Endocrine Diseases in Post-Chernobyl Period in Belarus

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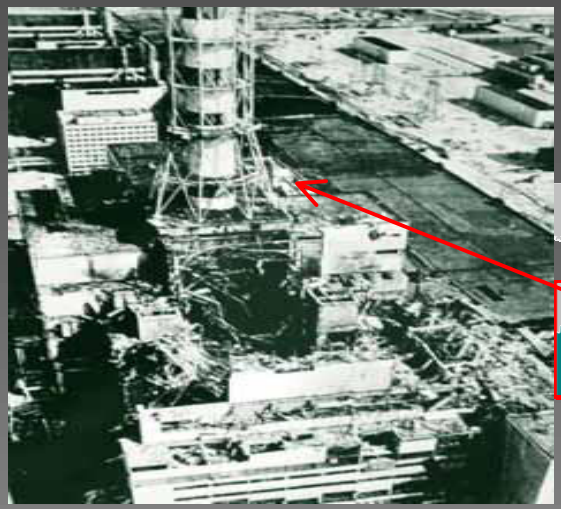
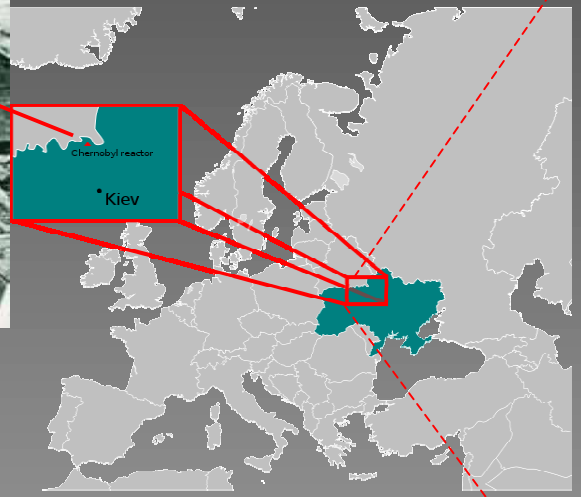
26 April 1986
The accident at the Chernobyl nuclear power plant





Radioactive substance release - 13 EBq:
^{131}I - 1.8 Ebq
^{137}Cs - 0.085 Ebq
^{90}Sr - 0.01 Ebq
Pu isotopes - 0.003 EBq

More than 200 000 sq km
of Europe were contaminated
with > 37 kBq/sq m of ^{137}Cs

Over 70 % of this area was in the three most affected countries,
Belarus, Russia and Ukraine.

The Chernobyl Forum: 2003-2005, IAEA

- The accident at the No. 4 reactor of the Chernobyl Power Station took place on April 26,1986, at 1:23 AM.
- Two explosions occurred, the first due to steam and a second one due to hydrogen. The explosions expelled fission products and fuel elements to the exterior that accumulated in a cloud reaching to approximately 7,000 m and centered at approximately 4,500 m.
- Because the graphite ignited, there was a second, more prolonged but less intense, release over a 9- to l0 day period that peaked on May 6,1986, and dropped sharply on May 11 as the fire was extinguished. The following volatile elements, as well as the noble gases xenon and krypton, constituted the most abundant released material: Iodine, cesium, and tellurium.

INTRODUCTION

- **Republic of Belarus belongs to European countries with predominantly light and moderate chronic iodine deficiency**
- **The State Program of iodine prophylaxis with iodinated salt or KI tablets was stopped in the end of 70-s yrs. and restored - during 1998-2000 yrs. (12 yrs. after the Chernobyl catastrophe);**

- ***There were no organized prophylaxis with stable iodine among the population during first hours/days/ weeks of the Chernobyl catastrophe*;**

- **Starting a week after the Accident and then - during all summer months in 1986yr. there was spontaneous individual intake of iodine solutions in different doses by different age group of population**
- **Side effects:**
  - ***Rashes***
  - ***very firm thyroid gland, autoimmune thyroiditis***
  - ***Wolf-Chaickoff effects***

Iodide Prophylaxis in Poland After the Chernobyl Reactor Accident: Benefits and Risks

J. NAUMAN, J. WOLFF//American J Medicine.1992 - V.94: 524-532.

In Poland, decided to adopt the very conservative dose commitment - increased air radioactivity was first detected on the of 50 mSv as the intervention level for children.

The commission on the morning of April 29: Whole body committed dose should not exceed 5 mSv/y (0.5 rem). Thyroid committed dose should not exceed 50 and amounted to 504 Bq of radioiodines /m3 air with 1.55- to 3.0~times higher values in northeast Poland. **Approximately 18 million doses of KI solution were sources distributed;**

"95.3% of children received iodide prophylaxis;

86.7% took a single dose,

2.39% took two or more doses,

and a surprising 6.14% were given diluted tincture of iodine by their parents before the start of the program and then took a single dose of KI"

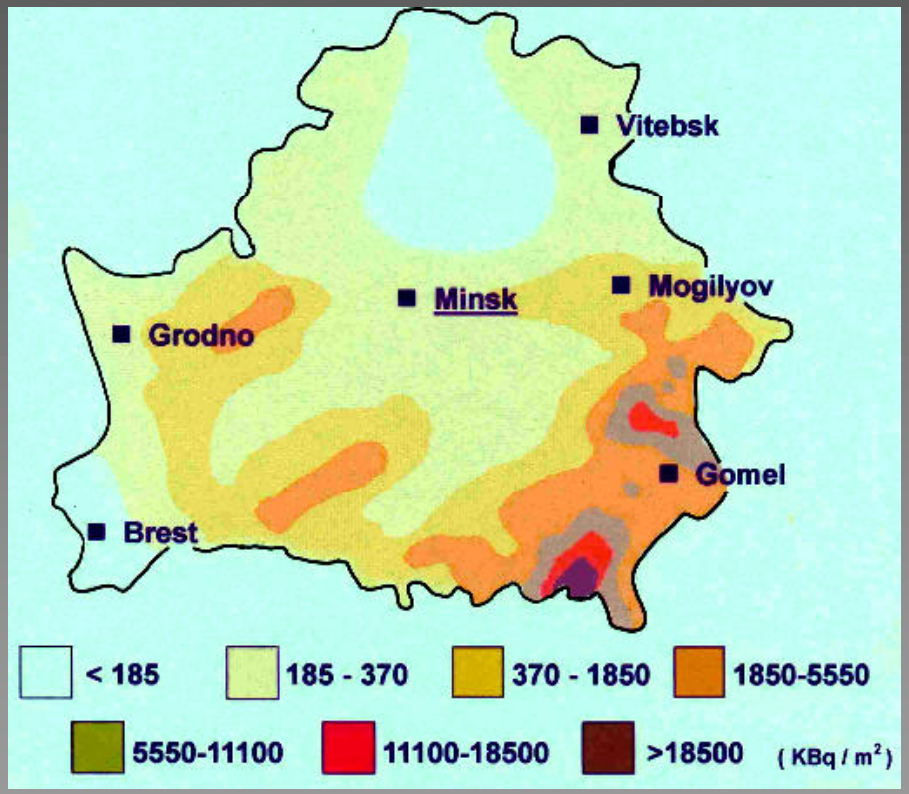
Approximately 10.5 million children 16 years old and under, and approximately 7 million adults received iodide

prophylaxis in Poland

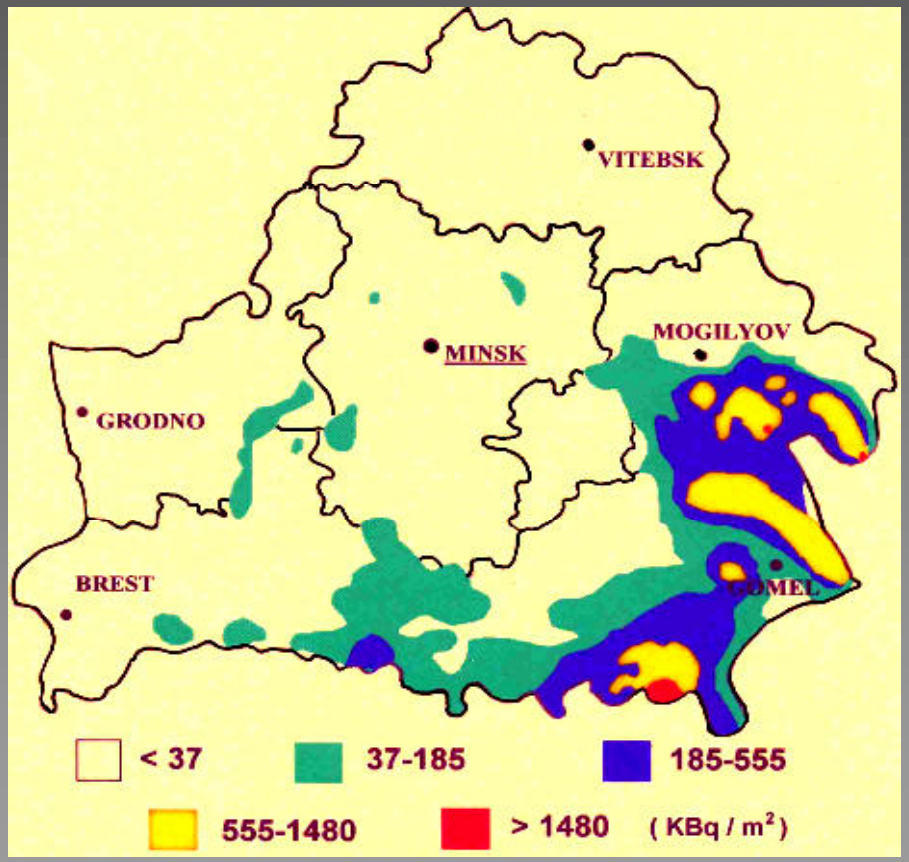
IODIDE PROPHYLAXIS IN POLAND AFTER THE CHERNOBYL REACTOR ACCIDENT: BENEFITS AND RISKS

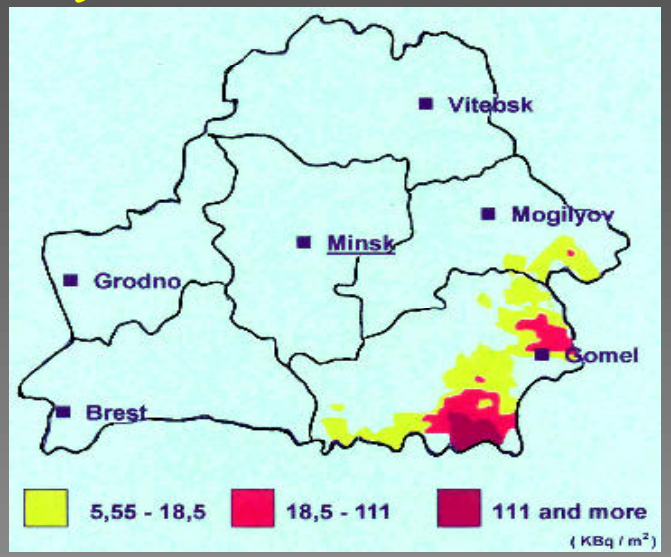
J. NAUMAN, J. WOLFF//AMERICAN J MEDICINE.1992 - V.94: 524-532.

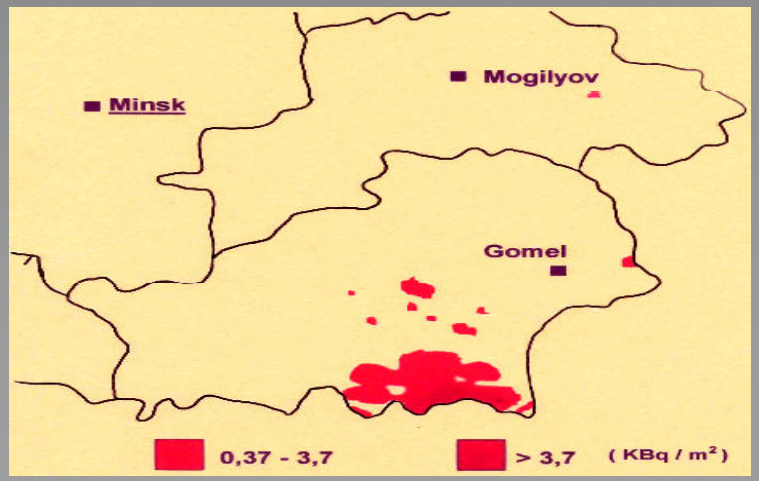
Distribution of Iodine-131 in the Soil
(May 10, 1986)



Belarusian territory: contamination with Cesium-137, Strontium-90 and Plutonium-238, 239, 240 *(January 1, 1995)*







Effect of chronic iodine deficiency and stable iodine consumption

Table 4. Estimated risk of developing thyroid cancer after a radiation dose of 1 Gy, by level of soil iodine in the settlement of residence at the time of the accident and by potassium iodide (i.e., antistrumin) consumption status (analyses restricted to subjects with radiation doses to the thyroid of less than 2 Gy)*

	OR at 1 Gy (95% CI)	
Consumption of potassium iodide	Highest two tertiles of soil iodine	Lowest tertile of soil iodine
No	3.5 (1.8 to 7.0)	10.8 (5.6 to 20.8)
Yes	1.1 (0.3 to 3.6)	3.3 (1.0 to 10.6)

*Levels of iodine in soil in settlement of residence at time of accident were divided into tertiles. OR = odds ratio at 1 Gy compared with no exposure; CI = confidence interval.

Cardis 2005

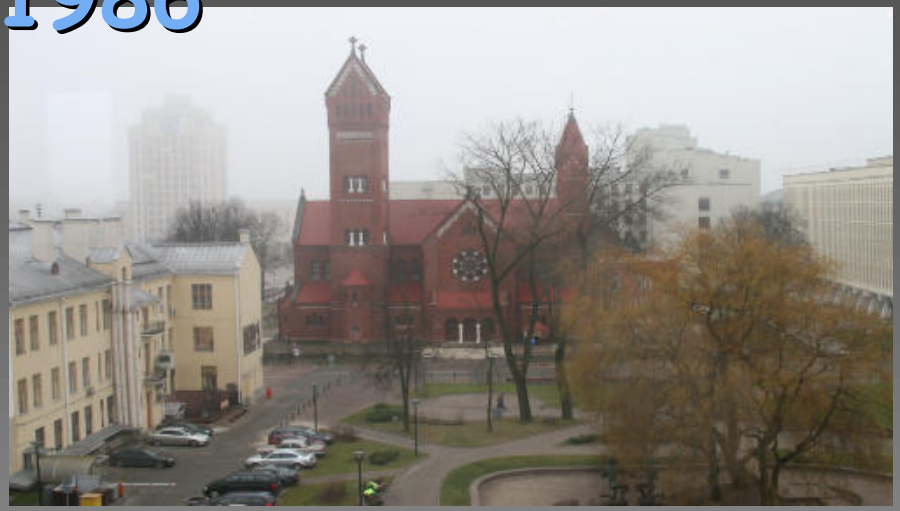
Exposure to ionizing radiation is the only established risk factor of thyroid cancer in early childhood

Cardis E, Kesminiene A, Ivanov V, Malakhova I, Shibata Y, Khrouch V, et al. Risk of thyroid cancer after exposure to 131I in childhood. J Natl Cancer Inst 2005;97:724–32.

Tab. 2. Excess relative risk for thyroid carcinoma. Comparing Chernobyl to external radiation, and comparing the effect of iodine intake on the risk (5)

	Chernobyl overall	External radiation	Chernobyl high iodine	Chernobyl low iodine	Chernobyl high I + KI	Chernobyl low I + Kl
ERR	4,5-7,4	7,7	2,5	9,8	0,1	2,3

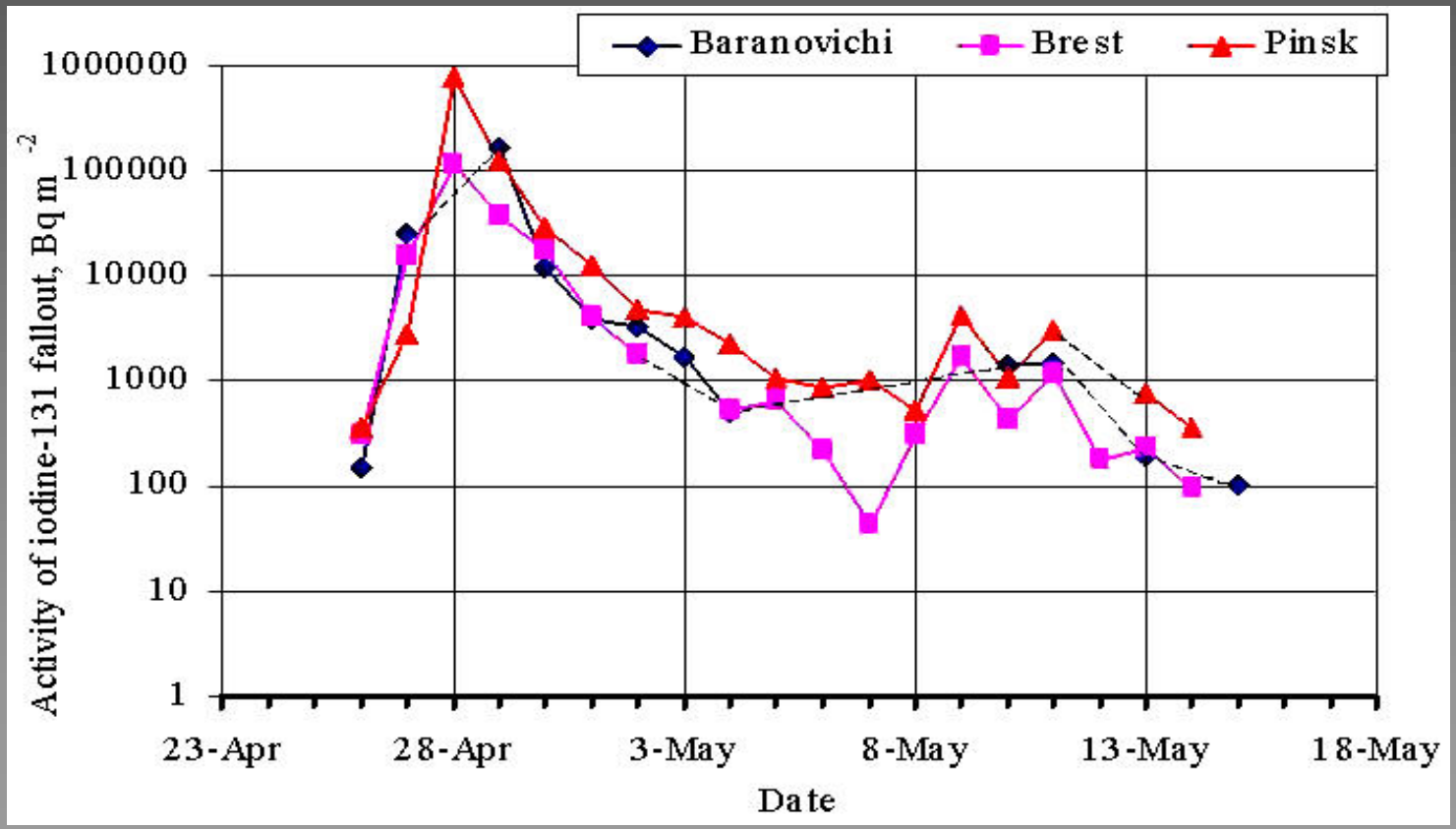
Screening for Chernobyl-associated disorders in Belarusian population started in May 1986



