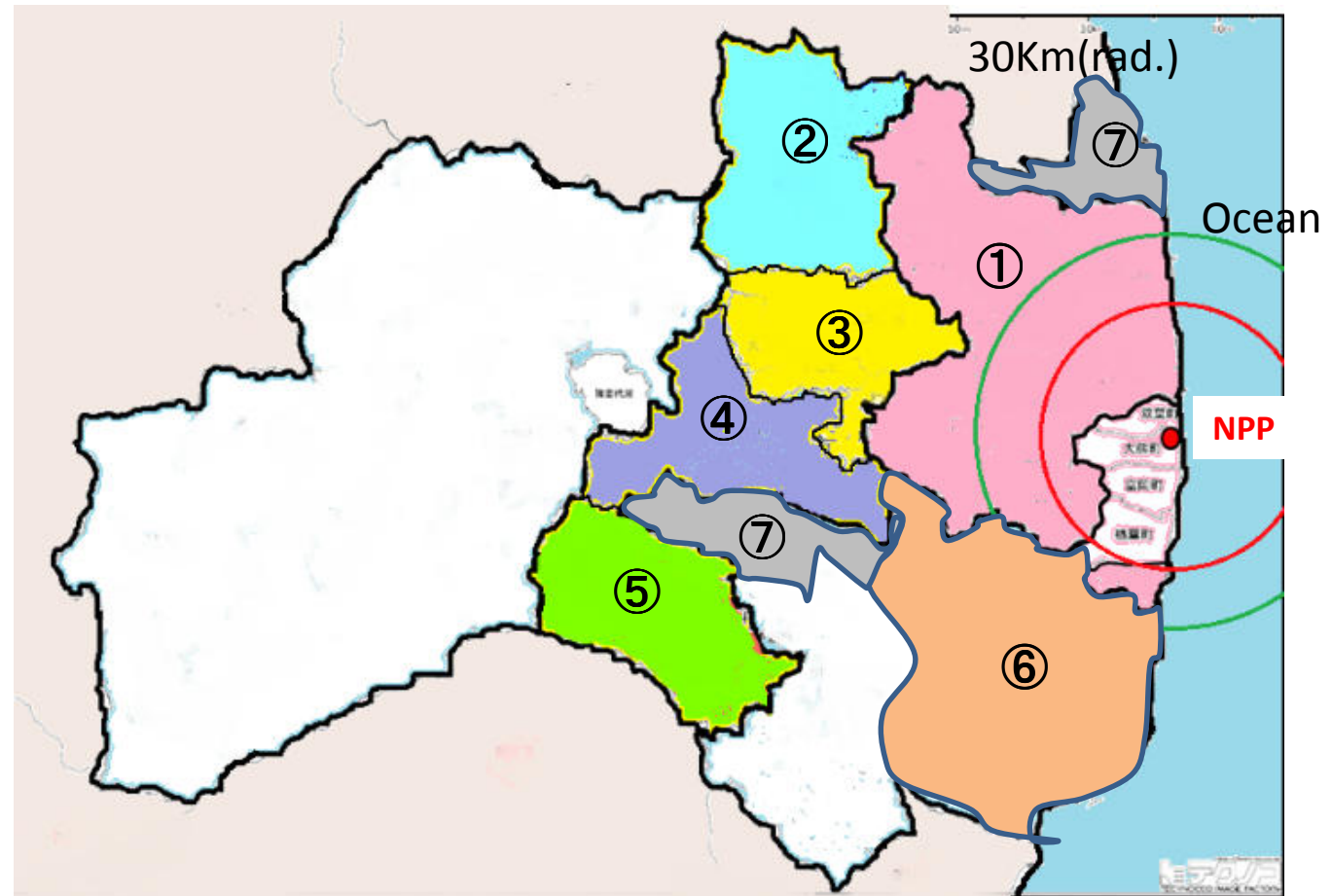
## <2> Analysis of Prevalence Odds Ratio (Comparison of Prevalence rate in areas and zones in Fukushima Prefecture)

- Estimation of Prevalence Odds Ratio and 95% confident interval
- Control area: “2013 year area other than Iwaki City ”  
AND “2nd screening determined Subject > 80% ”  
Prevalence (Sukagawa city, Sooma city, Kagamiishi city,  
Shinchi town)
- Comparative subjects:6 areas  
The year 2011=Near the Power Plant  
The year 2012=4 areas in Central Zone in Fukushima  
Prefecture  
The year 2013=Iwaki city

