

## **CHARACTERISTICS OF UROGENITAL CANCER INCIDENCE DYNAMICS IN UKRAINE AFTER THE CHERNOBYL ACCIDENT**

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**Summary.** The analysis of dynamics of incidence of urogenital system for the purpose of ascertainment of its characteristics in population of whole Ukraine and contaminated after the Chernobyl nuclear power plant accident oblasts has been performed. The rates have been calculated on the personal patients' data from National Cancer Registry database; methods of descriptive epidemiology, medical and mathematical statistics have been used. The analysis covered all cancer cases in Ukrainian population in 1998-2010 and tabular integrated retrospective incidence data of 1989-1996. It has been ascertained that urogenital cancer incidence of Ukrainian population has steadily increasing tendency with higher growth rates in the radiation-contaminated oblasts. Increment rate of kidney cancer incidence in 1986-2009 in all contaminated oblasts was higher than in whole Ukraine in female population, in male population of Vinnytska, Volynska, Zhytomyrska and Chernigivska oblasts it was higher than in whole Ukraine too. The results of the analysis become a scientific background for anti-cancer activity priorities that take into account the socioeconomic and gender characteristics of Ukrainian population.

**Key words:** cancer incidence, cancer epidemiology, personal data.

**Introduction.** Various nosological forms of malignant tumors caused by radiation have various latent periods, which can exceed 30 years and that is why study of possible oncological consequences of the Chernobyl accident are still actual. Our earlier studies of cancer incidence in population of Ukraine and contaminated after the accident territories during 20 years (1976-1996) found the reliable growth of cancer incidence rates in male, female and children population and steady increase of cumulative risk to get ill with cancer. The increasing incidence of young age groups of population was detected, likewise increasing cumulative cancer incidence risk for breast, thyroid gland and tumors of reticuloendothelial and lymphatic tissues, which are markers of radiation effect in population of contaminated with radiation oblasts. It is also known that radiation effect after the Chernobyl accident may extend on genitourinary organs – and this determined attention to the problem. Longtime monitoring the oncoepidemiological situation in Ukraine based on the records of Ukrainian National Cancer Registry makes feasible to detect variations of cancer incidence of Ukrainian population after the Chernobyl electric power station accident.

**Materials and methods.** Calculation of cancer incidence in Ukrainian population was carried out using personal records about cancer patients accumulated in Ukrainian National Cancer Registry (NCR) database. For the preceding creation of the NCR database period statistic tables (Forms № 61-ж and № 6) from all regions of Ukraine, which were verified for completeness and reliability at the time of statistical examinations, were used. It was ascertained that error of incidence rates is lower 5% that confirms statistical reliability of the rates calculated. Number of cancer cases for uterine body, ovary, prostate gland, kidney and bladder has become available in statistic tables since 1989 and that is why all rates for these nosologies have been analyzed since that year. In this study, methods of statistic analysis accepted in descriptive epidemiology and oncology were used. Data check of personal data records in NCR database has been performed with advanced procedures based on medical informatics principles and methods and rules of cancer registration.

**Results.** Most frequent sites of newly diagnosed cancers have been studied with the view of both quantitative and qualitative changes in cancer incidence of Ukrainian population in whole and in oblasts with the largest contamination with radiation. It was ascertained, that in 2010 10 most common cancer sites have different frequency values and rank orders in Ukraine and in the contaminated oblasts: cancer cases of bladder in male population took 6<sup>th</sup> place in the contaminated territories and 7<sup>th</sup> – in whole Ukraine. Cancer of bladder and kidney are not among the 10 most frequent cancer sites in female population, but growth rate of these cancers both in Ukraine and in the contaminated oblasts force to give special attention to study this phenomenon (Fig.1-2).

One of important characteristics of cancer effect on the population is a cumulative risk rate that defines probability to become ill with cancer during 75years of life. It was found that changes of cumulative risk are similar to those of cancer incidence rates (Table 1).

The highest value of cumulative risk of cancer in male population of Ukraine have malignant tumors of urogenital system, in addition during 1989-2010 cumulative risk for

prostate cancer became 2.3 times higher, for kidney cancer – 2.0 times higher, for bladder – 1.2 times higher. Cumulative risk of cancer of female population during the same period has grown both in whole Ukraine and contaminated territories, and the highest increment has been registered for urinary system.