Screening data of thyroid nodules and thyroid cancer in Belarus after the Chernobyl accident

Screening programs	Year of screening	N of subjects	Diseases			
			Thyroid nodes		Thyroid carcinoma	
			n	%	n	%
ICP, IAEA (Mettler et al, 1992)	1990	323	4	1,24	-	-
Screening program of Research Institute of Radiation Medicine, Choiniki, Gomel oblast, Belarus (Drozd et al., 1993, Drozd et al., 2002)	1990-1991 1993	1132 1546	14 32	1,24 2,1	7 5	0,62 0,3
IPHECA, WHO (Technical repot,1996)	1993-1994	14000	210	1,5	32	0,22
Chernobyl Sasakawa Project. Sasakawa Memorial Health Foundation (Yamashita, 1999) **Mogilev oblast** **Gomel oblast**	**1990-2000**	 **13868** **19790**	 **24** **350**	 **0,1** **1,7**	 **2** **38**	 **0,008** **0,19**
A Cohort study of Thyroid cancer and thyroid diseases after the Chernobyl Accident. Chernobyl disease study group of Belarus and USA Ostapenko et al.,2001 Stezhko V. et al. 2004	1996-2001 2004	 **11200** **25 161**	 **694** **n/I**	 **6,2** **n/i**	 **53** **100**	 **0,47** **0,4**
Screening project of Red Cross (Brest oblast) (unpublished data)	**1998-2008**	**164175**	**23693**	**14,4**	**499**	**0,3**

Dynamics of the measured daily Deposition Density of 131I in the Cities of Brest Oblast



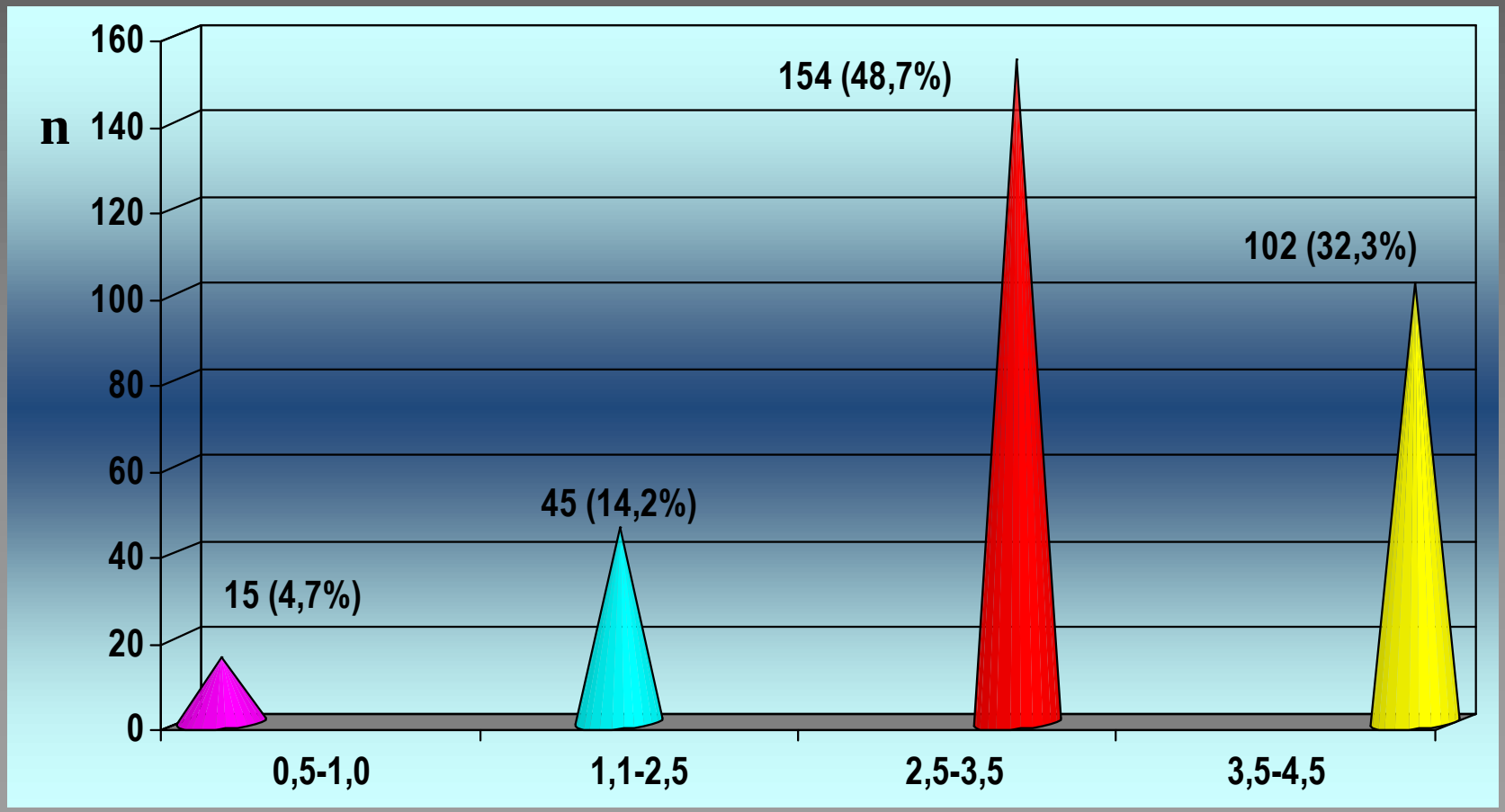
Yu. Gavrilin, S. Shinkarev, A. Bouville, M. Germenchuk, M. Hoshi, N. Luckyanov, P. Voilleque, O. Zhukova «Retrospective Assessment Of Thyroid Doses For The Residents Of Brest Oblast Of Belarus» ,2004

Screening in Stolin Brest region (1996-2008)

- In 2000-2011 active screening for thyroid diseases was performed in women of reproductive age in Minsk and Brest regions
  - Percentage of women with individual levels of TSH between 2.5-3.5 mIU/l was 48.7%, 3.5-4.5 mIU/l – 9.4%, > 4.5 mIU/l – 8.2%
  - Ultrasound abnormalities of thyroid gland were revealed in 44.6% examined women(among them – 23.4% were TPO-Ab positive)
- 2000-2002 fT4 and TSH-screening in pregnant women revealed non optimal distribution of individual levels during first 9 weeks of pregnancy
- Next fT4 and TSH-screening was performed in pregnant women (9 weeks of pregnancy) in 2009-2011 yrs

Distribution of the cases of different TSH levels in women during first 9 weeks of pregnancy (2000-2002)

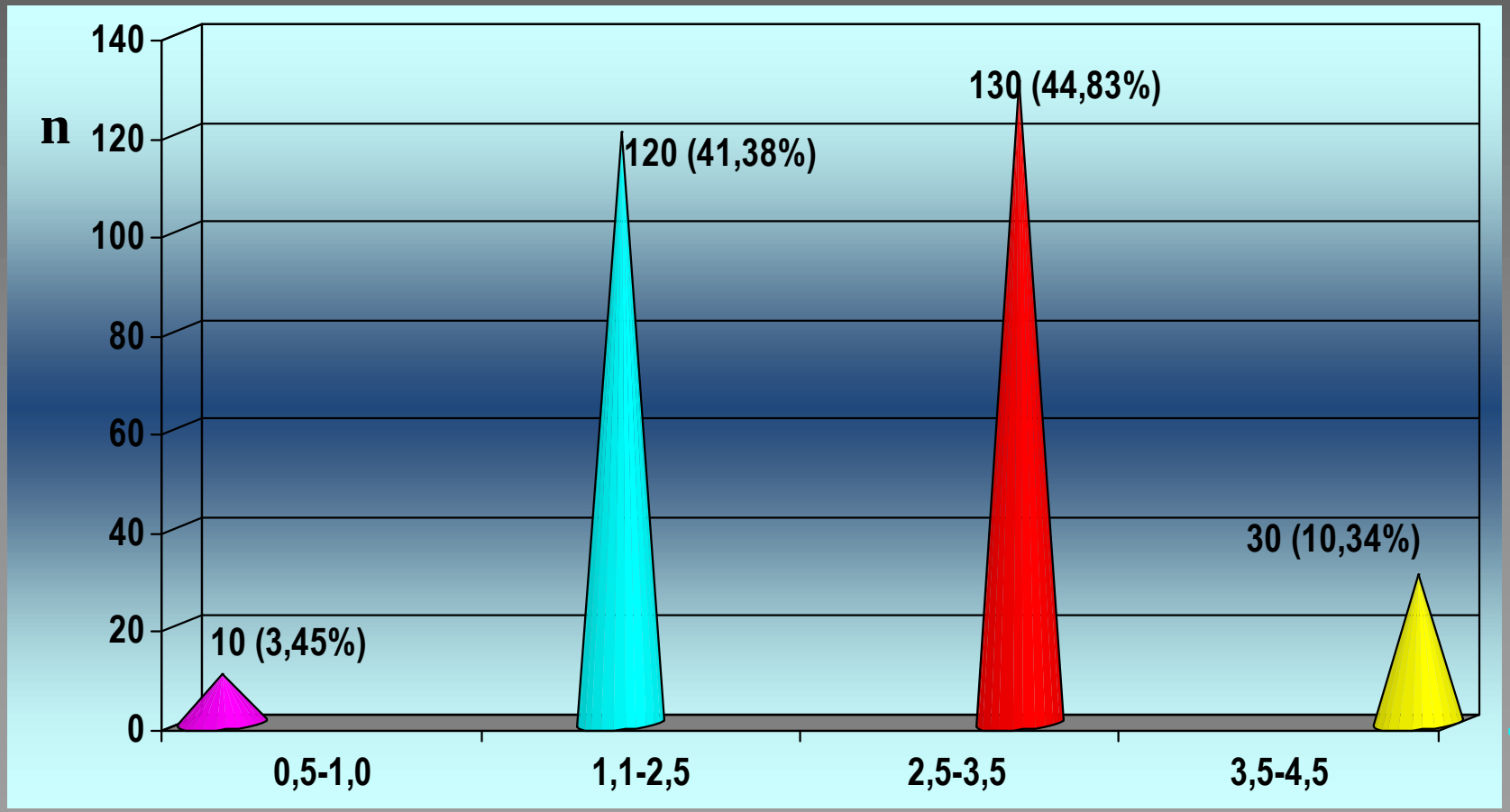
N=316



E.M.Kapustina et al., 2002.

Distribution of the cases of different TSH levels in women during first 9 weeks of gravities (2009-2011)

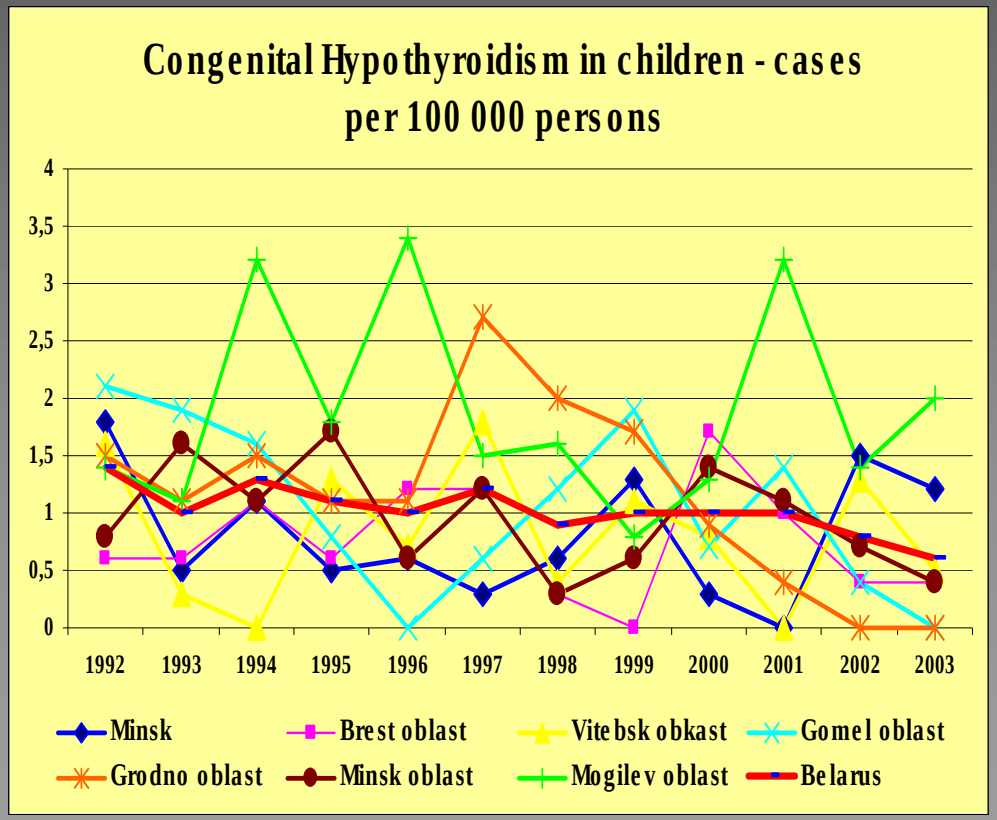
N=290



Iodine excretion screening in Brest and Minsk regions

- According to results of screening in some districts of Brest and Minsk regions - the situation is changing to the best.
  - The median levels of iodine excretion in Stolin (Brest region) in 2002 yr were 36.4 μg/L (18.3 / 47.5) in adults and 43.6 μg/L in schoolchildren.
  - In Minsk region median levels of iodine excretion during the same period were 59.8 μg/L in adults and 75.4 μg/L - in schoolchildren.
- In 2007 yr the median level of iodine excretion in children of
  - Stolin reached 76.3 μg/L
  - Minsk region - 73.2 μg/L.

Congenital Hypothyroidism

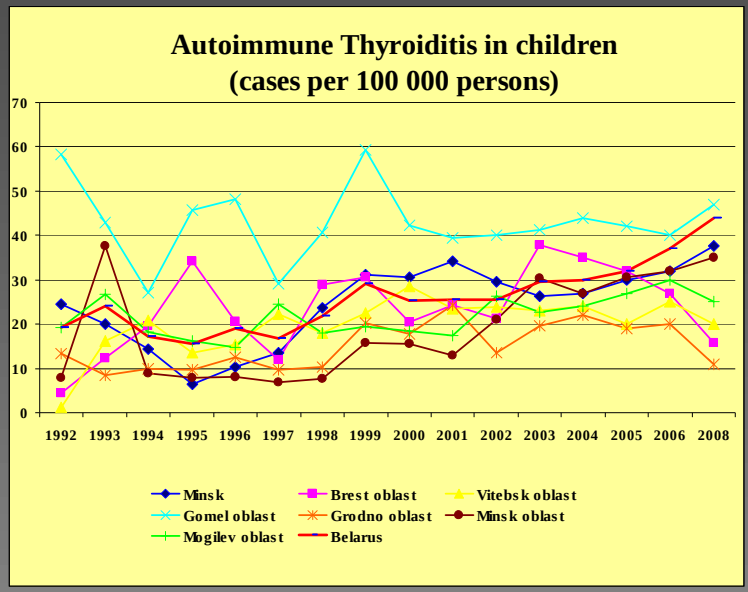


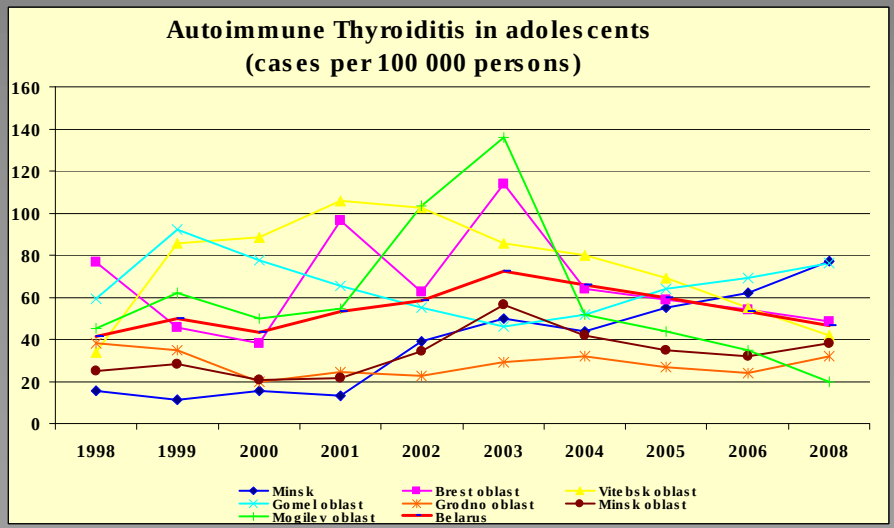
Screening programs for congenital hypothyroidism