# Analysis of Prevalence Odds Ratio

(Comparison of Prevalence rate in areas and zones in Fukushima Prefecture)

area	Cancer cases
①Near NPP (first year)	14(10)
②North Fukushima (second year)	12
③Central Nihonmatsu (second year)	11
④Koriyama (second year)	21
⑤south Shirakawa (second year)	6
⑥Iwaki (third year)	8





# Analysis of Prevalence Odds Ratio (control area\*\*)

(Prevalence Odds Ratio)\*  
(95% confident interval)



area	がん 症例数	一次検診 受診者数	POR*	(95% C.I.)*
①Near NPP (first year)	14	41,561	3.11	(0.81-20.22)
②North Fukushima (second year)	12	50,246	2.21	(0.58-14.53)
③Central Nihonmatsu (second year)	11	17,776	5.72	(1.42-37.98)
④Koriyama (second year)	21	54,120	3.58	(0.98-22.66)
⑤south Shirakawa (second year)	6	16,756	3.31	(0.70-23.82)
⑥Iwaki (third year)	8	46,201	1.60	(0.37-11.03)
⑦Control (third year) **	2	18,471	1	

\*\*2nd screening examined rate > 80%

partial reversion of data analysed by Dr.Tsuda

# Analysis of Prevalence Odds Ratio

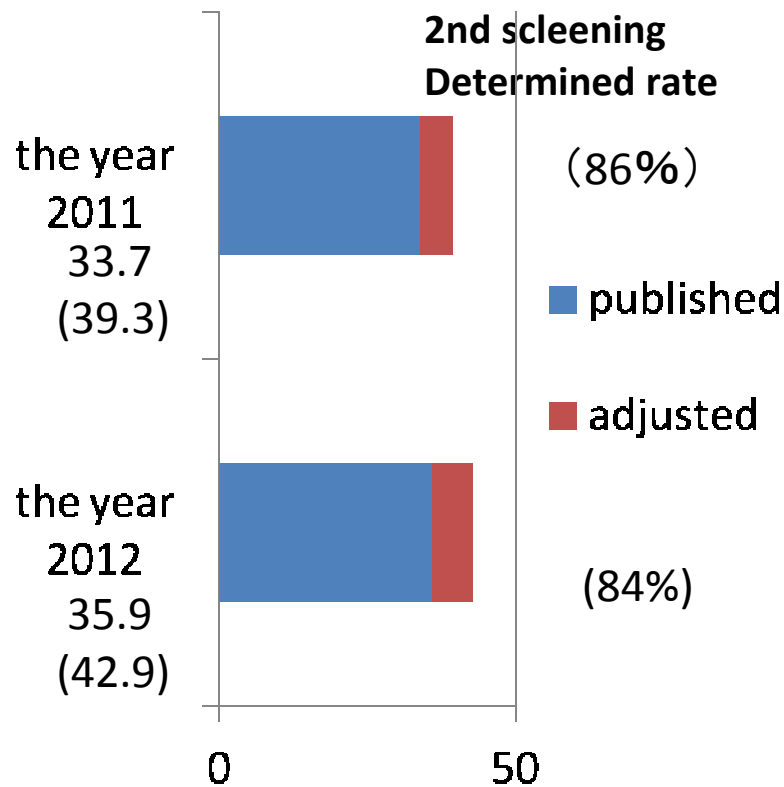
(Comparison of Prevalence rate in areas and zones  
in Fukushima Prefecture)