Kidney cancer incidence in Ukrainian population has high growth rate and intensity of its growth in the radiation-contaminated oblasts exceeds that of other cancer nosological forms. Incidence rates of kidney cancer have increased 4.0 times in male population and 4.5 times in female population during 1989-2010 (Table 2, Fig. 3-4).

Incidence rate of kidney cancer of male population exceeded average level of Ukraine in 1989 in Rivnenska oblast, in 1998 - in Vinnytska, Zhytomyrska, Kyivska and Chernigivska oblasts, in 2010 - in Vinnytska and Chernigivska oblasts. Age-standardized rate, which does not depend on the population age structure, in all oblasts but Kyivska was higher than in Ukraine. The most significant increment of kidney cancer incidence rate was registered in Vinnytska, Zhytomyrska, Kyivska and Chernigivska oblasts in 1989-1998. Volynska and Rivnenska oblasts had almost no difference in increment rate of kidney cancer incidence in 1989-1998 and 1998-2010.

Cumulative cancer incidence risk for cancer of kidney in male population has increased in all contaminated with radiation oblasts: 4.7 times – in Volynska oblast, 3.3 times – in Zhytomyrska, 3.0 times - in Rivnenska and Chernigivska, 2.6 times – in Vinnytska, 1.8 times – in Kyivska oblast.

Kidney cancer incidence rate of Ukrainian female population was growing gradually but increment of this rate in the radiation-contaminated oblasts varied on the intervals 1989-1998 and 1998-2010 in different territories. In 1989-1998 the lowest increment - 2.7% - was in Vinnytska oblast, the highest one - 243.8 % - in Zhytomyrska oblast; as well, this increment in Rivnenska, Kyivska and Chernigivska oblasts was higher than in whole Ukraine. During the next period, the increment of kidney incidence rate reached 239.2 % - in Vinnytska oblast, 112.6 % - in Volynska and 89.5 % - in Chernigivska.

Cumulative incidence risk for cancer of kidney in female population of the contaminated with radiation oblasts have grown intensively: it became 6.0 times higher in Zhytomyrska oblast, 4.0 times higher - in Vinnytska, 3.5 times higher – in Volynska and Rivnenska oblasts, 3.0 times higher – in Chernigivska and 2.3 times higher – in Kyivska oblast.

Bladder cancer incidence of male population is on the 7<sup>th</sup> place among the most frequent cancer sites in Ukraine and on the 6<sup>th</sup> place in the radiation-contaminated oblasts. This site of cancer incidence draw attention since bladder is an organ of urinary excretion of hazardous substances, including radionuclides. Increment of incidence rate of male bladder cancer was stable during all interval of study with some scattering among oblasts (Table 3, Fig. 5). Increment of bladder cancer incidence of male population in the contaminated territories was lower than in whole Ukraine during 1989-2010 with the exception of Volynska oblast, where this increment reached 80.0%; peak value of the increment in Vinnytska, Zhytomyrska and Kyivska oblasts was in 1998-2010, in Volynska, Rivnenska and Chernigivska oblasts – in 1989-1998.

Cumulative bladder cancer incidence risk in male population increased 1.2 times – in Vinnytska oblast, 1.4 times – in Volynska, 1.5 times - in Zhytomyrska oblast, and in Kyivska, Rivnenska and Chernigivska oblasts this risk remained unchanged.

Increment of incidence rate of bladder cancer in female population in 1989-2010 was 75.0% in whole Ukraine, in Zhytomyrska oblast it was 123.1 % and in Rivnenska oblast - 172.7% (Table 3, Fig. 6).

Age-standardized incidence rates of bladder cancer of female population in 1989 varied from 0.5<sup>0</sup>/0000 in Zhytomyrska oblast to 1.8<sup>0</sup>/0000 – in Kyivska, in Volynska and Chernigivska oblasts this rate exceeded level of whole Ukraine. In 2010, only in Vinnytska oblast this rate was higher than in whole Ukraine, the rates of other oblasts were 1.5-1.7<sup>0</sup>/0000.