Thyroid tests and Prophylaxis with stable iodine during pregnancy

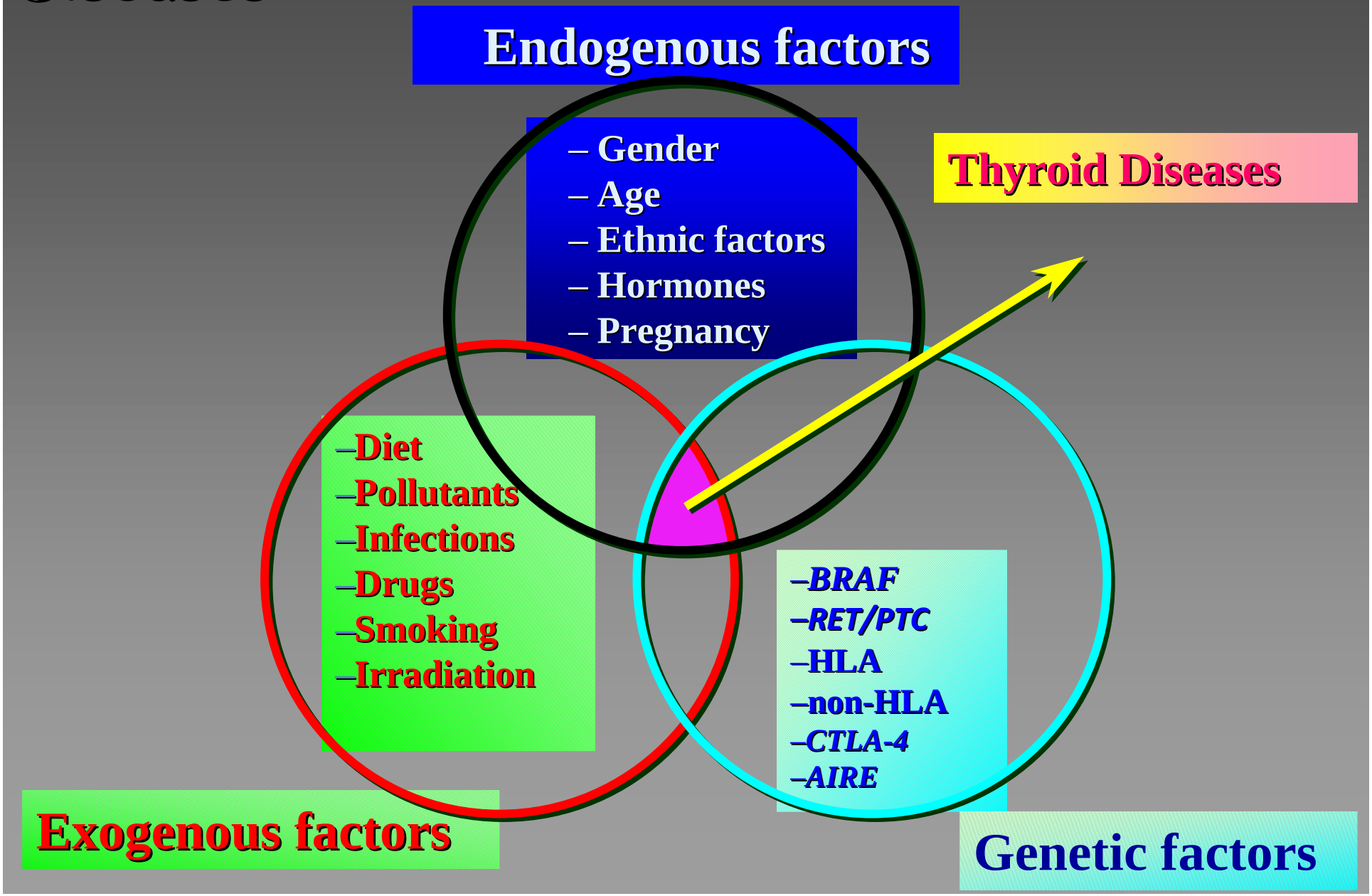
Autoimmune thyroiditis

- Increased incidence of autoimmune endocrine diseases in children and adolescents Autoimmune thyroiditis during 1995-2000 yrs.)
- Clinical features of autoimmune thyroiditis in groups of patients under 25 yrs. – subclinical forms and coexistence with nodular pathology, coexistence with DM type 1;
- Retardation/ impairments of physical and sexual development in children and adolescents





Possible Etiologic Factors of Thyroid Diseases



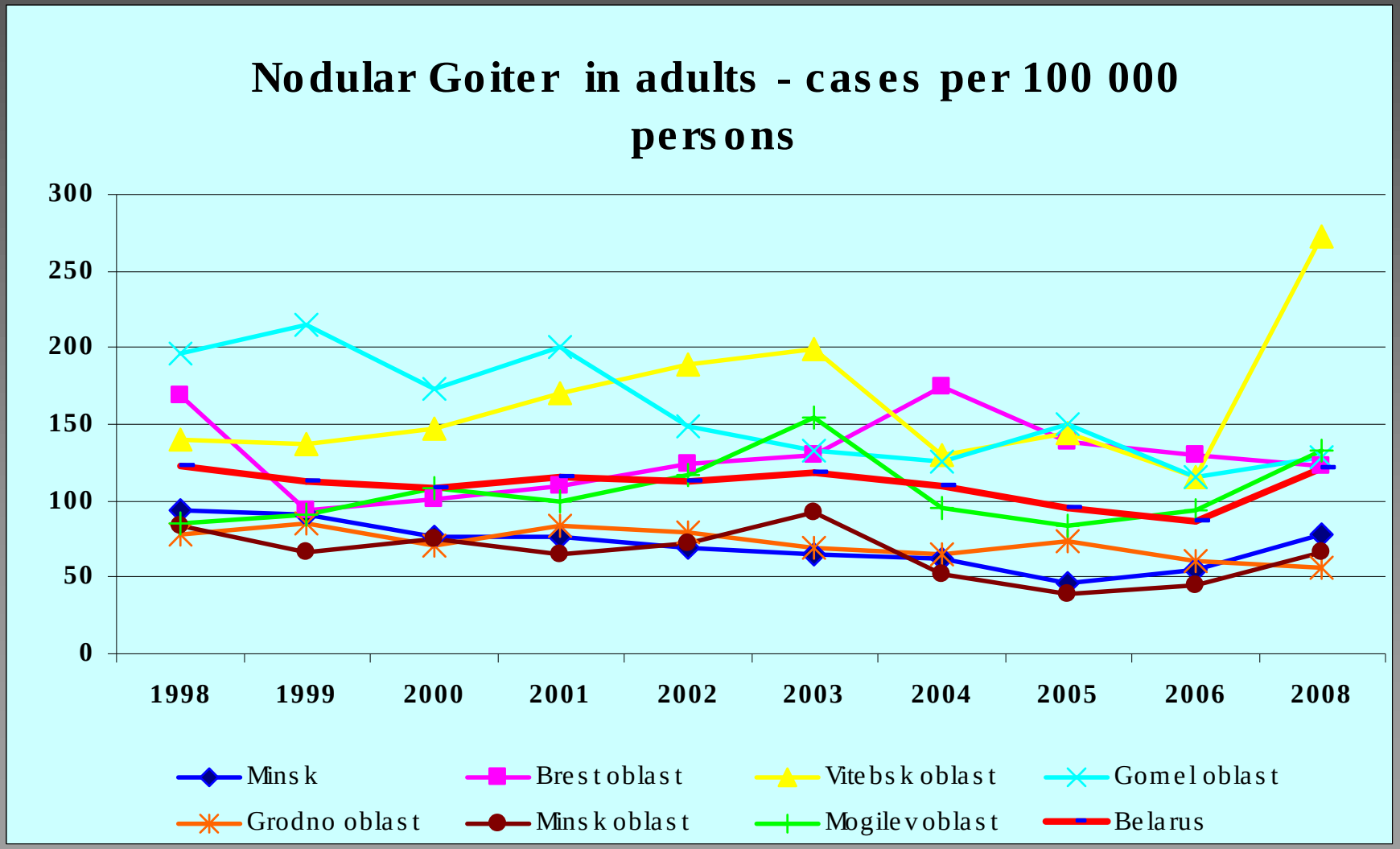
Thyroid nodules in clinical practice

- *Their prevalence depends to a great extent on the method used for detection. With the increased utilization of US for evaluation of the lesions of the neck, the incidental finding of unsuspected thyroid nodules has dramatically increased. The prevalence of thyroid nodules is higher in women in areas of iodine deficiency and increases with advancing age.*
- *Factors that increase the risk of malignancy include radiation exposure , history of head and neck irradiation, and very young or advanced age*

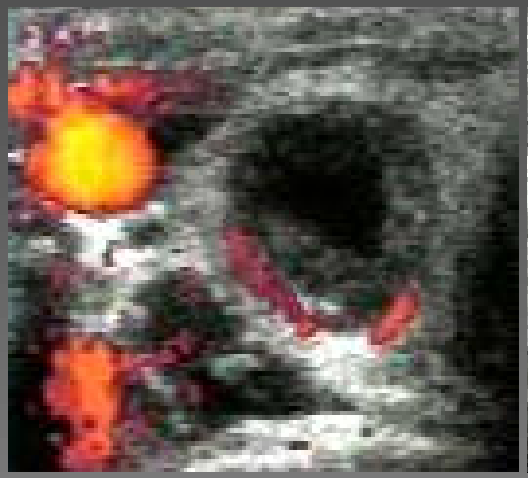
TR.S. Bahn,M. R.Castro /J Cl E Met, 2011, 96(5):1202–1212

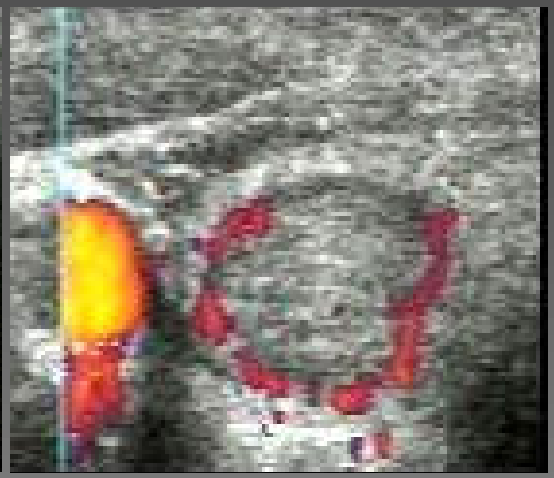
Nodular Goiter / Incidence rate

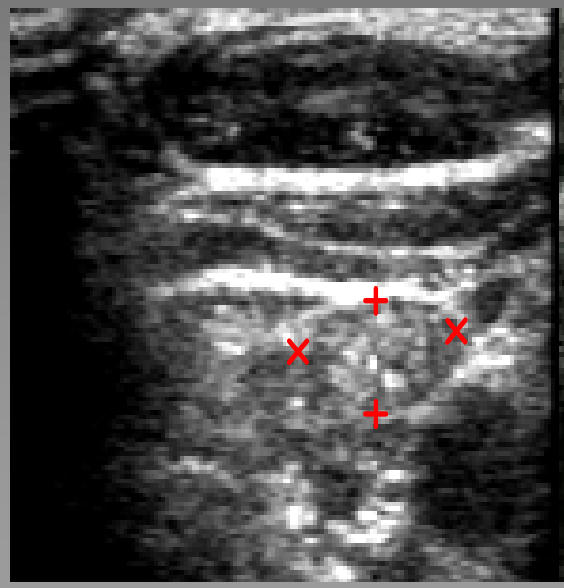
Statistical data of the Ministry of Public Health

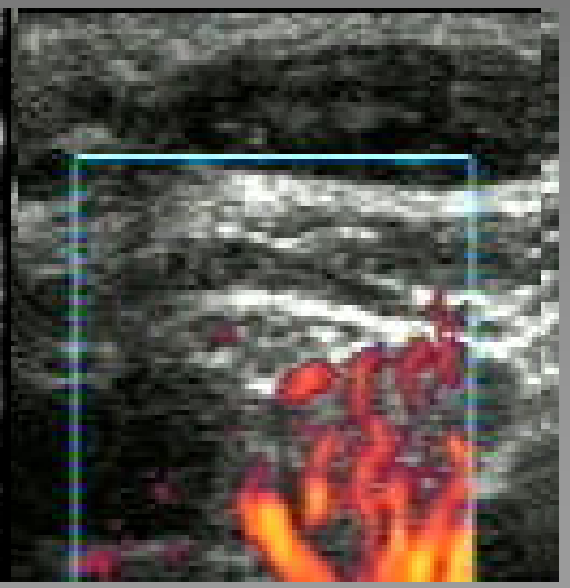


Nodular thyroid disease









Incidence of thyroid cancer diagnosed in 1986-2002

Age at exposure (yr)	No. of cases			
	Belarus	Russian Federation	Ukraine	Total
0-14	1,711	349	1,762	3,822
15-17	299	134	582	1,015
Total	2,010	483	2,344	4,837

UNSCEAR 2008 Report, Annex D: Over 6,000 thyroid cancers by 2006

Health Effects of the Chernobyl Accident and Special Health Care Programmes / Report of the UN Chernobyl Forum, 2006

The Belarus-USA Study

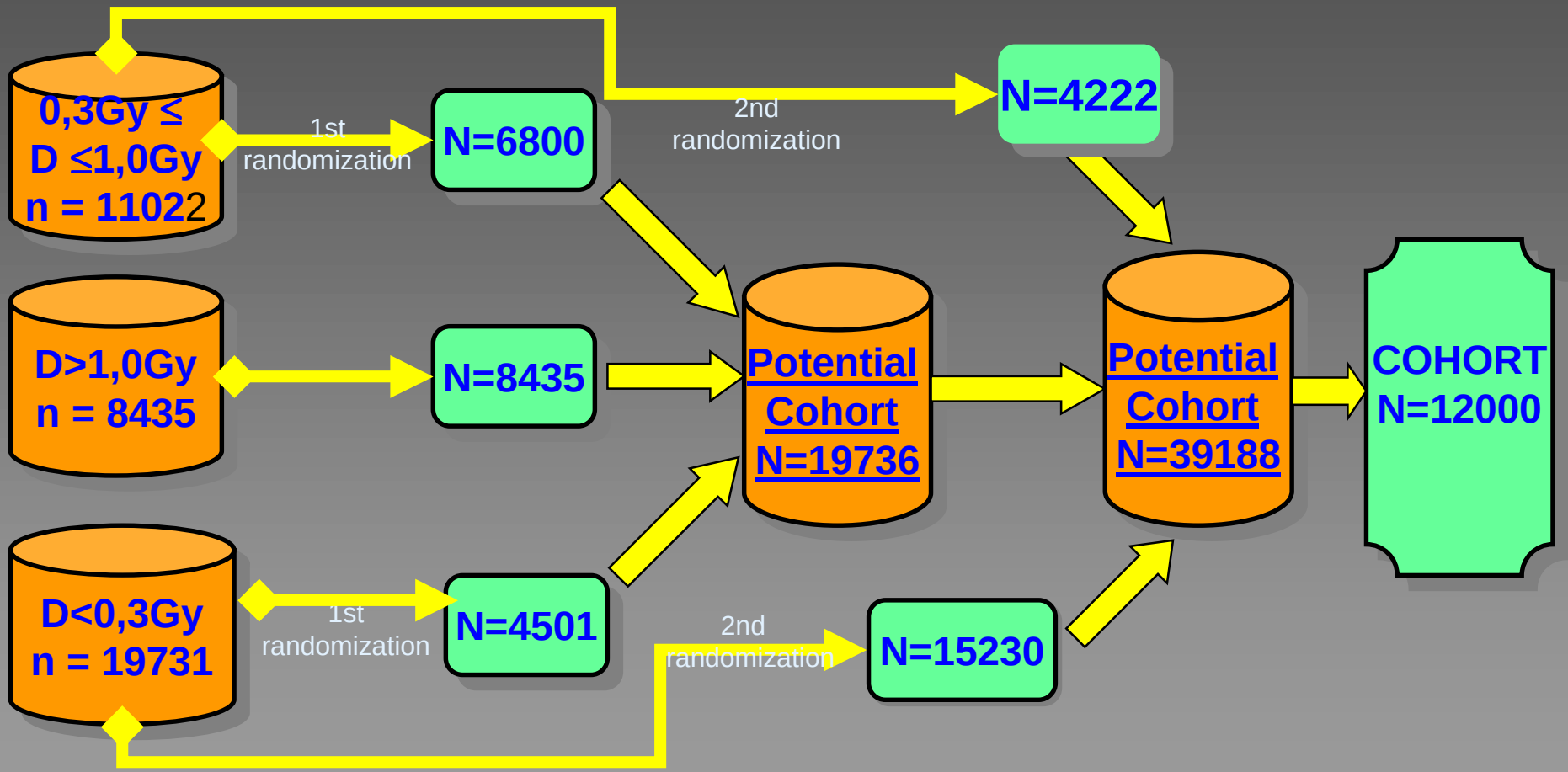
There has been a great increase in the incidence of thyroid cancer and benign thyroid nodules following the release of radioiodine by the Chernobyl accident, which occurred on 26 April 1986. Less thoroughly evaluated has been the prevalence of thyroid autoimmunity, even though external irradiation is recognized to increase the incidence of autoimmune thyroiditis. The Belarus-USA Study was established to quantitate the risk of thyroid and parathyroid disease in a well-defined cohort of individuals under age 18 years at the time of the accident who had direct thyroid radiation measurements. Subjects are examined at least biennially and undergo diagnostic procedures including thyroid palpation and ultrasound (US) and assay of serum for thyroid antibodies, TSH, free T4, and thyroglobulin. By 1 October 2000, 9400 cohort members have been screened at least once.

PREVALENCE OF THYROID ANTIBODIES IN THE BELARUS-USA COHORT STUDY OF THYROID CANCER AND OTHER THYROID DISEASES FOLLOWING THE CHERNOBYL ACCIDENT/ ITC, Kyoto

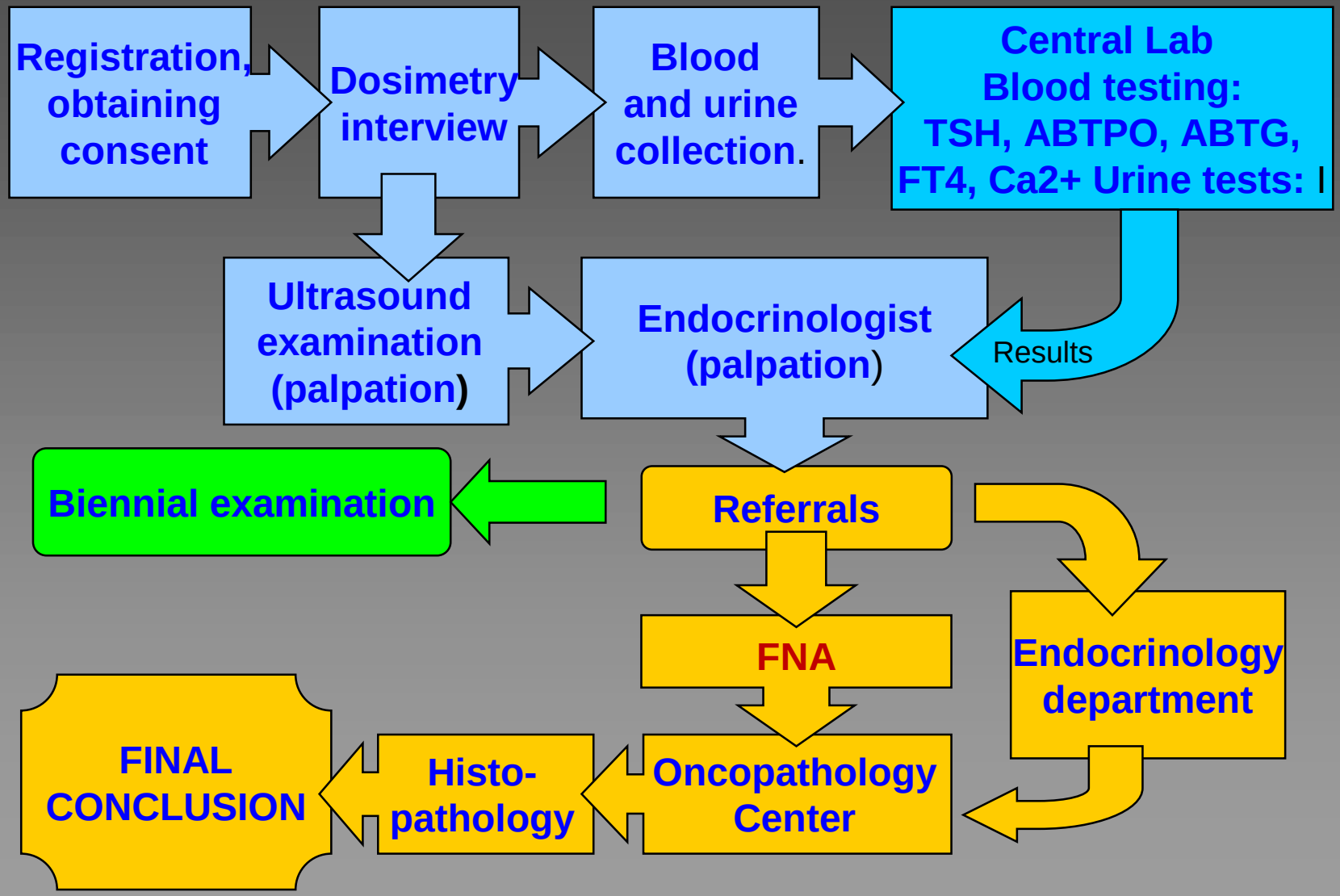
V. Ostapenko, S. Petrenko, O. Polyanskaya, V. Rzheutski, N. Litvinova, N. Lesnikova, E. Buglova, V. Drozd, L. Danilova, V. Stezhko, G.W. Beebe, A.B. Brill, D. Fink, E. Greenebaum, G. Howe, R. McConnell, I. Masnyk, J. Robbins Research Clinical Institute of Radiation Medicine and Endocrinology, Ministry of Health, Belarus; National Cancer Institute, National Institute of Health, Rockville, MD, USA; Columbia University, New York, NY, USA.