## Result

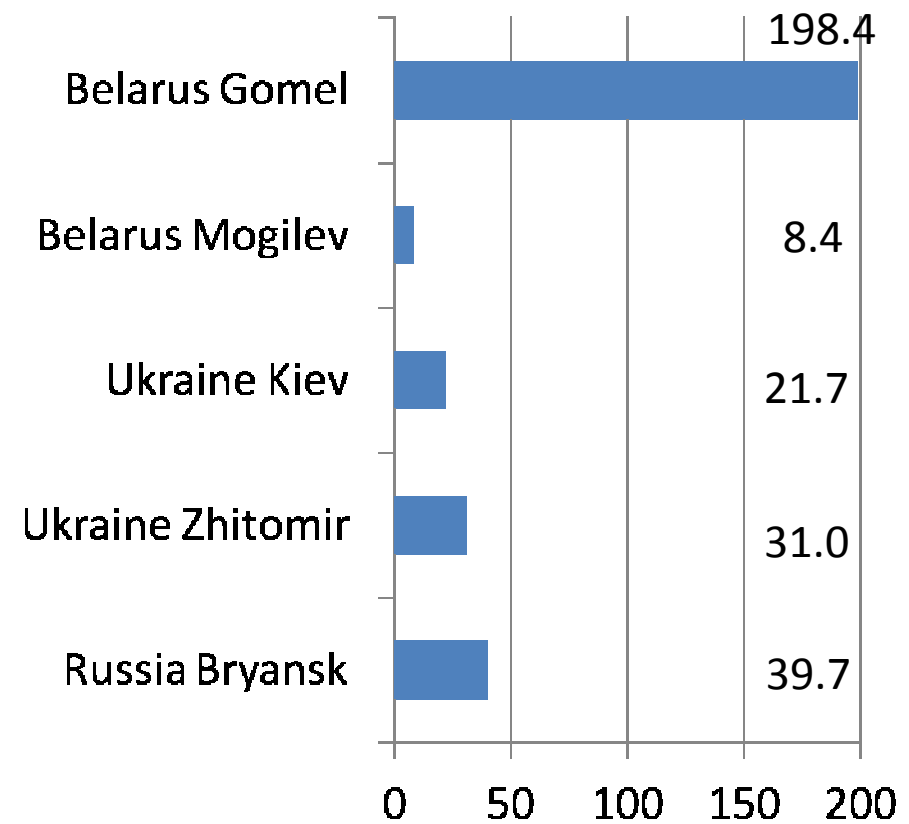
- Prevalence Odds Ratio is obviously high.
- Clear rise in Prevalence Odds Ratio that is supposed to run in accordance with the average distance from NPP and exposed dose of radiation, in the Central Zone(NakaDoori).
- In an estimation of grade of outbreak of thyroid cancer, Screening effect can not be excluded.

# <3> Comparison of Prevalence rate in Fukushima Prefecture and in Chernobyl Accident

Prevalence rate in Fukushima (/100,000)



Prevalence rate in Chernobyl Accident Echo-screening by Yamashita et.al. (1991-1996) (/100,000)



# Conclusion

- Incidence Rate Ratio of thyroid cancer in Fukushima Prefecture is obviously high comparison with average incidence rate in Japan.
- Prevalence Odds Ratio (Comparison of Prevalence rate in areas and zones in Fukushima Prefecture) is clearly high.
- Prevalence rate in Fukushima Prefecture is comparable to prevalence rate in some areas in Chernobyl after the accident.
- Incidence Rate of thyroid cancer in Fukushima Prefecture is definitely high, there is no reason that clear and real outbreak of thyroid cancer will not occur.
- Above-mentioned studies offers that an explanation for the outbreak of thyroid cancer in Fukushima Prefecture is provided by screening effect.