Bladder cancer cumulative incidence risk in female population has increased 3.0 times in Vinnytska oblast, 50 times – in Zhytomyrska, 200 times – in Rivnenska and remained unchanged in Volynska, Kyivska and Chernigivska oblasts.

Incidence rate of prostate cancer was increasing during all period of study, in Ukraine it has grown 2.9 times, and in the radiation-contaminated territories its increasing varied from 1.7 times in Rivnenska oblast to 2.7 – in Volynska; age-standardized rates increments were lower (Table 4, Fig. 7).

In 1989 in all contaminated oblasts but Zhytomyrska level of prostate cancer incidence was higher than in whole Ukraine; in 1998 prostate cancer incidence rates in Zhytomyrska and Rivnenska oblasts were lower than in whole Ukraine, and in 2010 lower than in Ukraine rates were registered in Volynska, Zhytomyrska and Rivnenska oblasts.

There were detected some peculiarities of increment of prostate cancer incidence rate in the contaminated territories: in 1989-2010 rates of all oblasts were lower than average Ukrainian rate (Fig. 8). However, comparing of two intervals of the study, 1989-1998 and 1998-2010, showed that in Vinnytska oblast during the first period this increment was 118.9% and during the next one it was 15.3%, and on the contrary in Rivnenska oblast during the first period prostate cancer incidence rate decreased by 13.7% and during the next one it increased by 97.7%.

Prostate cancer cumulative incidence risk became 3.7 times as much in Volynska oblast, 2.5 times – in Kyivska, 2.2 times – in Vinnytska, 1.3 times – in Zhytomyrska, Rivnenska and Chernigivska oblasts.

Variations of female genitals cancer incidence rates attract special attention due to the effect on the reproductive function. Frequency of ovary cancer cases takes 8<sup>th</sup> place among the most common diagnosed cancers of female population of Ukraine and its frequency has grown up and got 6<sup>th</sup> place in the contaminated areas. During 1989-2010 average for Ukraine incidence level of ovary cancer was exceeded in Kyivska oblast only (Table 5, Fig. 9). In Vinnytska, Volynska, Kyivska, Rivnenska and Chernigivska oblasts increment of ovary cancer incidence cumulative risk was on the average Ukrainian level and tended to increase; in Zhytomyrska oblast it became 1.7 higher.

Increment of incidence rate of ovary cancer occurred substantially during 1998-2010 (Fig. 10); age-standardized incidence rate had similar behavior. During 1989-1998 ovary cancer incidence rates in Vinnytska and Volynska oblasts have decreased with

subsequent increasing during the next period of study. As opposed to this tendency, in Chernigivska oblast maximal increment of this rate was in 1989-1998 with further decrease during the next period. Incidence rates of ovary cancer in Zhytomyrska and Kyivska oblasts exceeded the average Ukrainian level 2.1-2.5 times and were permanently growing.

Uterine body cancer incidence is stably growing both in Ukraine, with increment 61.3%, and in the contaminated oblasts – with increment 38.7-93.7% (Table 1). This nosological form of cancer was the 3<sup>rd</sup> among the most frequently diagnosed cancers; excess of average Ukrainian level was in Volynska oblast in 1989 and in Kyivska – in 2010. There was not found clear regularity in varying of growth rate of cancer incidence of uterine body with time and that is why detailed analysis of this incidence in connection with effect of Chernobyl accident needs to be postponed to further period.

**Conclusion.** The detected features of oncoepidemiological process give evidence of real possibility for urinary system to be involved in evacuation of radioactive substances from organisms of residents of the contaminated territories. The epidemiological process of kidney cancer incidence in female Ukrainian population resembles one of thyroid cancer incidence when relatively low value of the rate demonstrates its high increment: 158.3% in Ukraine and up to 412.3% in Zhytomyrska oblast.

Dynamic models of progress of genital system cancer incidence both in male and female population did not show any considerable difference between whole Ukraine and radiation-contaminated oblasts with the exception of ovary cancer incidence, which is notable for its more intensive increment rates.

Table 1. Cumulative cancer incidence risk (under the age of 75), %.