There has been a great increase in the incidence of thyroid cancer and benign thyroid nodules following the release of radioiodine by the Chernobyl accident, which occurred on 26 April 1986. Less thoroughly evaluated has been the prevalence of thyroid autoimmunity, even though external irradiation is recognized to increase the incidence of autoimmune thyroiditis. The Belarus-USA Study was established to quantitate the risk of thyroid and parathyroid disease in a well-defined cohort of individuals under age 18 years at the time of the accident who had direct thyroid radiation measurements. The cohort consists of 8400 children with a thyroid dose estimate of $\geq$ 1 Gy, 3500 with a dose of 0.3 to < 1 Gy, and 3500 with a dose of < 0.3 Gy. Subjects are examined at least biennially by thyroid palpation and ultrasound (US) and assay of serum for thyroid antibodies, TSH, free T4, and thyroglobulin. By 1 January 2000, 5965 cohort members have been screened at least once, among whom there were 2638 with palpable thyroid glands who also had thyroid antibody measurements. Either antiTPO or antiTG, or both, was elevated in 167 (6.3%), of whom 111 were female and 56 male (F/M=2/1). In 80 (3.0%) only antiTPO was elevated, in 44 (1.7%) only antiTG, and in 43 (1.6%) both. The highest prevalence (13.1%) was in females aged 15-18 years at the time of the accident. Thyroid US volume was available in 2669 cohort members who also had antibody assay. Compared to an age-matched, unexposed Belarussian population, 423 (15.8%) had volumes above normal. Either antibody was elevated in 6.2% of subjects with normal volumes, 8.2% of those up to 150% of normal, and 12.2% of those 150-200% of normal. Antibody measurements were available in 27 of 31 with thyroid cancer diagnosed for the first time (all but 1 were papillary cancer), 179 of 287 with solitary nodules (palpation and US), and 77 of 103 with more than 1 nodule . Either antibody was elevated in 5 (18.5%) of the cancers, 11 (6.1%) of the solitary nodules, and 8 (10.4%) of the multinodular goiters. Of 283 subjects with either cancer or nodular disease, the highest prevalence of positive antibodies (26.9%) was found in females aged 15 –18 years at the time of the accident. The eventual goal of this part of the cohort study is to correlate individually reconstructed thyroid radiation doses with the occurrence of autoimmune thyroiditis.

SELECTION OF THE Bel-Am -COHORT



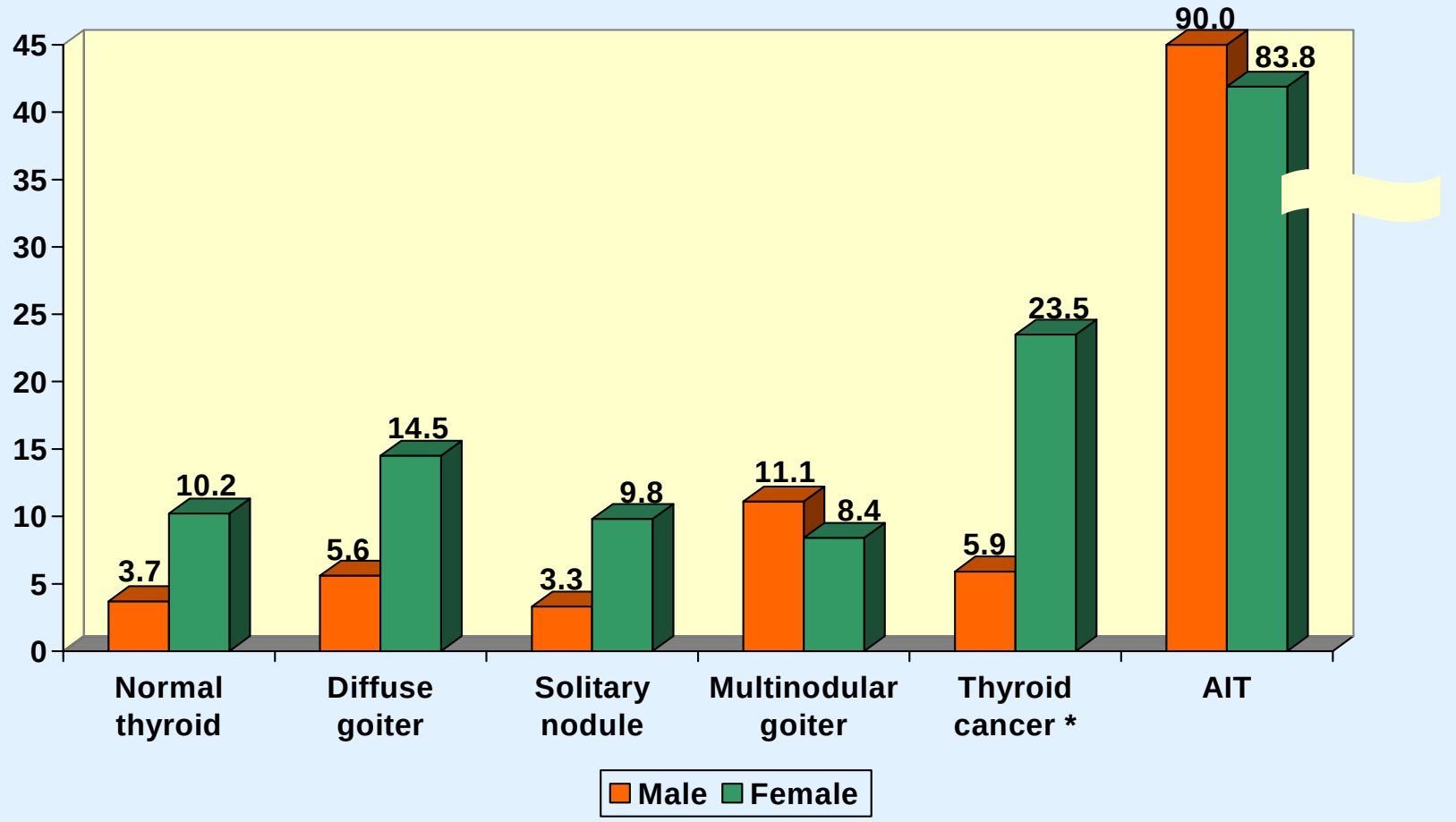
MEDICAL EXAMINATION CHART



PREVALENCE OF ANTITHYROID ANTIBODIES IN EXPOSED SUBJECTS OF BELARUS AND RUSSIA

Characteristics	*BelAm*	*Sasakawa Project*	*F.Pacini et al., 1998*	*F.Vermiqlio et al., 1999*
Age in 1986, years	0 - 18	0 - 10	<1 - 10	In utero - 3
Age at examination, years	11 - 32	5 - 20	6 - 17	5 - 15
Year of examination	1997-2000	1991-1996	1992-1994	1997
Prevalence of ABTPO	5.8%	2.5%	16.7%	18.9%
Prevalence of ABTG	4.9%	1%	8.4%	12.6%

PREVALENCE OF AB(+) IN SUBJECTS WITH THYROID PATHOLOGY



** All diagnoses but thyroid cancer made according to preliminary endocrinological conclusion. Thyroid cancer pathologicaly confirmed*

Y axis - % AB(+)

Consequences of Chernobyl Accident

Measures of Thyroid Function among Belarusian Children and Adolescents Exposed to Iodine-131 from the Accident at the Chernobyl Nuclear Plant

Evgenia Ostroumova,[1] Alexander Rozhko,[2] Maureen Hatch,[1] Kyoji Furukawa,[3] Olga Polyanskaya,[2] Robert J. McConnell,[4] Eldar Nadyrov,[2] Sergey Petrenko,[5] George Romanov,[2] Vasilina Yauseyenka,[2] Vladimir Drozdovitch,[1] Viktor Minenko,[6] Alexander Prokopovich,[2] Irina Savasteeva,[2] Lydia B. Zablotska,[7] Kiyohiko Mabuchi,[1] and Alina V. Brenner[1]

[1]Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Department of Health and Human Services, Bethesda, Maryland, USA; [2]The Republican Research Center for Radiation Medicine and Human Ecology, Gomel, Belarus; [3]Department of Statistics, Radiation Effects Research Foundation, Hiroshima, Japan; [4]The Thyroid Center, Columbia University, New York, New York, USA; [5]Department of Anthropoecology and Epidemiology, International Sakharov Environmental University, Minsk, Belarus; [6]Belarusian Medical Academy of Post-Graduate Education, Minsk, Belarus; [7]Department of Epidemiology and Biostatistics, University of California, San Francisco, San Francisco, California, USA

Background: Thyroid dysfunction after exposure to low or moderate doses of radioactive iodine-131 (^{131}I) at a young age is a public health concern. However, quantitative data are sparse concerning ^{131}I-related risk of these common diseases.

Objective: Our goal was to assess the prevalence of thyroid dysfunction in association with ^{131}I exposure during childhood (≤ 18 years) due to fallout from the Chernobyl accident.

Methods: We conducted a cross-sectional analysis of hypothyroidism, hyperthyroidism, autoimmune thyroiditis (AIT), serum concentrations of thyroid-stimulating hormone (TSH), and autoantibodies to thyroperoxidase (ATPO) in relation to measurement-based ^{131}I dose estimates in a Belarusian cohort of 10,827 individuals screened for various thyroid diseases.

Results: Mean age at exposure (± SD) was 8.2 ± 5.0 years. Mean (median) estimated ^{131}I thyroid dose was 0.54 (0.23) Gy (range, 0.001–26.6 Gy). We found significant positive associations of ^{131}I dose with hypothyroidism (mainly subclinical and antibody-negative) and serum TSH concentration. The excess odds ratio per 1 Gy for hypothyroidism was 0.34 (95% CI: 0.15, 0.62) and varied significantly by age at exposure and at examination, presence of goiter, and urban/rural residency. We found no evidence of positive associations with antibody-positive hypothyroidism, hyperthyroidism, AIT, or elevated ATPO.

Conclusions: The association between ^{131}I dose and hypothyroidism in the Belarusian cohort is consistent with that previously reported for a Ukrainian cohort and strengthens evidence of the effect of environmental ^{131}I exposure during childhood on hypothyroidism, but not other thyroid outcomes.

Key words: antithyroid antibodies, autoimmune thyroiditis, Chernobyl, Chornobyl, dose response, hyperthyroidism, hypothyroidism, radioiodine, thyroid gland.

Environ Health Perspect 121:865–871 (2013). http://dx.doi.org/10.1289/ehp.1205783 [Online 7 May 2013]

The most severe accident in the history of nuclear industry occurred on 26 April 1986, evidence of a decline in radiation-related risk of thyroid cancer (Brenner et al. 2011).

In a screening study among 12,000 subjects in Ukraine with doses estimated from individual measurements of thyroid radioactivity, significant associations were found between ^{131}I thyroid dose (mean dose of 0.79 Gy) and prevalence of subclinical hypothyroidism (Ostroumova et al. 2009) and antibodies to thyroperoxidase (ATPO) (Tronko et al. 2006a), but not autoimmune thyroiditis (AIT) (Tronko et al. 2006a) or hyperthyroidism (Hatch et al. 2010).

To extend findings from the Ukrainian cohort, we evaluated functional thyroid outcomes in relation to individual ^{131}I thyroid doses in a comparable cohort of exposed children and adolescents from Belarus who were screened for thyroid cancer and other thyroid diseases. The methods used to estimate thyroid doses and to screen for thyroid diseases in Belarus and Ukraine were similar (Stezhko et al. 2004).

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PLOS | ONE

Impact of Uncertainties in Exposure Assessment on Estimates of Thyroid Cancer Risk among Ukrainian Children and Adolescents Exposed from the Chernobyl Accident

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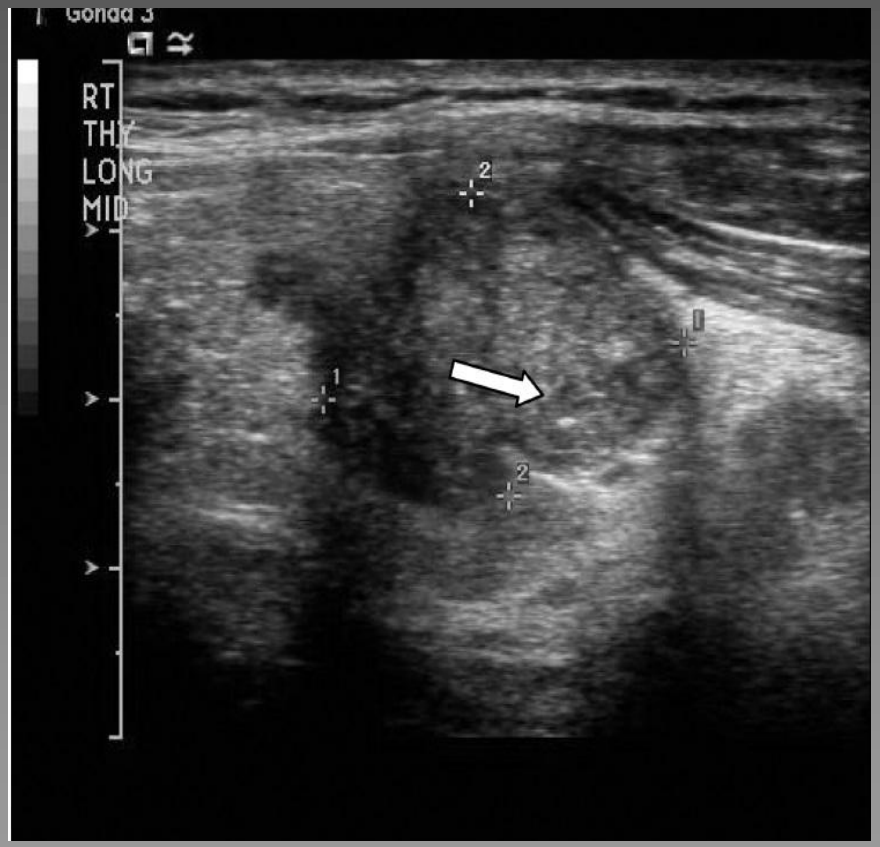
Abstract

The 1986 accident at the Chernobyl nuclear power plant remains the most serious nuclear accident in history, and excess thyroid cancers, particularly among those exposed to releases of iodine-131 remain the best-documented sequelae. Failure to take dose-measurement error into account can lead to bias in assessments of dose-response slope. Although risks in the Ukrainian-US thyroid screening study have been previously evaluated, errors in dose assessments have not been addressed hitherto. Dose-response patterns were examined in a thyroid screening prevalence cohort of 13,127 persons aged <18 at the time of the accident who were residents in the most radioactively contaminated regions of Ukraine. We extended earlier analyses in this cohort by adjusting for dose error in the recently developed TD-10 dosimetry. Three methods of statistical correction, via two types of regression calibration, and Monte Carlo maximum-likelihood, were applied to the doses that can be derived from the ratio of thyroid activity to thyroid mass. The two components that make up this ratio have different types of error, Berkson error for thyroid mass and classical error for thyroid activity. The first regression calibration method yielded estimates of excess odds ratio of 9.78 Gy^{-1} (95% CI 1.92, 27.04), about 7% higher than estimates unadjusted for dose error. The second regression-calibration method gave an excess odds ratio of 4.78 Gy^{-1} (95% CI 1.64, 19.69), about 11% lower than unadjusted analysis. The Monte Carlo maximum-likelihood method produced an excess odds ratio of 4.93 Gy^{-1} (95% CI 1.67, 19.90), about 8% lower than unadjusted analysis. There are borderline significant ($p = 0.101$, 0.112) indications of downward curvature in the dose response, allowing for which nearly doubled the low-dose linear coefficient. In conclusion, dose-error adjustment has comparatively modest effects on regression parameters, a consequence of the relatively small errors, of a mixture of Berkson and classical form, associated with thyroid dose assessment.