# Acknowledgment

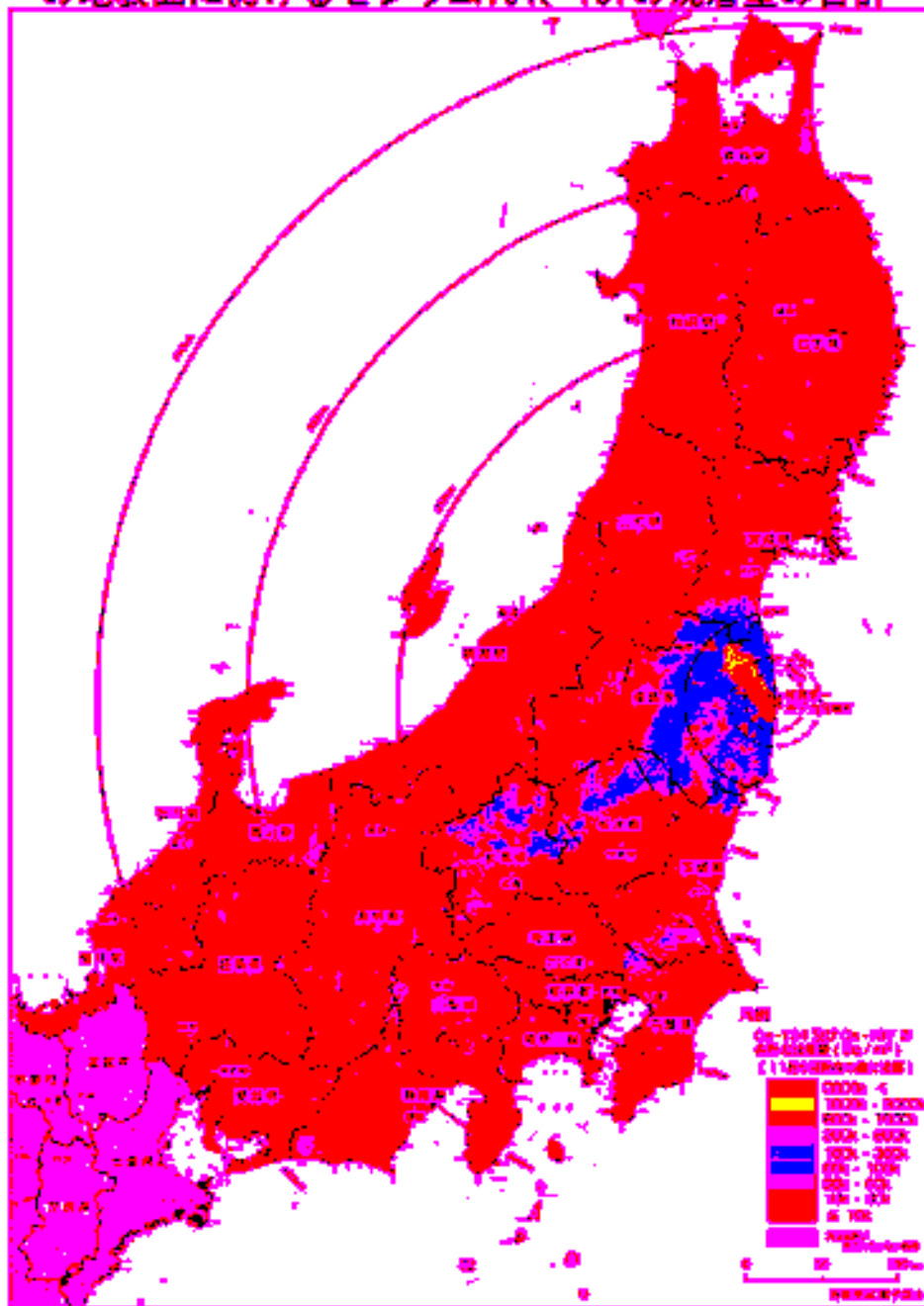
- I thank Dr. Toshihide Tsuda, Department of Environmental life science at Okayama University for epidemiological and statistical analysis.

## Joint Study Researchers

- Dr. N. Irie, Dr. M. Ijuuin, Dr. N. Umeda,  
K. Kawasaki, Dr. S. Muro, Dr. K. Mori,  
Dr. H. Yamamoto, Dr. K. Hayashi

# Reference

(参考2)  
第4次航空機モニタリングの測定結果を反映した東日本全域  
の地表面におけるセシウム134、137の沈着量の合計



- 群馬県、栃木県-  
北半分, 埼玉県と  
東京都の  
一部
- 茨城県の南部と北部,  
千葉県の北部
- 宮城県の南部と北部,  
岩手県や新潟  
県の一部

被曝線量である40,000Bq/m<sup>2</sup>を超える  
汚染地帯=「放射線管理区域」  
面積は、20,000平方Kmにもおよび、  
約1000万人の人々が該当