Site	Ukraine		Vinnytska		Volynska		Zhytomyrska		Kyivska		Rivnenska		Chernigivska	
	1989	2010	1989	2010	1989	2010	1989	2010	1989	2010	1989	2010	1989	2010
	Males													
Kidney	0,6	1,0	0,5	1,3	0,3	1,4	0,4	1,3	0,6	1,1	0,8	1,4	0,4	1,3
Bladder	1,4	1,7	1,5	1,8	1,2	1,7	1,4	1,8	1,7	1,7	1,1	1,4	1,4	1,7
Prostate gland	1,3	2,8	1,4	3,0	0,9	3,3	1,6	2,0	1,1	2,8	1,7	2,2	1,4	2,3
	Females													
Kidney	0,3	0,6	0,2	0,8	0,2	0,7	0,1	0,6	0,3	0,7	0,2	0,7	0,2	0,6
Bladder	0,1	0,2	0,1	0,3	0,2	0,2	0,04	0,2	0,2	0,2	0,01	0,2	0,2	0,2
Ovary	1,2	1,2	0,9	1,0	1,1	1,4	0,8	1,4	1,2	1,5	1,2	1,2	0,8	0,9
Uterine body	1,4	2,2	1,2	2,1	1,7	2,9	1,2	2,0	1,4	2,4	1,0	2,7	0,9	1,8

Table 2. Kidney cancer incidence rates.

Administrative territory	Incidence rate per 100,000 of population						Increment, %		
	Crude			Age-standardized			1989-2010	1989-1998	1998-2010
	1989	1998	2010	1989	1998	2010			
Males									
Ukraine	6,0	13,4	14,8	5,0	7,4	10,7	146,6	66,4	48,1
Vinnyska	5,3	16,8	17,1	4,0	8,4	12,0	222,6	135,7	36,9
Volynska	5,0	7,0	12,8	4,5	7,3	10,8	156,0	54,6	65,6
Zhytomyrska	3,7	14,0	14,1	2,9	6,2	10,8	283,1	122,0	72,6
Kyivska	5,4	15,2	12,8	5,3	7,6	9,2	135,8	73,7	35,7
Rivnenska	7,1	9,1	14,7	6,6	9,2	12,9	107,0	39,6	48,3
Chernigivska	5,4	15,2	16,1	3,7	8,8	11,0	196,6	136,6	25,4
Females									
Ukraine	3,6	5,6	9,3	2,3	3,5	5,5	158,3	55,6	66,1
Vinnyska	3,3	3,4	11,5	1,7	2,4	7,3	248,5	2,7	239,2
Volynska	2,9	4,3	9,1	2,1	3,1	6,4	213,8	47,6	112,6
Zhytomyrska	1,6	5,5	8,2	0,9	4,6	5,6	412,5	243,8	49,1
Kyivska	3,3	6,0	9,4	2,2	3,6	6,4	184,8	81,8	56,7
Rivnenska	2,4	5,3	8,1	1,7	3,9	5,8	237,5	121,3	52,5
Chernigivska	3,1	5,7	10,8	1,9	3,5	5,3	248,4	83,9	89,5

Table 3. Bladder cancer incidence rates.

Administrative territory	Incidence rate per 100,000 of population						Increment, %		
	Crude			Age-standardized			1989-2010	1989-1998	1998-2010
	1989	1998	2010	1989	1998	2010			
Males									
Ukraine	13,4	16,8	20,2	11,2	11,8	13,2	50,9	25,4	20,4
Vinnyska	16,8	17,5	23,9	12,2	12,0	14,4	42,3	4,3	36,3
Volynska	7,0	12,3	12,6	5,9	9,7	9,6	80,0	75,6	2,5
Zhytomyrska	14,0	16,6	21,0	10,9	10,9	14,0	49,8	18,7	26,3
Kyivska	15,2	17,7	21,6	12,6	13,1	14,6	42,4	16,6	22,1
Rivnenska	9,1	11,5	13,2	8,4	10,2	10,6	45,1	26,5	14,7
Chernigivska	15,2	22,1	22,5	10,3	13,4	12,8	48,4	45,9	1,7
Females									
Ukraine	2,4	2,9	4,2	1,3	1,5	2,0	75,0	20,8	44,8
Vinnyska	2,7	2,2	4,8	1,0	1,1	2,3	77,8	-18,9	119,2
Volynska	2,3	2,0	3,5	1,4	1,0	1,6	52,2	-14,8	78,6
Zhytomyrska	1,3	3,9	2,9	0,5	2,1	1,5	123,1	200,0	-25,6
Kyivska	3,8	3,1	3,6	1,8	1,4	1,7	-5,3	-18,4	16,1
Rivnenska	1,1	1,8	3,0	0,6	1,1	1,7	172,7	60,9	69,5
Chernigivska	3,7	3,8	4,0	1,4	1,5	1,6	8,1	2,9	5,1