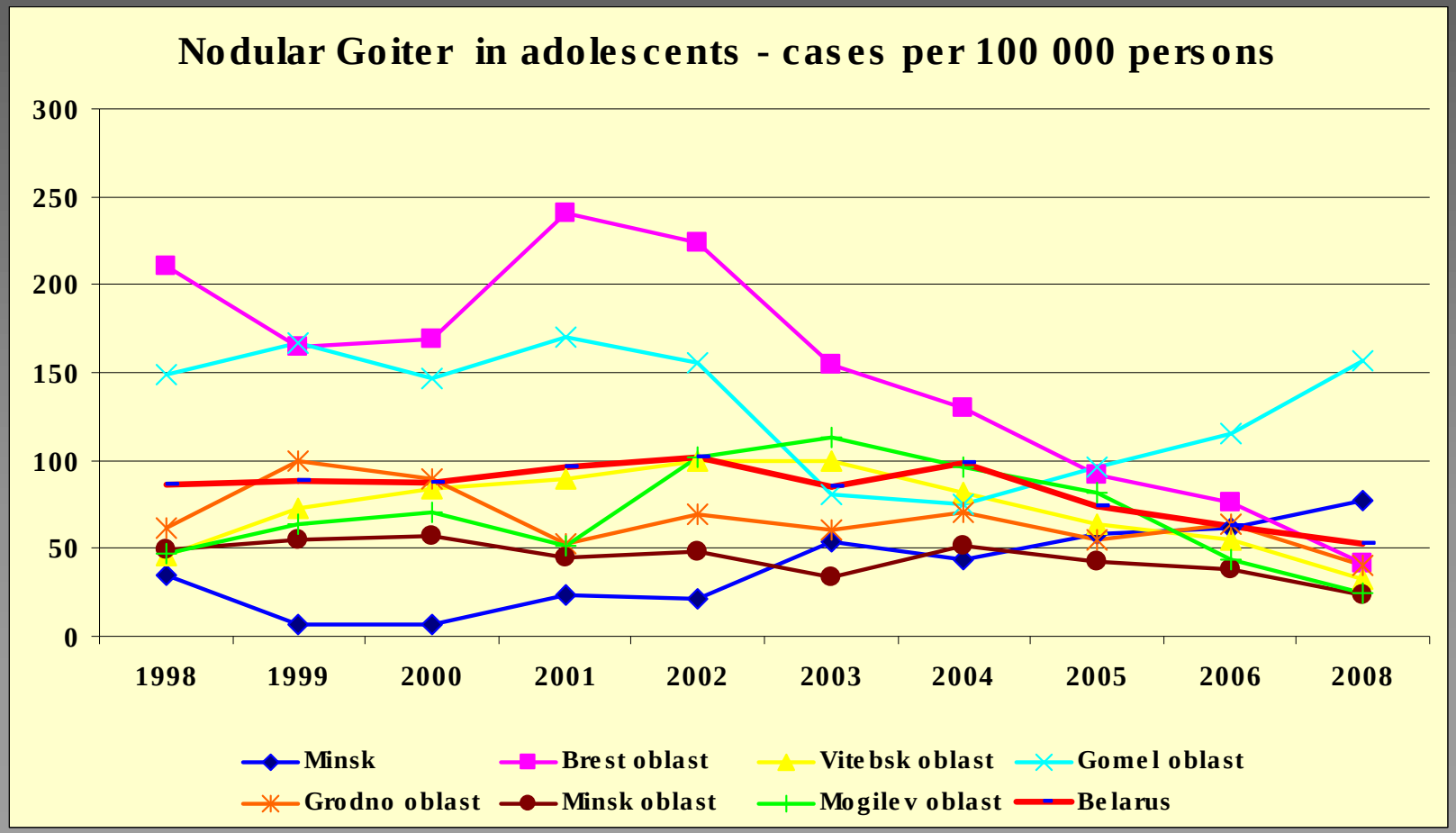
Thyroid cancer



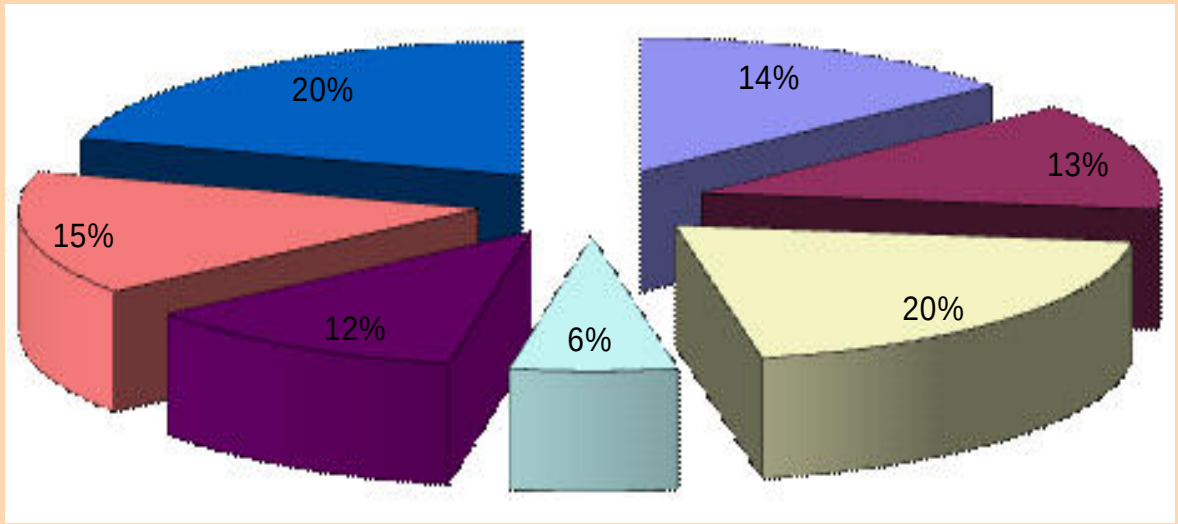
- *Current Belarusian guidelines for the treatment of progressive DTC include optimization of TSH suppression, 131I, resection of selected metastases, bisphosphonates for bony metastases (Y. Demidchik, L.Danilova, V.Drozd, M.Lushchyk, 2010);*
- *Like the RET/PTC, mutations in BRAF are thought to occur early in thyroid cancers tumorigenesis (Nikiforova et al. 2003) and discussed as an attractive target for molecular therapies.*

Nodular Goiter / Incidence adolescents

Statistical data of the Ministry of Public Health

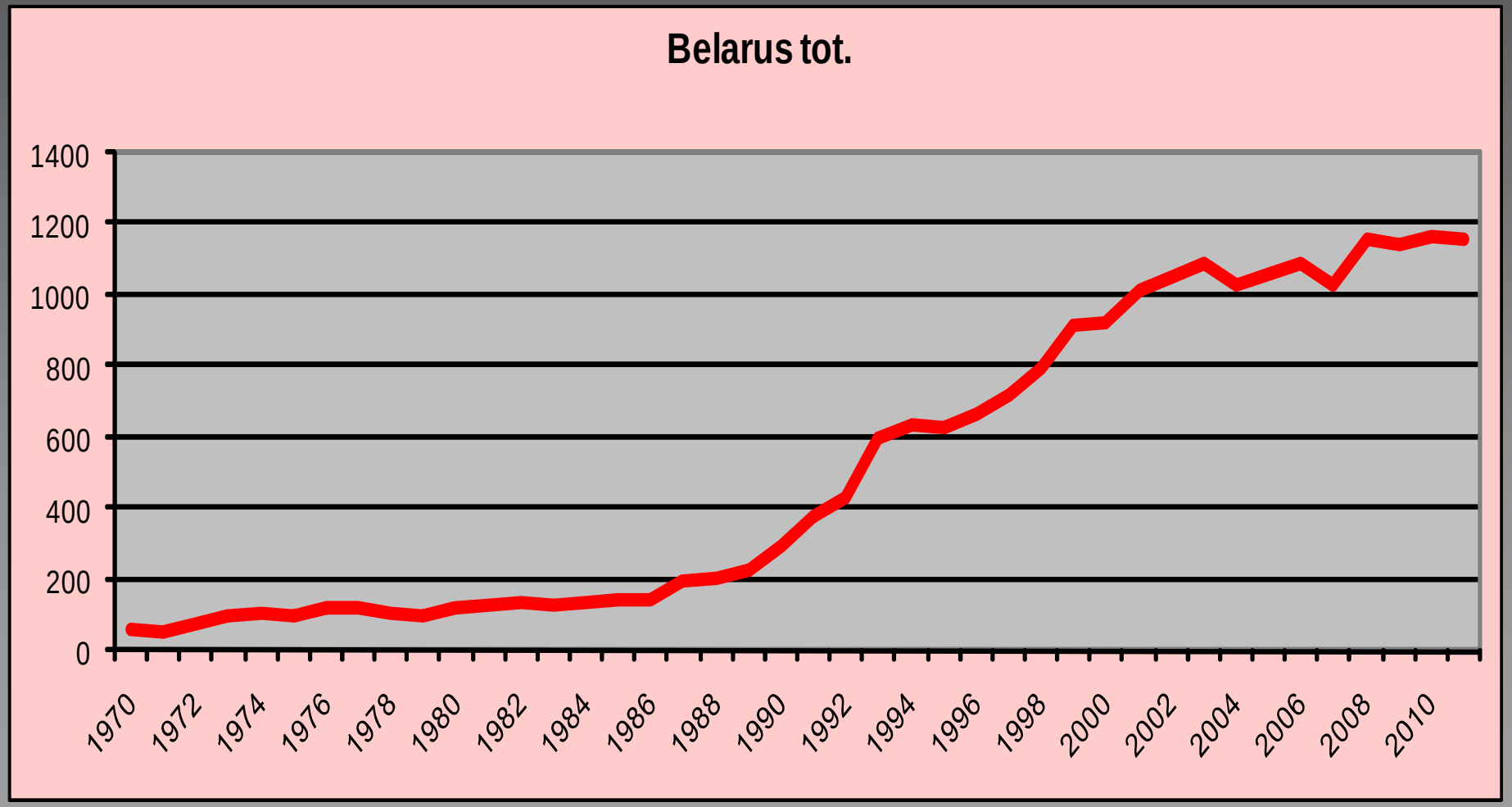


Distribution of total amount of patients with Thyroid Cancer in different regions of Belarus 1990-2011 (21 616 cases)

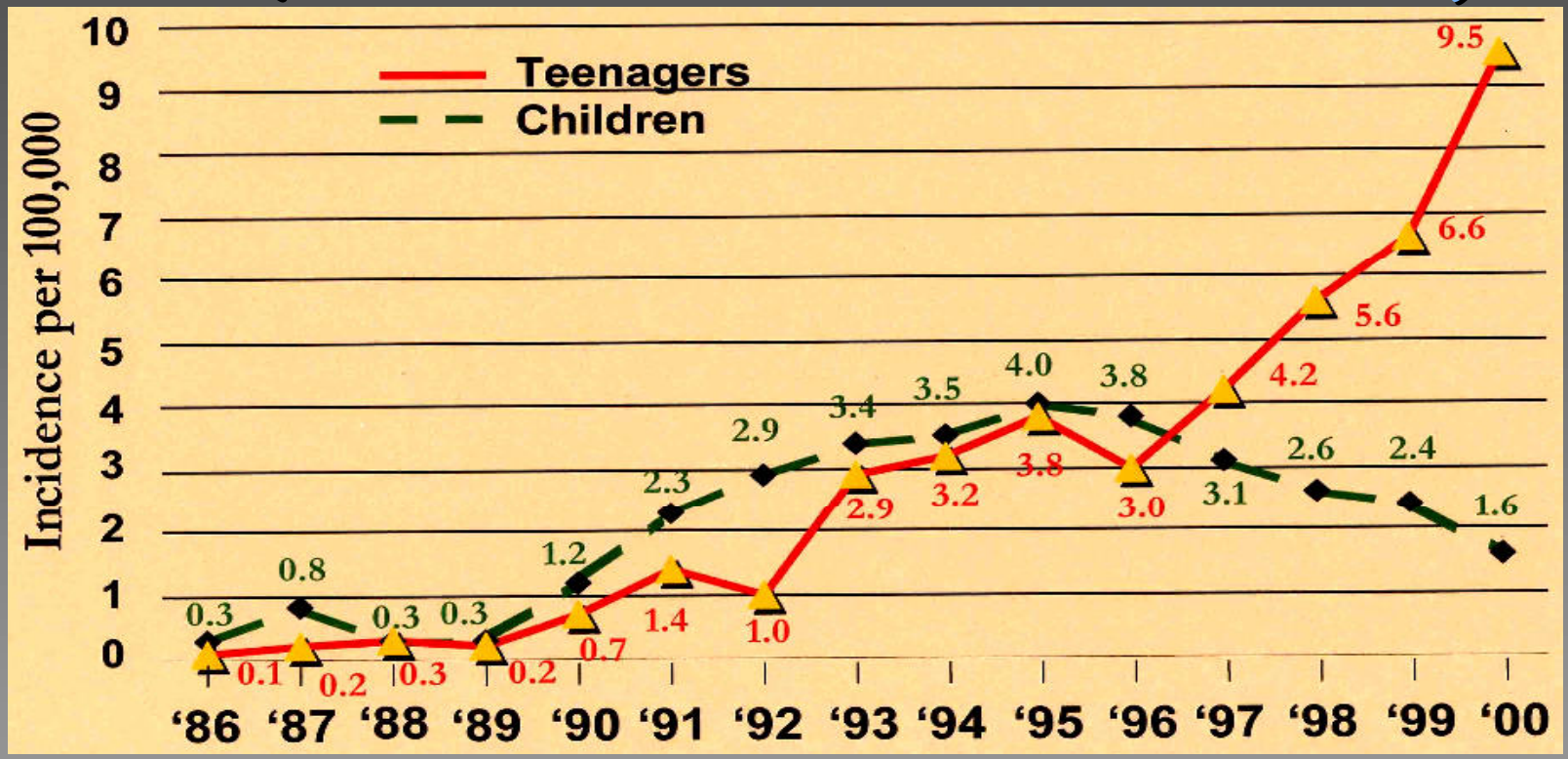


Yearly number of patients with thyroid cancer in Belarus: 1990 to 2011

Statistical data of the Ministry of Public Health

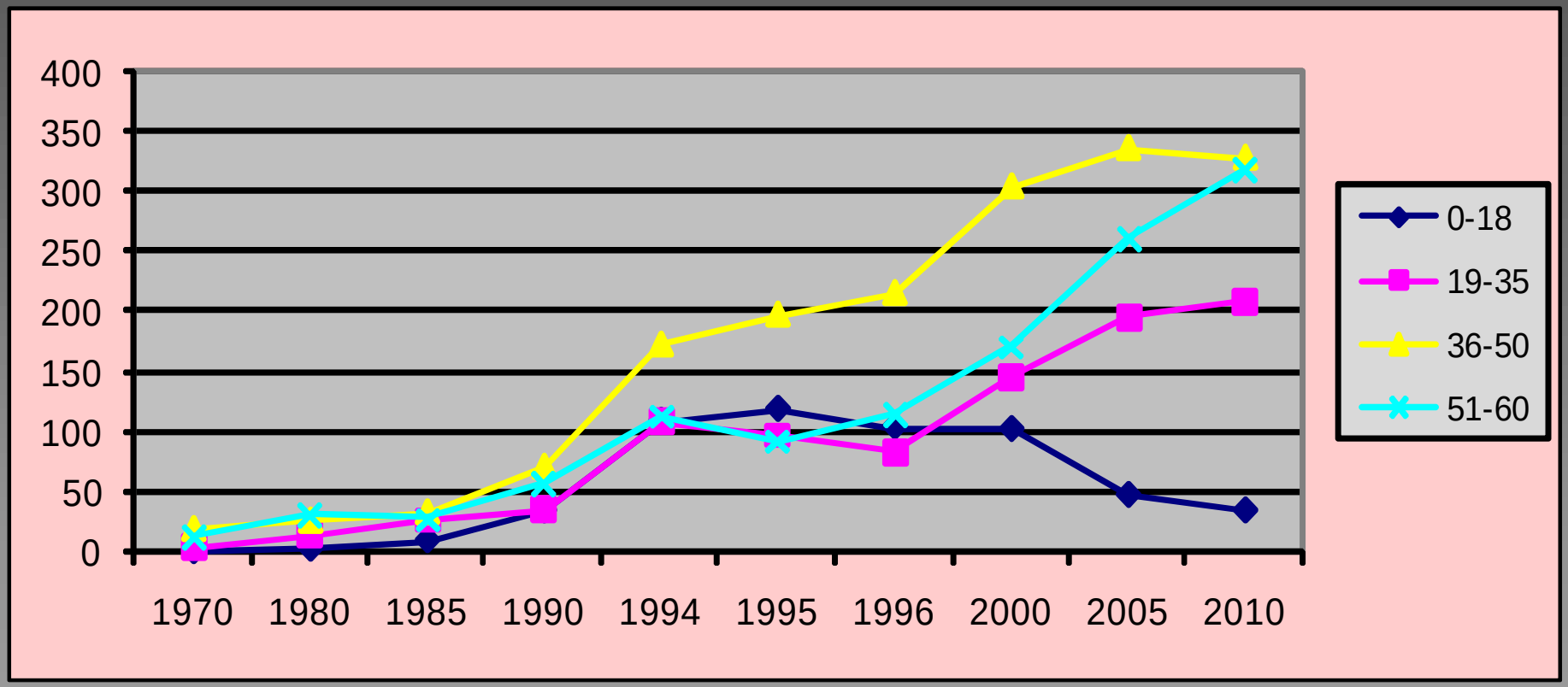


Thyroid Cancer in Children and Teenagers (E.P.Demidchik et al, 2002-2004)



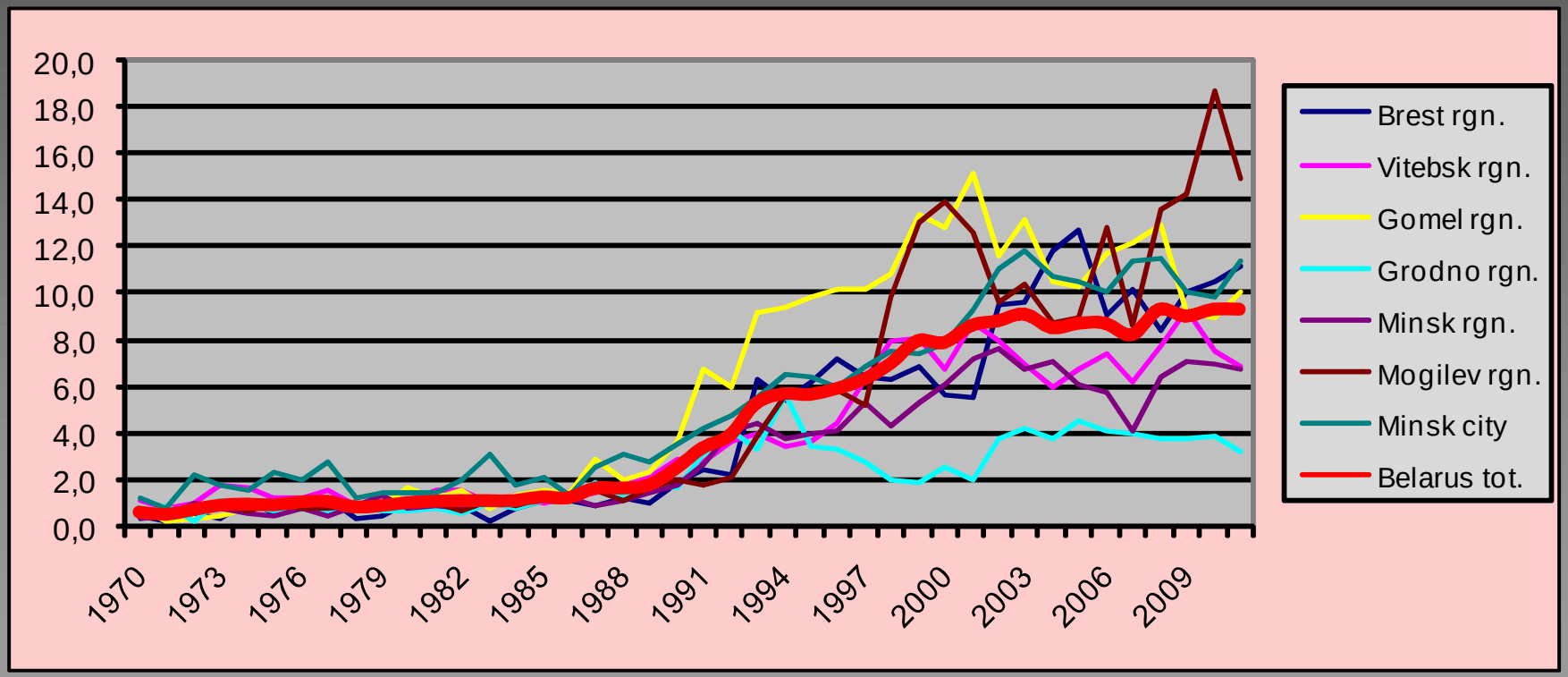
Thyroid cancer: Age-dependent incidence

(Y.Demidchik et al, 2012)