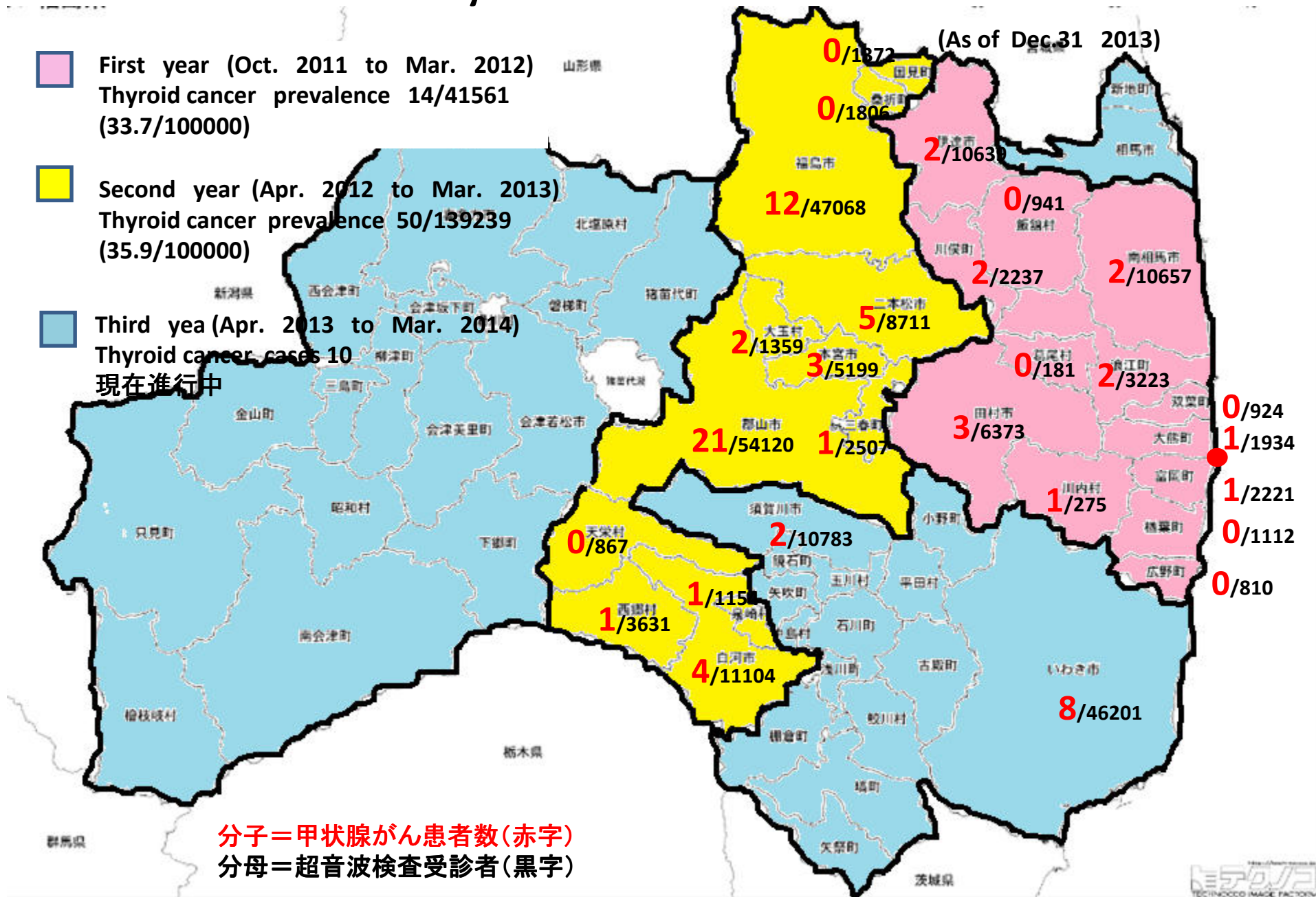
# Childhood Thyroid cancer Prevalence in Fukushima

(As of Dec.31 2013)