Table 4. Prostate gland cancer incidence rates.

Administrative territory	Incidence rate, per 100,000 of population						Increment, %		
	Crude			Age-standardized			1989-2010	1989-1998	1998-2010
	1989	1998	2010	1989	1998	2010			
Ukraine	12,0	19,0	34,4	10,1	13,1	21,6	187,3	58,6	81,1
Vinnytska	14,7	32,2	37,1	10,5	20,4	22,0	152,4	118,9	15,3
Volynska	12,6	21,8	33,4	10,7	16,8	25,2	165,1	73,1	53,1
Zhytomyrska	16,0	16,8	24,4	12,4	11,5	15,4	52,5	4,9	45,4
Kyivska	14,2	21,7	33,3	9,5	16,0	21,3	134,4	52,4	53,8
Rivnenska	12,3	10,6	21,0	11,5	9,5	16,9	70,7	-13,7	97,7
Chernigivska	14,2	22,3	36,0	9,4	13,2	18,6	153,4	56,9	61,4

Table 5. Ovary cancer incidence rates.

Administrative territory	Incidence rate per 100,000 of population						Increment, %		
	Crude			Age-standardized			1989-2010	1989-1998	1998-2010
	1989	1998	2010	1989	1998	2010			
Ukraine	15,4	15,8	17,0	10,5	10,1	10,8	10,4	2,6	7,6
Vinnytska	13,8	11,5	15,0	8,2	8,1	9,7	8,7	-16,7	30,4
Volynska	14,5	12,3	15,9	10,4	9,8	12,0	9,7	-15,2	29,3
Zhytomyrska	10,9	12,2	13,7	7,0	8,3	9,9	25,7	11,9	12,3
Kyivska	16,3	17,8	19,9	11,3	12,0	13,4	22,1	9,2	11,8
Rivnenska	13,4	13,3	15,7	9,9	11,0	11,6	17,2	-0,7	18,0
Chernigivska	12,0	17,1	13,1	6,9	10,8	8,0	9,2	42,5	-23,4