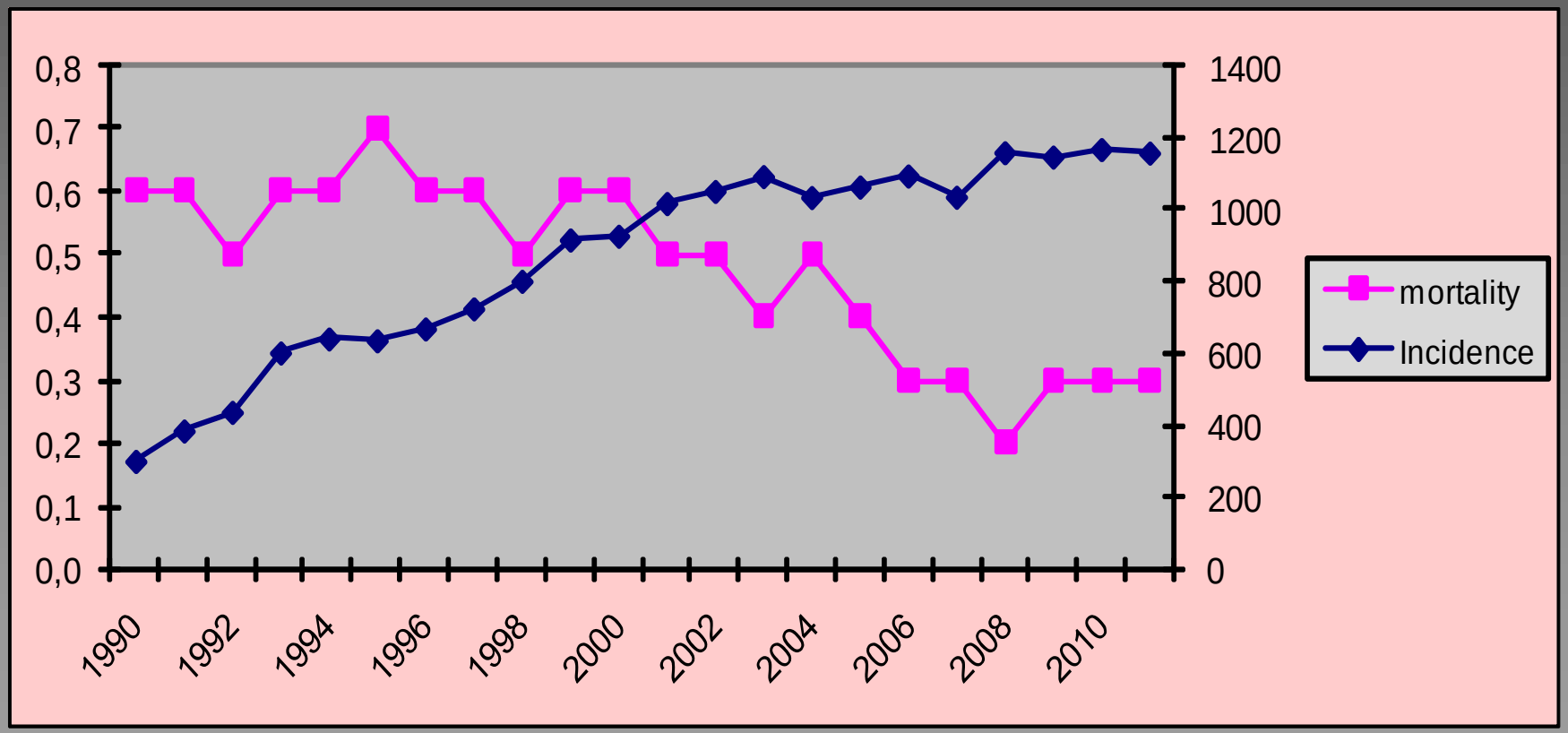
Thyroid cancer in the regions of Belarus Standardized Incidence Rate (per 100 000 people)

Statistical data of the Ministry of Public Health

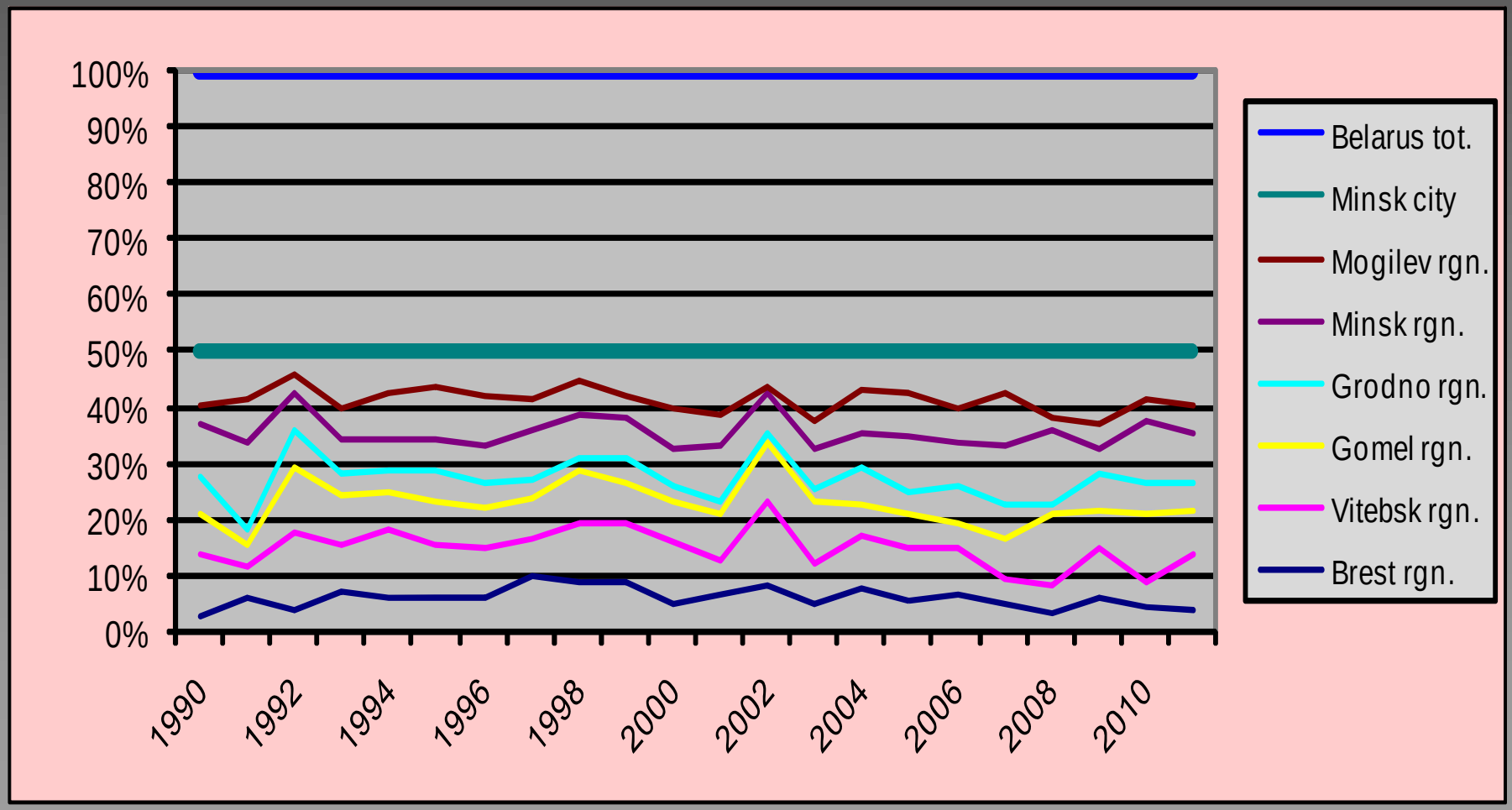


Thyroid cancer : Mortality and Incidence rate

Statistical data of the Ministry of Public Health

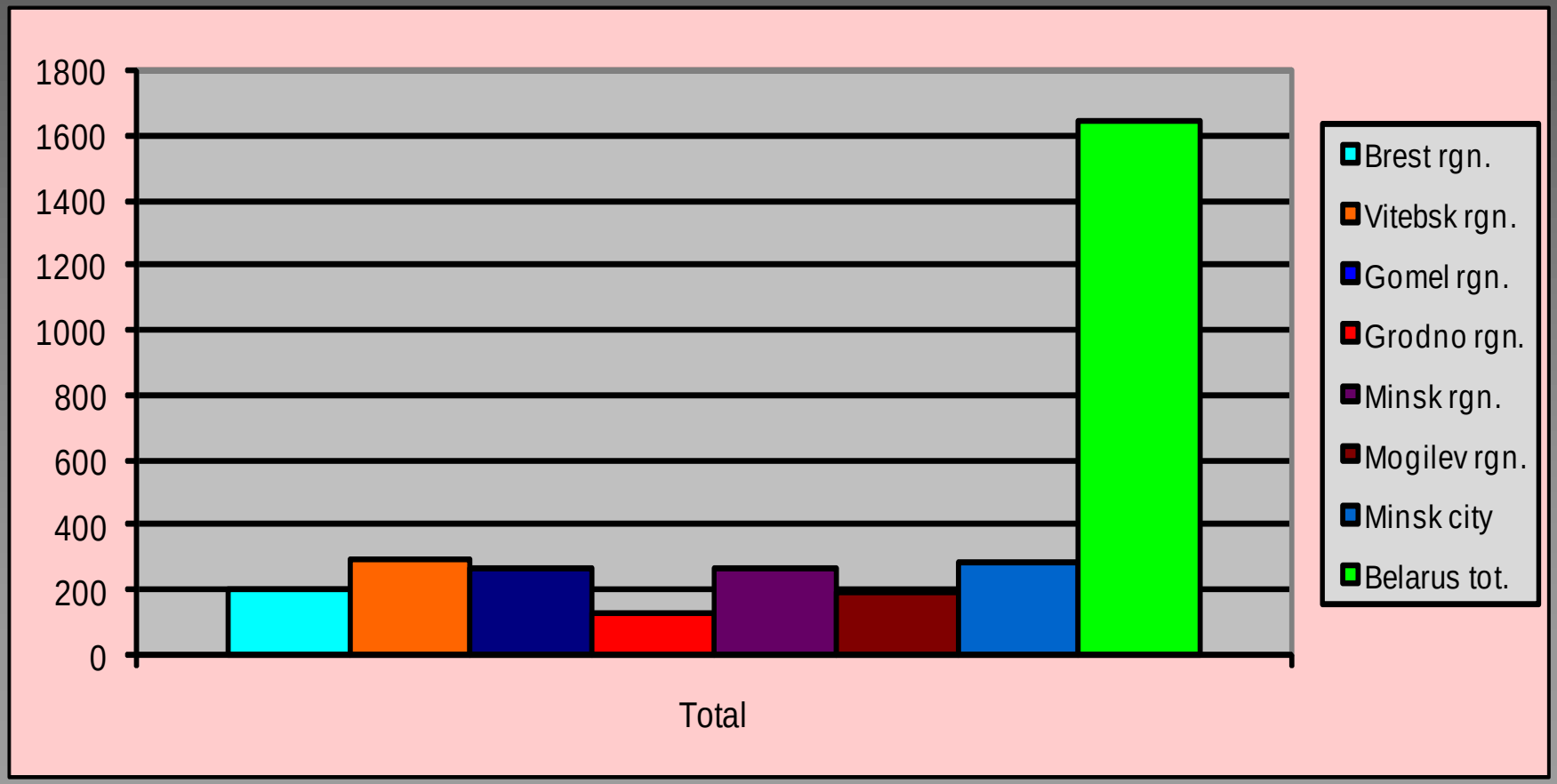


Thyroid cancer : mortality since 1990, absolute number of cases (normalized graph) *(Y.Demidchik et al, 2012)*



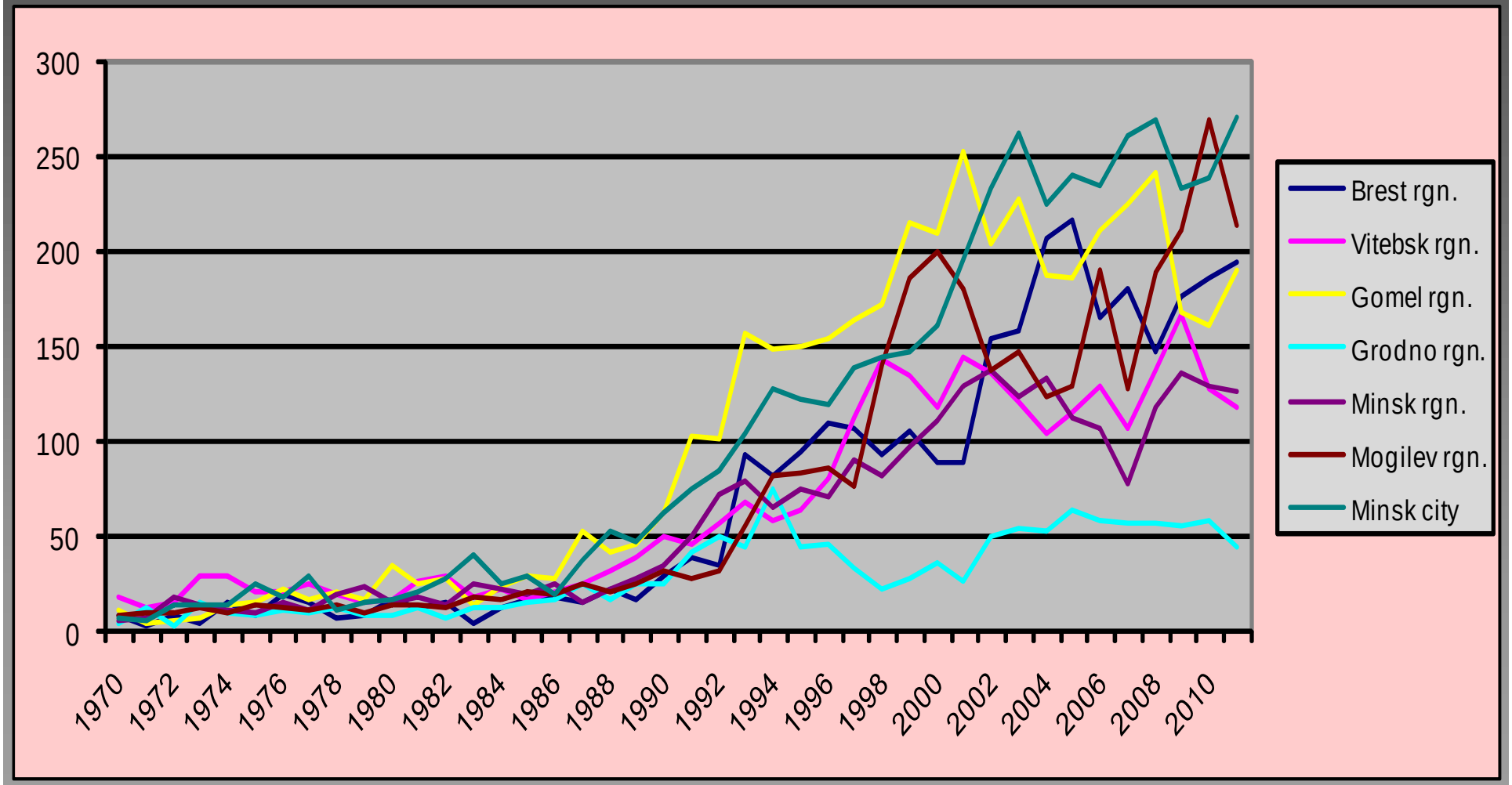
Thyroid cancer: mortality, total number of deceased 1990-2013

Statistical data of the Ministry of Public Health



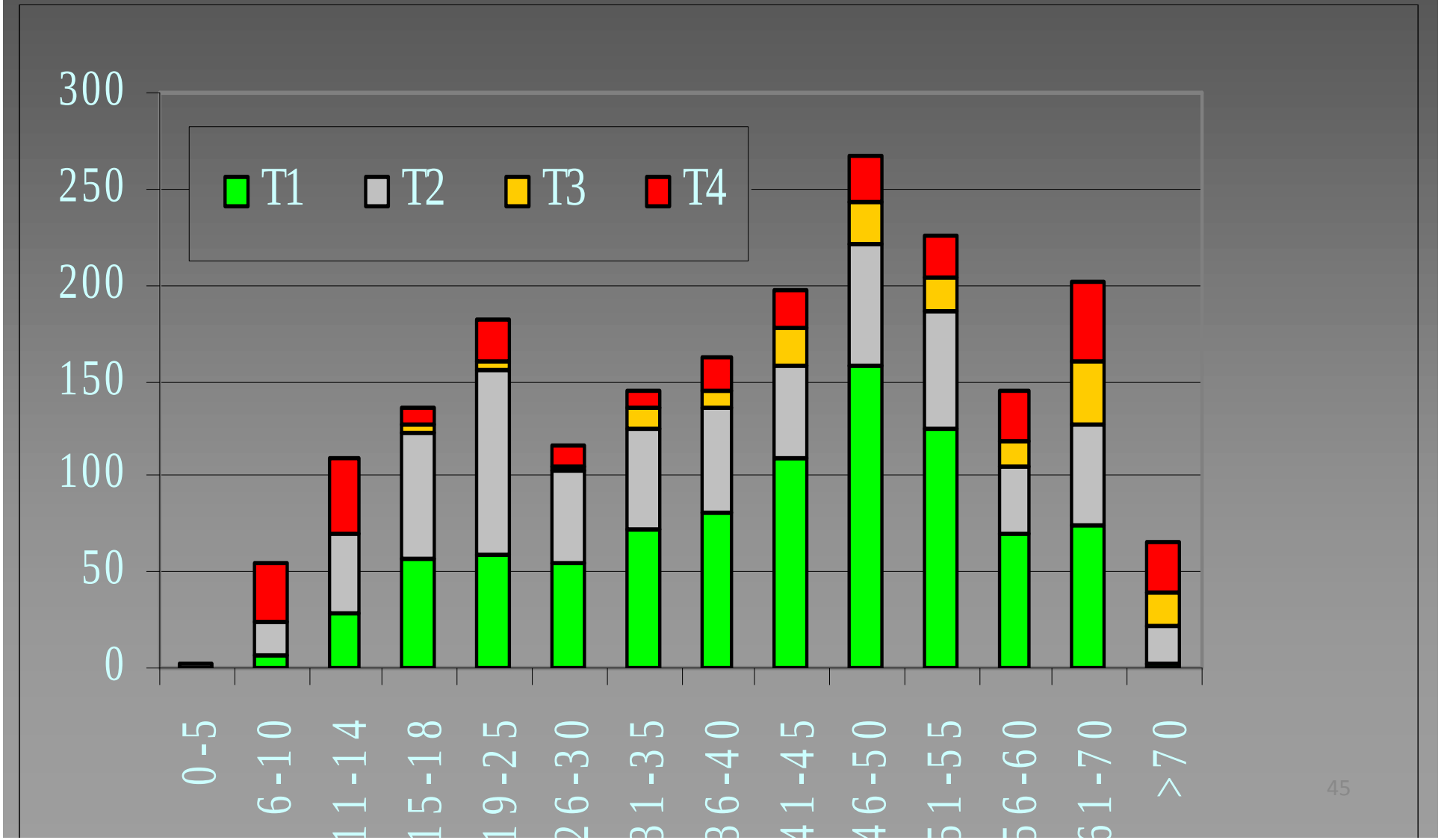
Yearly number of patients with thyroid cancer 1990-2011 in Belarus