**First year (Oct. 2011 to Mar. 2012)**  
 Thyroid cancer prevalence 14/41561  
 (33.7/100000)

**Second year (Apr. 2012 to Mar. 2013)**  
 Thyroid cancer prevalence 50/139239  
 (35.9/100000)

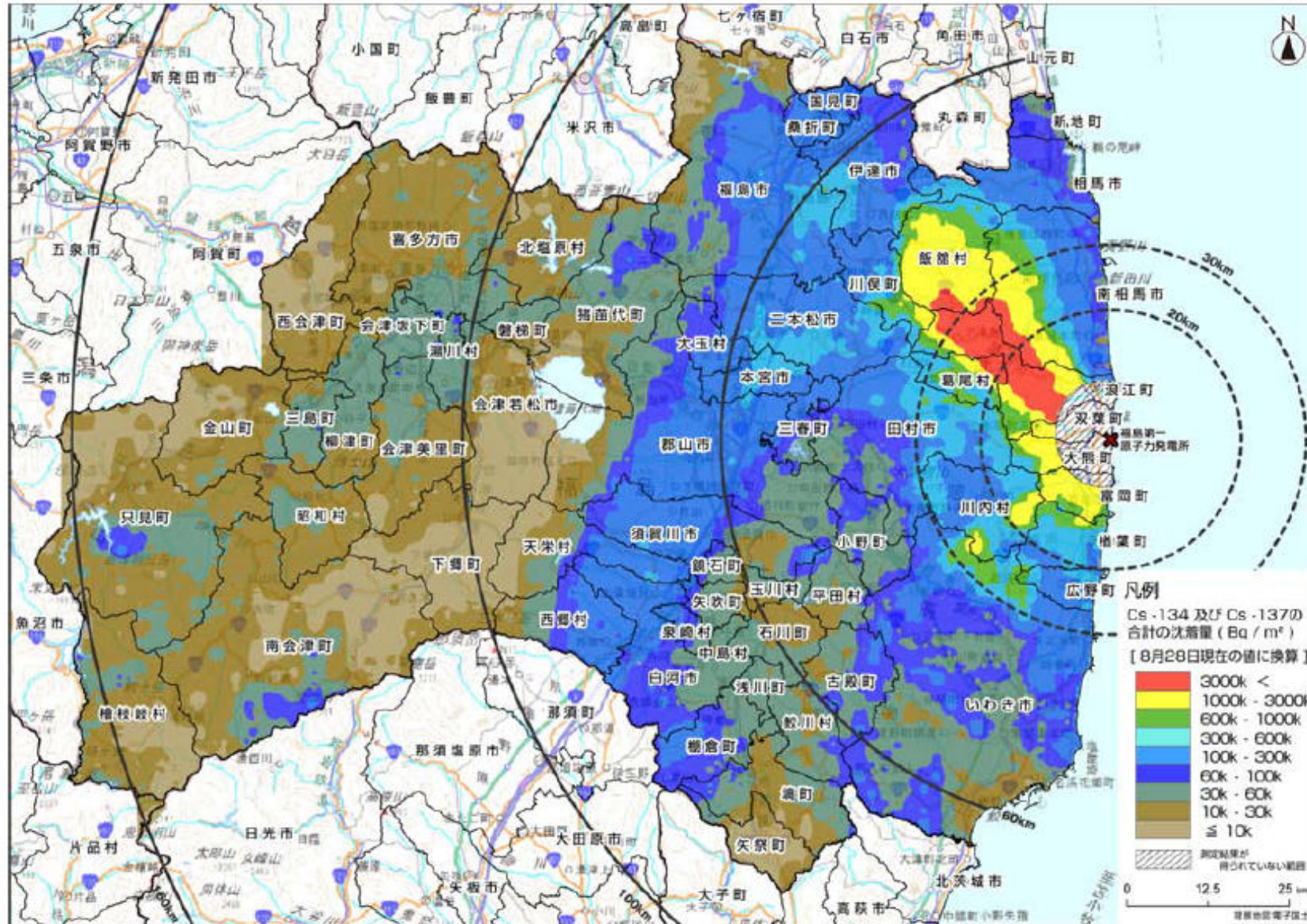
**Third year (Apr. 2013 to Mar. 2014)**  
 Thyroid cancer cases 10  
 現在進行中



分子=甲状腺がん患者数(赤字)  
 分母=超音波検査受診者(黒字)