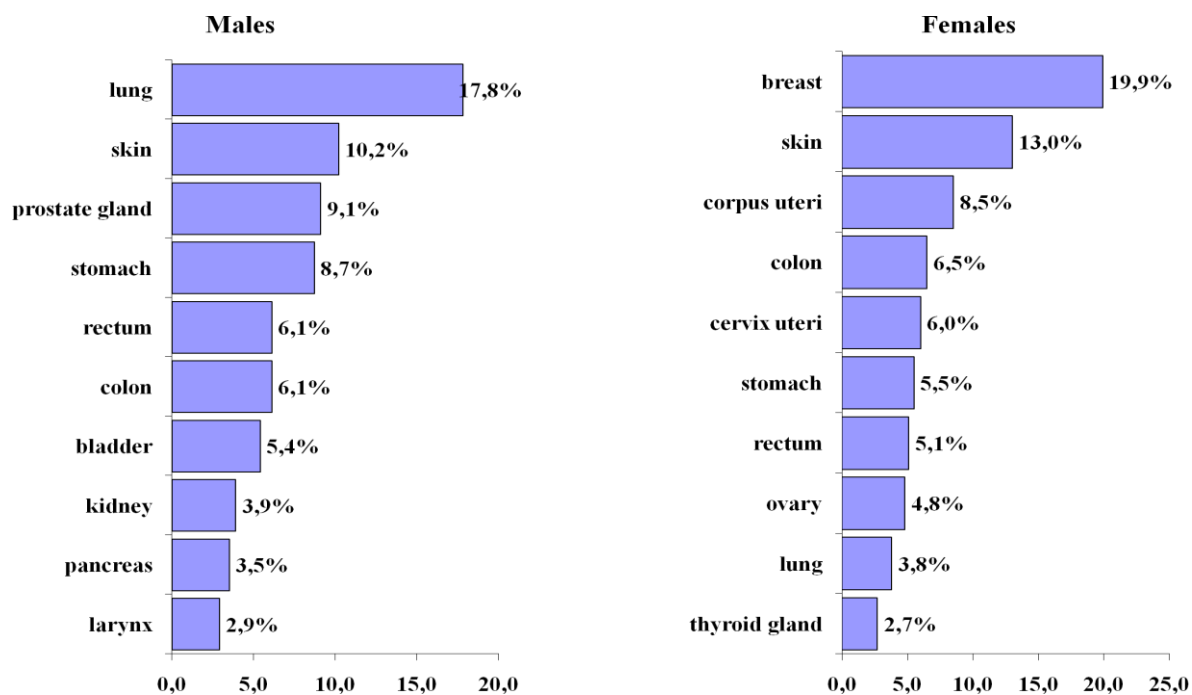


Figure 1. 10 most commonly diagnosed cancer sites, Ukraine, 2010.