Statistical data of the Ministry of Public Health



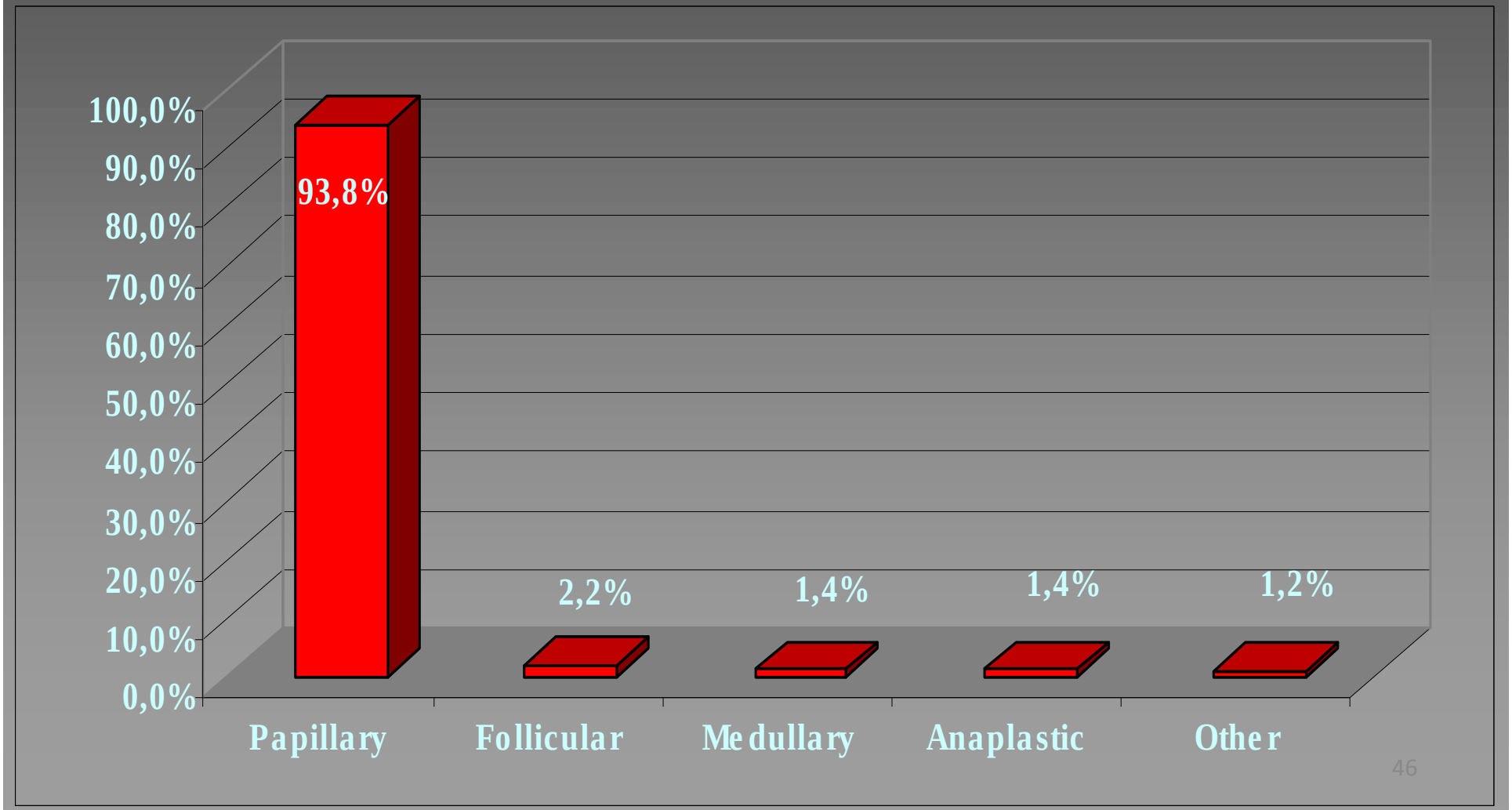
Distribution of Thyroid Cancer cases in different age groups according to TNM stages

Brest region n=2005 / Brest Regional Dispensary statistic data

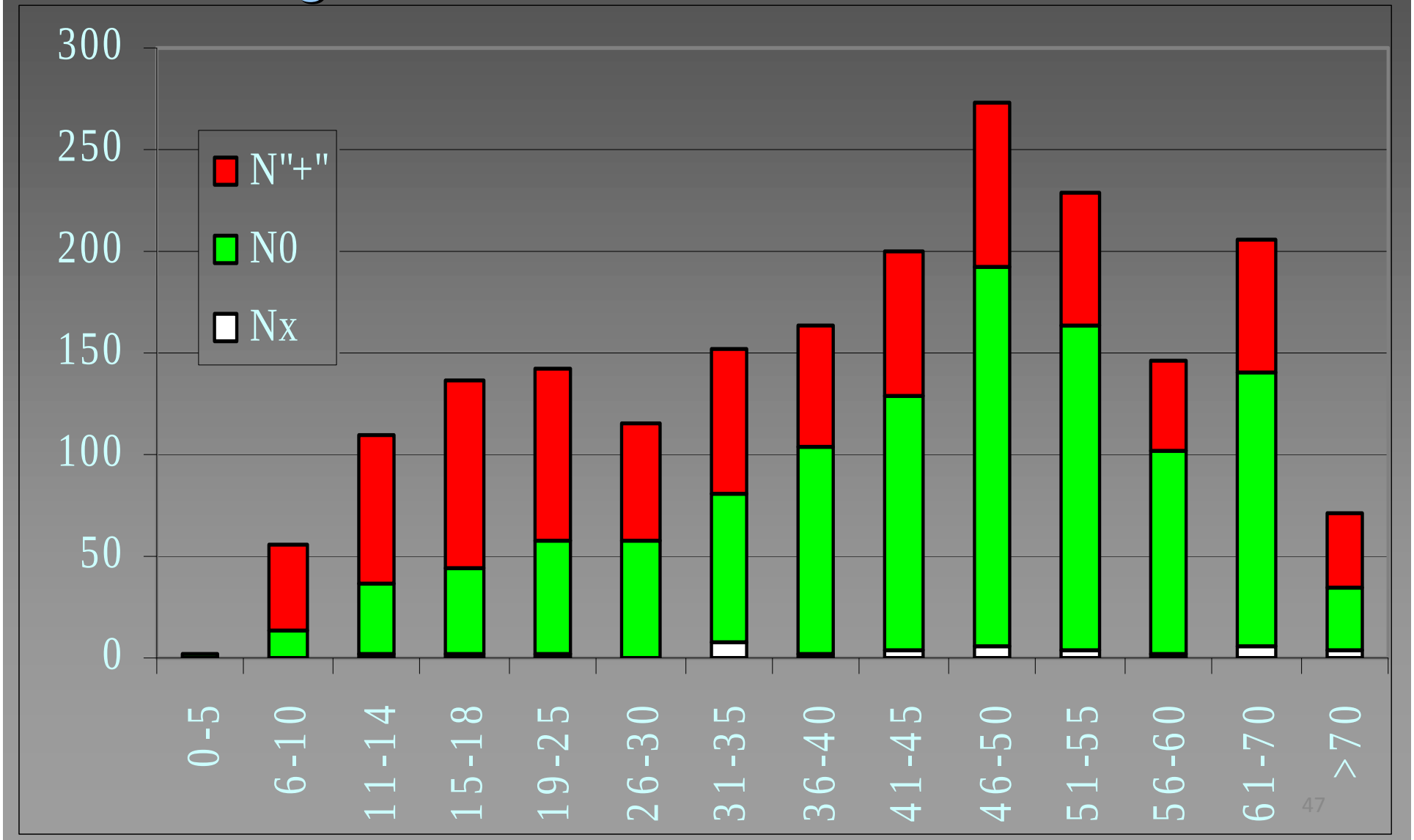


Percentage ratio of different morphological variants of thyroid cancer in Brest region 1990-2013

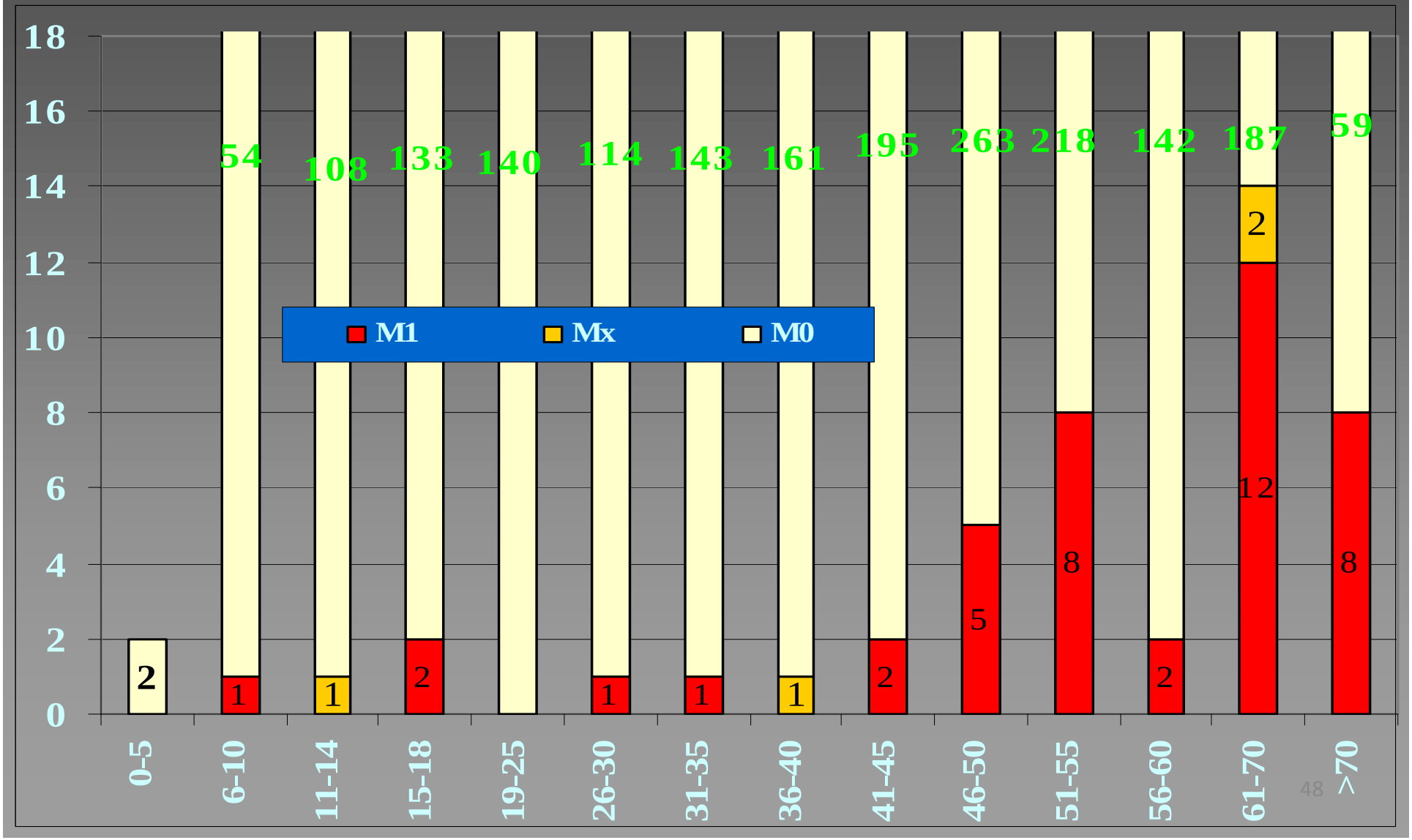
Brest Regional Dispensary statistic data



Distribution of Thyroid Cancer cases in different age groups according to TNM stages Brest region n=2000

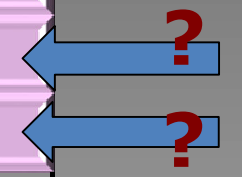


Distribution of Thyroid Cancer cases in different age groups according to TNM stages In Brest region n=1965



Thyroid average and collective doses /131-Iodine and number of thyroid cancer cases in Republic of Belarus

Contaminated territory	Average dose (mGy)			Collective dose	Number of Thyroid Cancer cases	
	0-7 years	14-18 years	adults	persone-Gy	Predicted	Real to 2005
Minsk oblast	22,9	7,1	7,4	14 530	101	124
Gomel oblast	475,8	145,0	148,1	321 750	569	509
Mogilev oblast	97,6	29,4	30,7	50 020	173	55
Brest oblast	77,8	23,9	24,7	45 170	49	223
Grodno oblast	16,7	5,2	5,4	7 780	20	49
Vitebsk oblast	5,5	1,6	1,7	2 720	8	16
Belarus	122	37	37	476 000	920	976



Gavrilin, Y., V. Khrouch, S. Shinkarev et al. Individual thyroid dose estimation for a case-control study of Chernobyl-related thyroid cancer among children of Belarus-part I: 131I, short-lived radioiodines (132I, 133I, 135I), and short-lived radiotelluriums (131mTe and 132Te). Health Phys. 86(6): 565-585 (2004).

Gavrilin, Y.I., V.T. Khrouch, S.M. Shinkarev et al. Chernobyl accident: reconstruction of thyroid dose for inhabitants of the Republic of Belarus. Health Phys. 76(2): 105-119 (1999).

Thyroid cancer in Belarus

- **The incidence of thyroid cancer in children is likely to be decreased;**
  - **2007- 11 newly diagnosed cases,**
  - **2010 – 11 cases,**
  - **2011 - 19 cases;**
- ***The incidence of thyroid cancer among older age groups of population is increasing***
  - **1993 – 484 cases**
  - **2010 – 1098 cases**
  - **2011 - 1165**

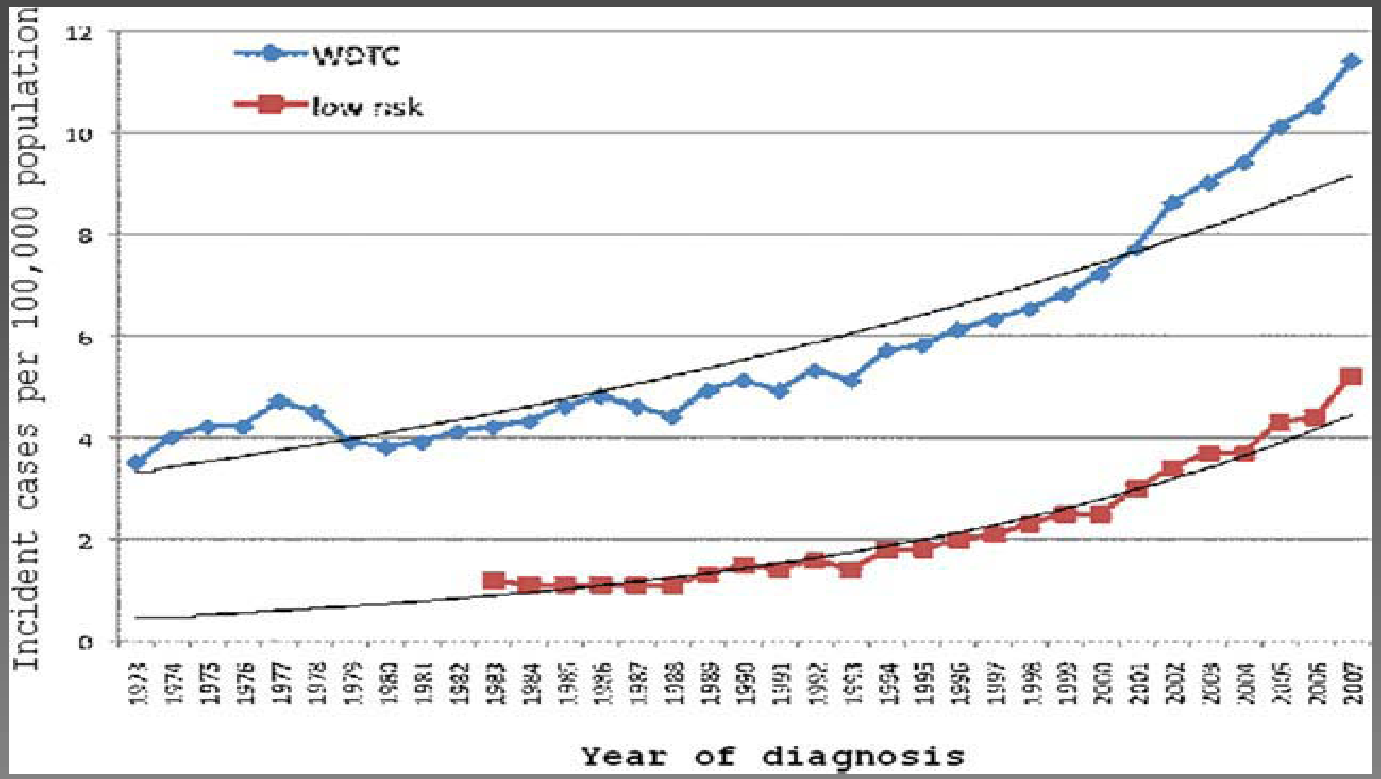
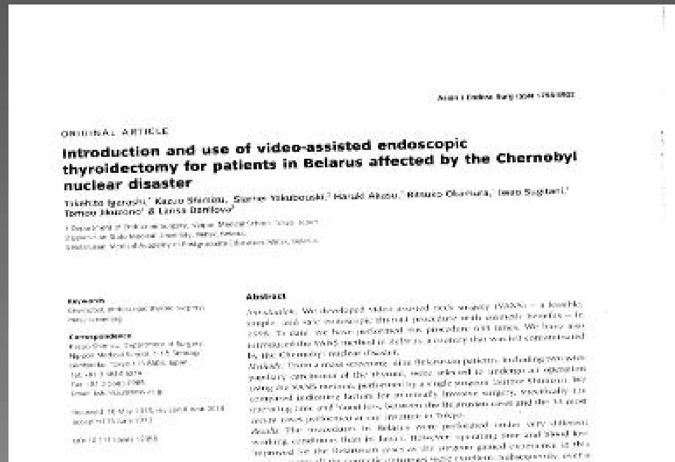