# 航空機モニタリング-Cs134,137

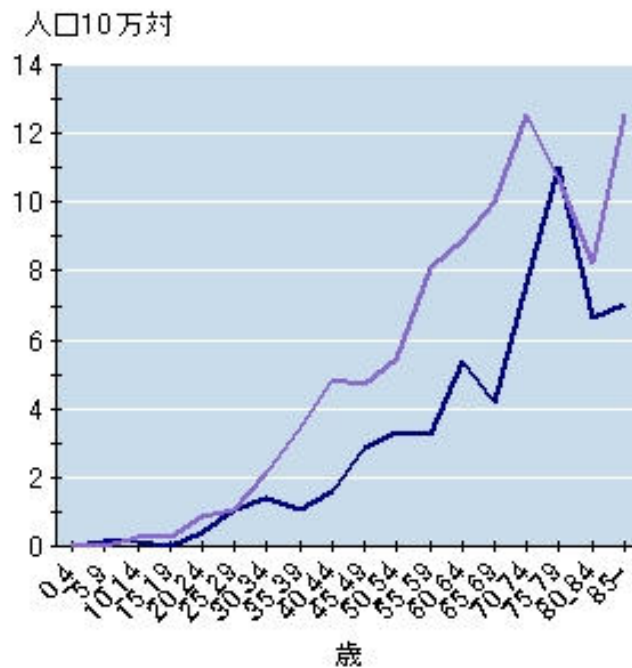


文部科学省による福島県西部の航空機モニタリングの測定結果について  
(福島県内の地表面へのセシウム134、137の沈着量の合計)

# 甲状腺がん罹患率(対人口10万人比・人数)

(2008年、独立行政法人国立がん研究センターがん対策情報センター)

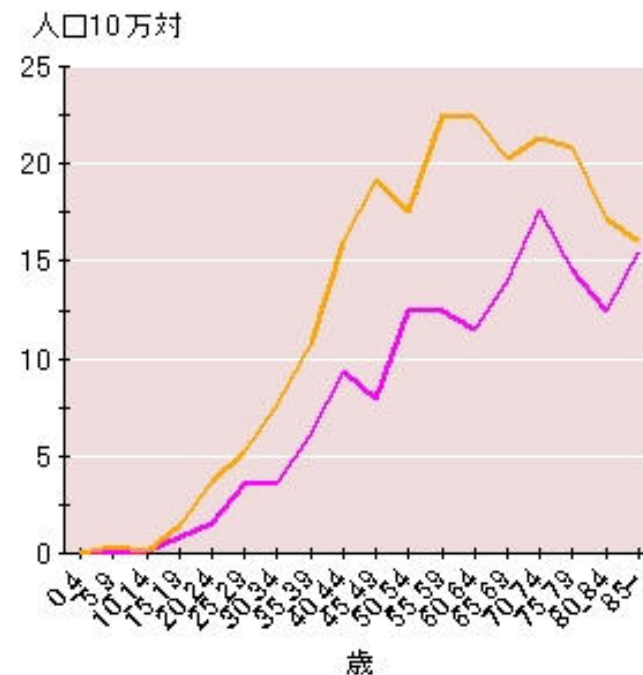
年齢階級別罹患率複数年  
(男性)  
[甲状腺 複数年]



— 1985 — 2008

資料: 独立行政法人国立がん研究センターがん対策情報センター  
Source: Center for Cancer Control and Information Services,  
National Cancer Center, Japan

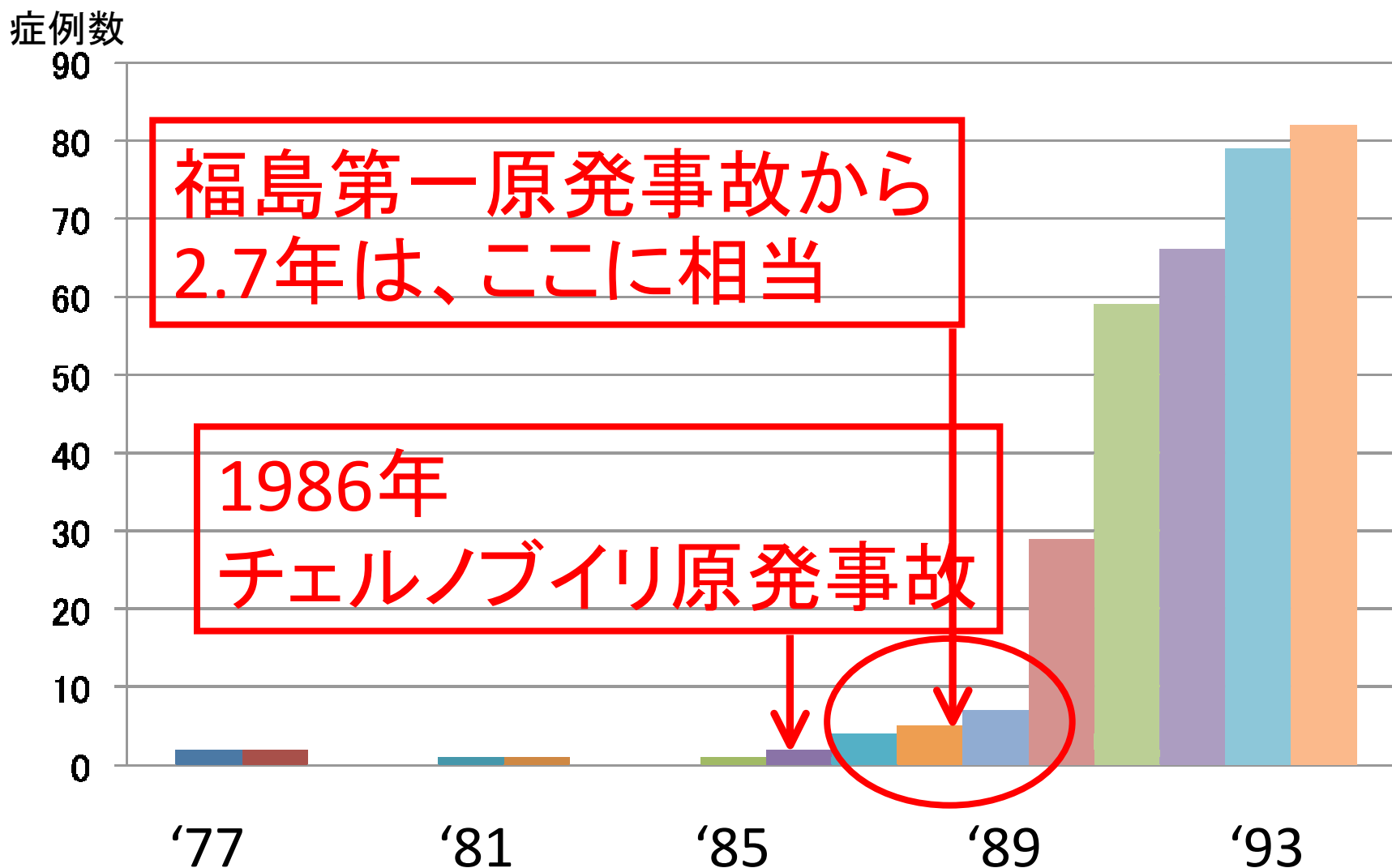
年齢階級別罹患率複数年  
(女性)  
[甲状腺 複数年]



— 1985 — 2008

資料: 独立行政法人国立がん研究センターがん対策情報センター  
Source: Center for Cancer Control and Information Services,  
National Cancer Center, Japan

# 甲状腺がんの流行曲線・チェルノブイリ(ベラルーシ:14歳以下)



# 表5チェルノブイリの非曝露集団等における集団検診データ

研究名	事故時年齢	調査時期	調査時年齢	調査地域	調査人数	発見数
Belarus Screening Program*1	胎児でもない	2002	14歳以下	Gomel	25,446人 (方法不明)	0人
Shibata *2	胎児でもない	1998-2000	8-13歳	Gomel	9,472人 (超音波)	0人
Ito*3	0-10歳	1993-1994	7-18歳	Mogilev	12,285人 (超音波)	0人
Ito*3	0-10歳	1993-1994	7-18歳	Bryanks	12,147人 (超音波)	0人
Ito*3	0-10歳	1993-1994	7-18歳	Zhitomir	11,095人 (超音波)	1人
合計					70,445人	1人

\*1:Demidchik YE: Childhood thyroid cancer in Belarus, Russia and Ukraine after Chernobyl and at present.

Arq Bras Endocrinol Metab 2007; 51: 748-762.

林敬次医師作成、津田改変

\*2:Shibata Y et al: 15 years after Chernobyl: new evidence of thyroid cancer. Lancet 2001; 358: 1956-1966.

\*3: Ito M et al: Childhood thyroid disease around Chernobyl evaluated by ultrasound examination and fine needle aspiration cytology. Thyroid 1995; 5: 365-368.