Fig. The incidence of well differentiated thyroid cancer (WDTC) over time is illustrated for all patients and for low risk patients

Gopalakrishna Iyer N, Morris L, Michael Tuttle R, ; Shaha A, Ganly I, Rising Incidence of Second Cancers in Patients With Low-Risk (T1N0) Thyroid Cancer Who Receive Radioactive Iodine Therapy. Cancer 2011; Published online in Wiley Online Library (wileyonlinelibrary.com)

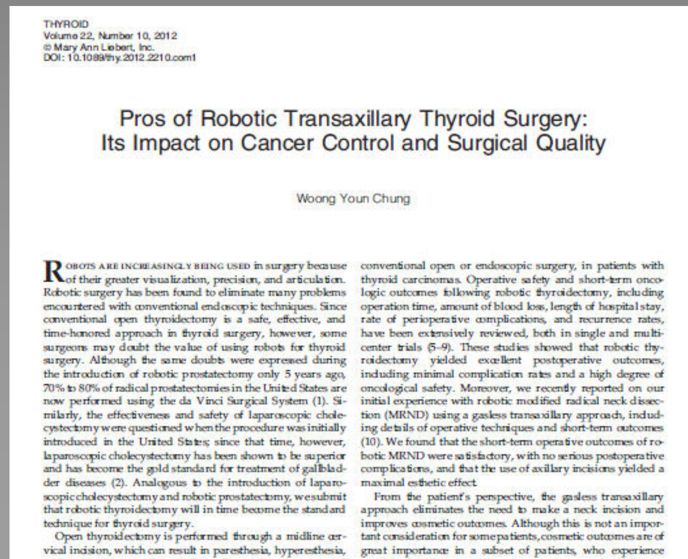
New surgical technologies in Nodular Thyroid disease



ORIGINAL ARTICLE

Introduction and use of video-assisted endoscopic thyroidectomy for patients in Belarus affected by the Chernobyl nuclear disaster

Abstract



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DOI: 10.1089/thy.2012.2210.com1

Pros of Robotic Transaxillary Thyroid Surgery: Its Impact on Cancer Control and Surgical Quality

Woong Youn Chung

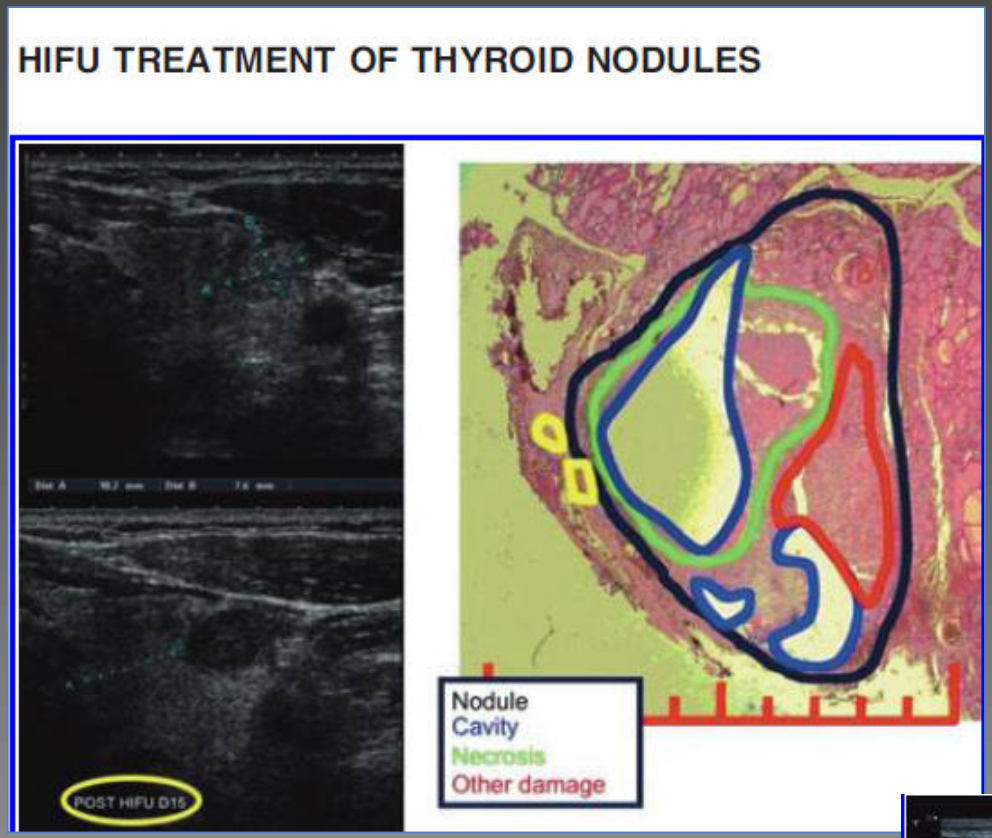
Robots are increasingly being used in surgery because of their greater visualization, precision, and articulation. Robotic surgery has been found to eliminate many problems encountered with conventional endoscopic techniques. Since conventional open thyroidectomy is a safe, effective, and time-honored approach in thyroid surgery, however, some surgeons may doubt the value of using robots for thyroid surgery. Although the same doubts were expressed during the introduction of robotic prostatectomy only 5 years ago, 70% to 80% of radical prostatectomies in the United States are now performed using the da Vinci Surgical System (1). Similarly, the effectiveness and safety of laparoscopic cholecystectomy were questioned when the procedure was initially introduced in the United States; since that time, however, laparoscopic cholecystectomy has been shown to be superior and has become the gold standard for treatment of gallbladder diseases (2). Analogous to the introduction of laparoscopic cholecystectomy and robotic prostatectomy, we submit that robotic thyroidectomy will in time become the standard technique for thyroid surgery.

Open thyroidectomy is performed through a midline cervical incision, which can result in paresthesia, hyperesthesia,

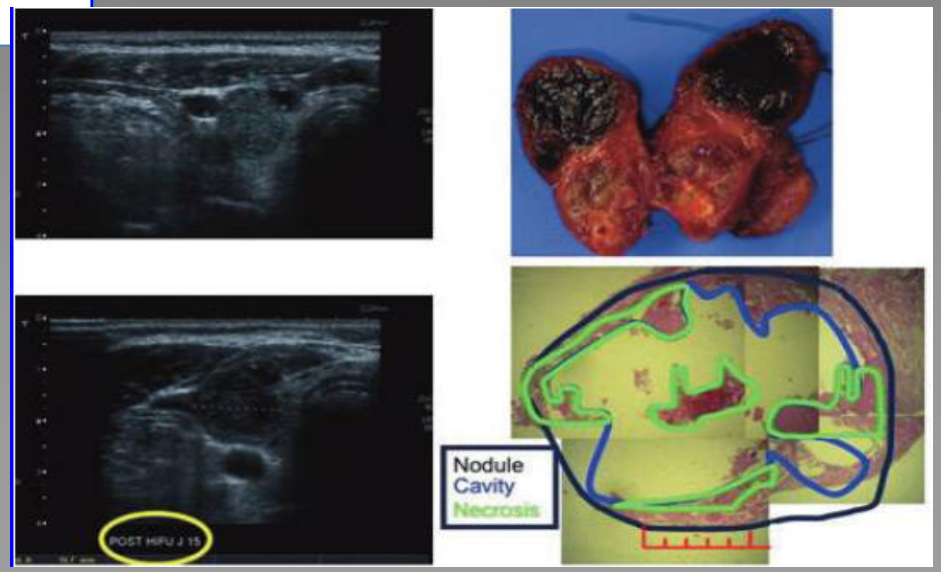
conventional open or endoscopic surgery, in patients with thyroid carcinomas. Operative safety and short-term oncologic outcomes following robotic thyroidectomy, including operation time, amount of blood loss, length of hospital stay, rate of perioperative complications, and recurrence rates, have been extensively reviewed, both in single and multicenter trials (5–9). These studies showed that robotic thyroidectomy yielded excellent postoperative outcomes, including minimal complication rates and a high degree of oncological safety. Moreover, we recently reported on our initial experience with robotic modified radical neck dissection (MRND) using a gasless transaxillary approach, including details of operative techniques and short-term outcomes (10). We found that the short-term operative outcomes of robotic MRND were satisfactory, with no serious postoperative complications, and that the use of axillary incisions yielded a maximal esthetic effect.

From the patient's perspective, the gasless transaxillary approach eliminates the need to make a neck incision and improves cosmetic outcomes. Although this is not an important consideration for some patients, cosmetic outcomes are of great importance in a subset of patients, who experience

Conservative Treatment of Thyroid Nodular Disease

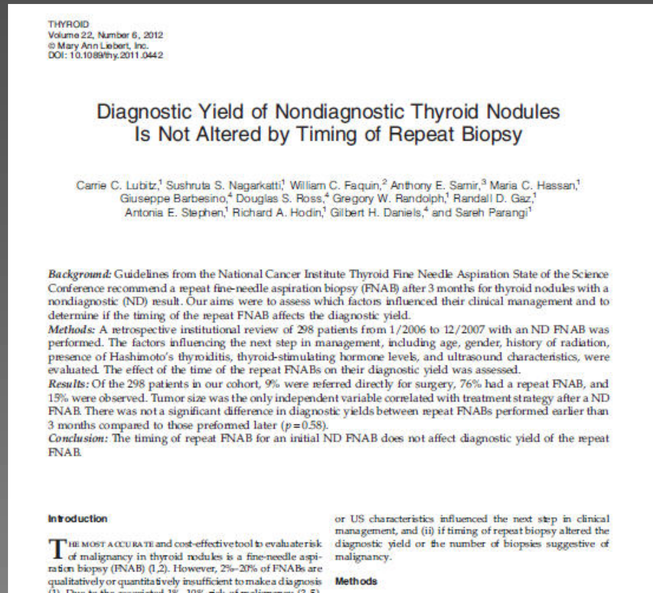


- New ablation technologies in Nodular Thyroid diseases



Thyroid nodules

- ***BRAF was found to be mutated (BRAFV600E) in 28–69% of PTC (Cohen et al. 2003, Fukushima et al. 2003, Kimura et al. 2003, Namba et al. 2003, Nikiforova et al. 2003, Soares et al. 2003, Xu et al. 2003, Trovisco et al. 2004, Xing et al. 2004).***
- ***BRAF is a non-receptor serine threonine kinase involved in the RAS/RAF/MAPK/ERK signaling cascade***



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Diagnostic Yield of Nondiagnostic Thyroid Nodules Is Not Altered by Timing of Repeat Biopsy

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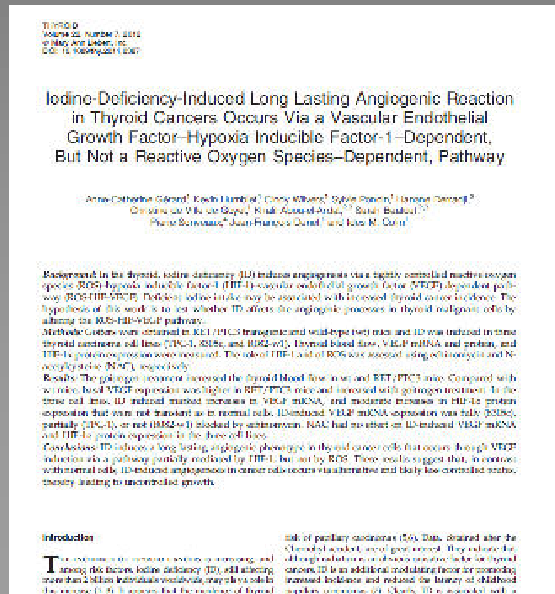
Background: Guidelines from the National Cancer Institute Thyroid Fine Needle Aspiration State of the Science Conference recommend a repeat fine-needle aspiration biopsy (FNAB) after 3 months for thyroid nodules with a nondiagnostic (ND) result. Our aims were to assess which factors influenced their clinical management and to determine if the timing of the repeat FNAB affects the diagnostic yield.
Methods: A retrospective institutional review of 298 patients from 1/2006 to 12/2007 with an ND FNAB was performed. The factors influencing the next step in management, including age, gender, history of radiation, presence of Hashimoto's thyroiditis, thyroid-stimulating hormone levels, and ultrasound characteristics, were evaluated. The effect of the time of the repeat FNABs on their diagnostic yield was assessed.
Results: Of the 298 patients in our cohort, 9% were referred directly for surgery, 76% had a repeat FNAB, and 15% were observed. Tumor size was the only independent variable correlated with treatment strategy after a ND FNAB. There was not a significant difference in diagnostic yields between repeat FNABs performed earlier than 3 months compared to those preformed later ($p = 0.58$).
Conclusion: The timing of repeat FNAB for an initial ND FNAB does not affect diagnostic yield of the repeat FNAB.

Introduction

THE MOST ACCURATE and cost-effective tool to evaluate risk of malignancy in thyroid nodules is a fine-needle aspiration biopsy (FNAB) (1,2). However, 2%–20% of FNABs are qualitatively or quantitatively insufficient to make a diagnosis

or US characteristics influenced the next step in clinical management, and (ii) if timing of repeat biopsy altered the diagnostic yield or the number of biopsies suggestive of malignancy.

Methods



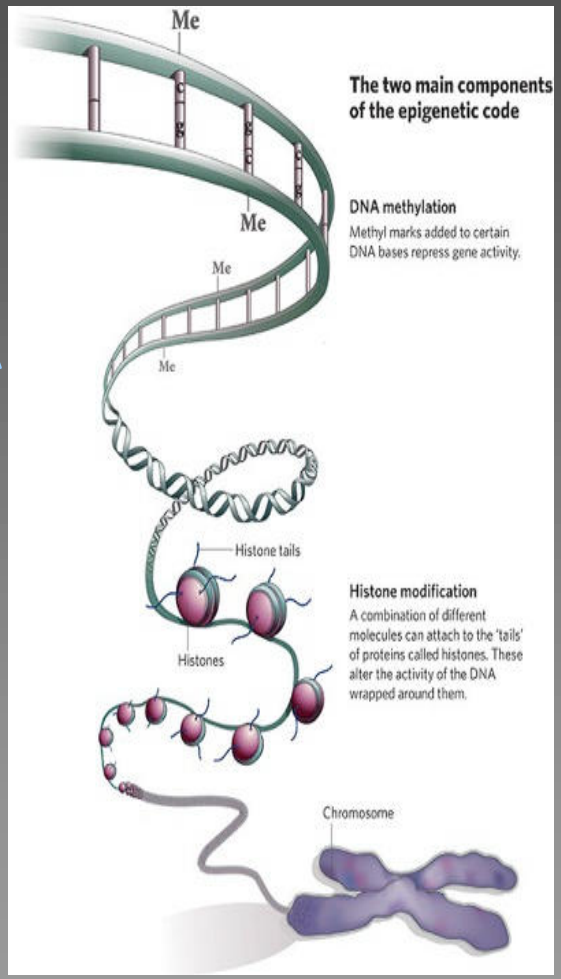
Iodine-Deficiency-Induced Long Lasting Angiogenic Reaction in Thyroid Cancers Occurs Via a Vascular Endothelial Growth Factor–Hypoxia Inducible Factor-1–Dependent, But Not a Reactive Oxygen Species–Dependent, Pathway

Personalized Thyroidology

- Personalized prophylaxes
- Personalized diagnosis
- Personalized treatment
- Personalized prognosis

Epigenetic therapy and prophylaxes

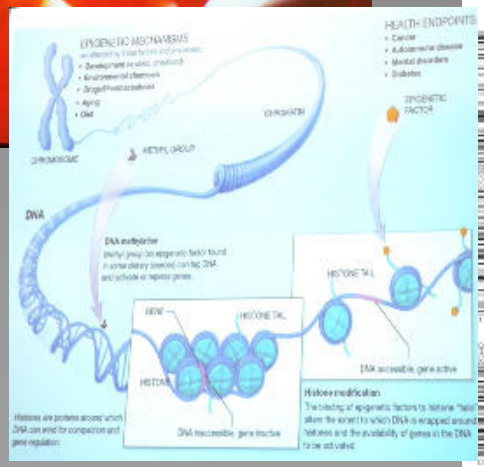
- The complexity of human carcinogenesis cannot be accounted for by genetic alterations alone, but also involves epigenetic changes in processes such as DNA methylation, histone modifications, and microRNA expression.
- In turn, these molecular alterations lead to permanent changes in the expression of genes that regulate the neoplastic phenotype, such as cellular growth and invasiveness.
- *Targeting epigenetic modifiers has been referred to as epigenetic therapy*

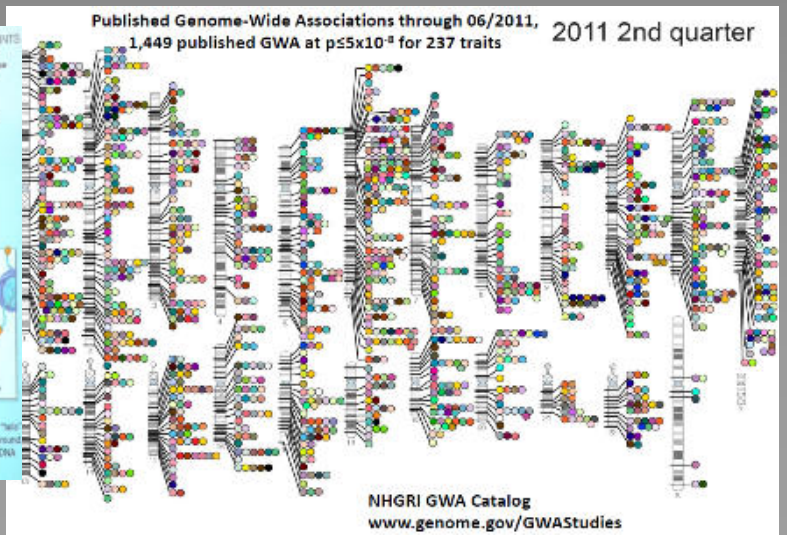


R.Taby, J.-P. J. Issa, Cancer J Clin 2010; W.G. Feero, et al. NEJM 362; 2010

Thyroid cancer in Belarus:
Personalized prognosis, diagnosis and treatment

- *Environmental chemicals*
- *Drugs/Pharmaceuticals*
- *Combined effect of radiation exposure and environmental factors*
- *Development in utero and in childhood*





Conclusion

- ***Continuation of active screening programs in contaminated and non contaminated regions of Belarus are required to elucidate the prevalence of widespread thyroid dysfunctions, early detection of thyroid cancer in high risk groups (those who had radiation exposure to the thyroid gland in utero and childhood, people living in the areas around Chernobyl or moved to other places after they had received radiation doses), and verified influence of endocrine disrupters in modifying epigenetic mechanisms or potentiate the carcinogenic effect of radiation exposure***

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Republican Oncology Center

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