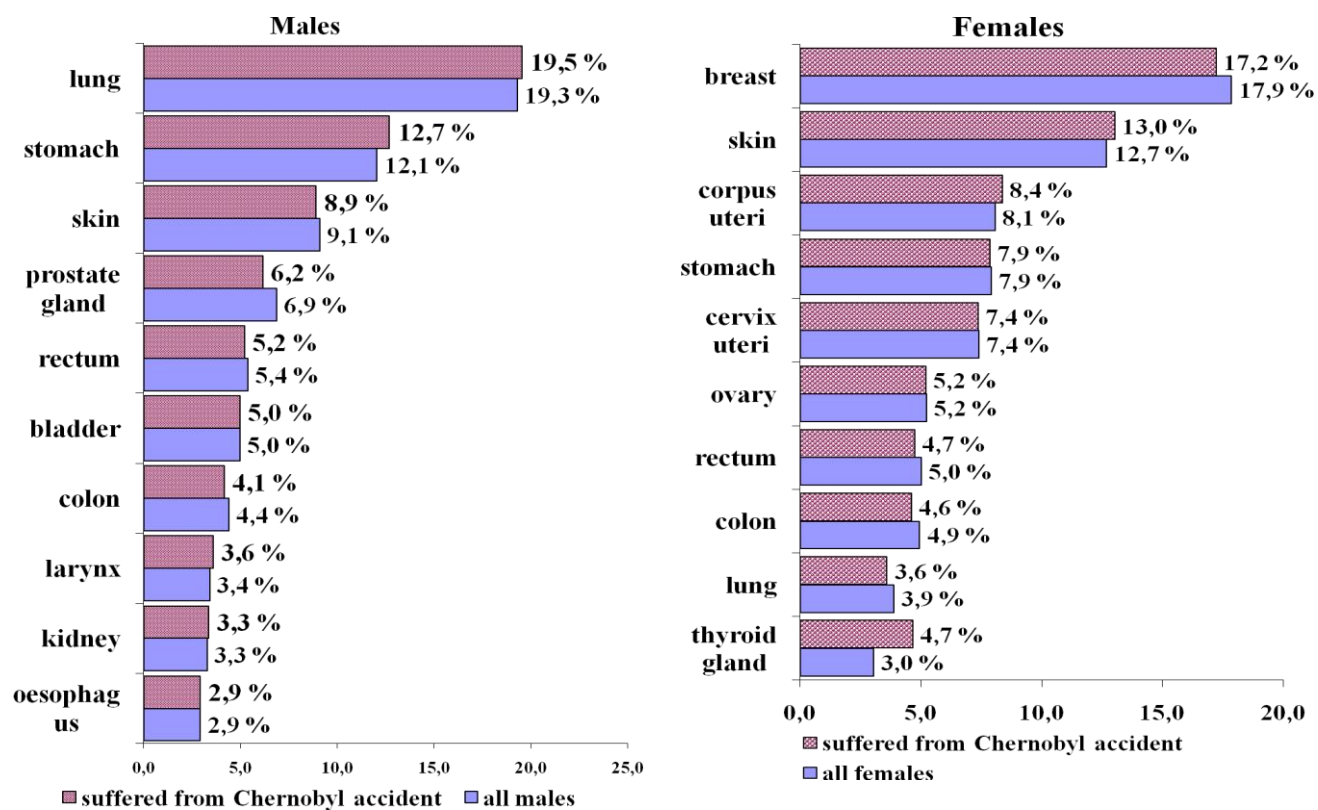


Figure 2. 10 most commonly diagnosed cancer sites, radiation-contaminated oblasts, 2010.

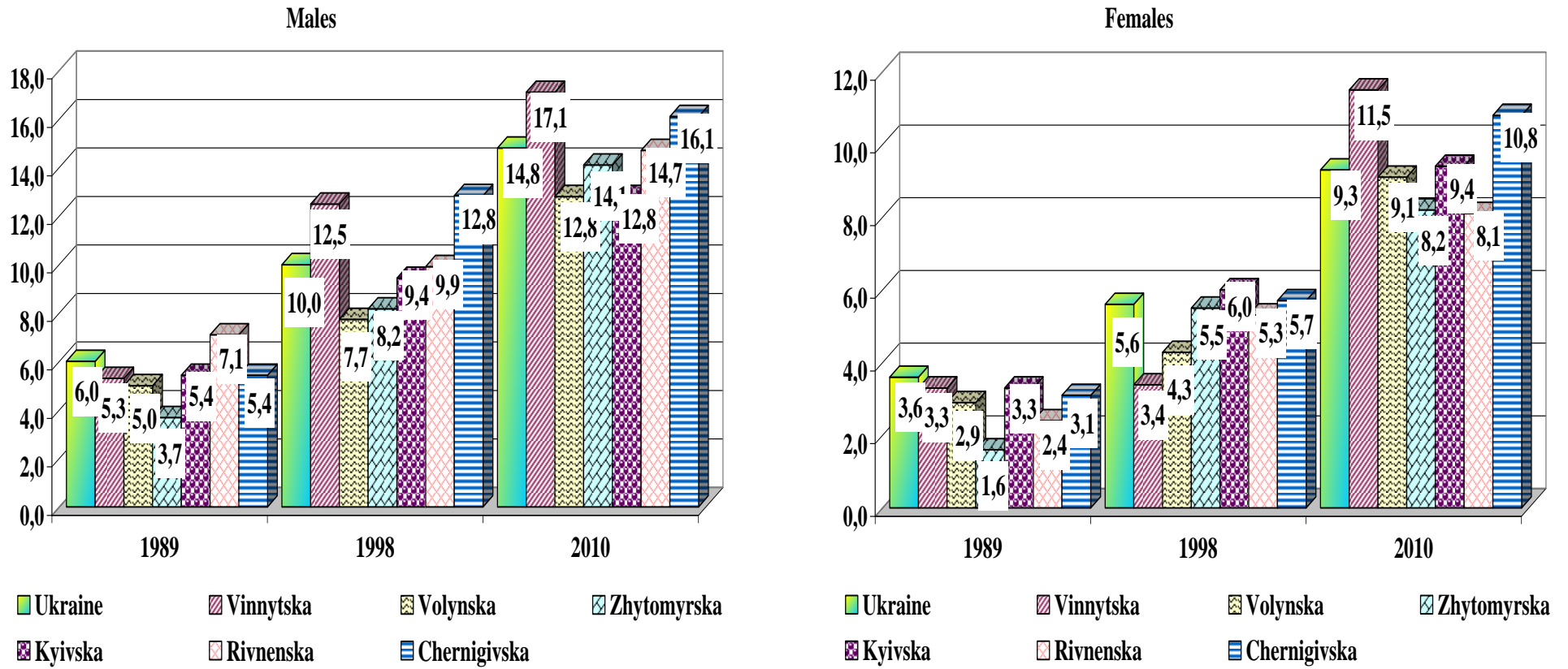


Figure 3. Kidney cancer incidence rates, per 100,000 of population of the corresponding sex.

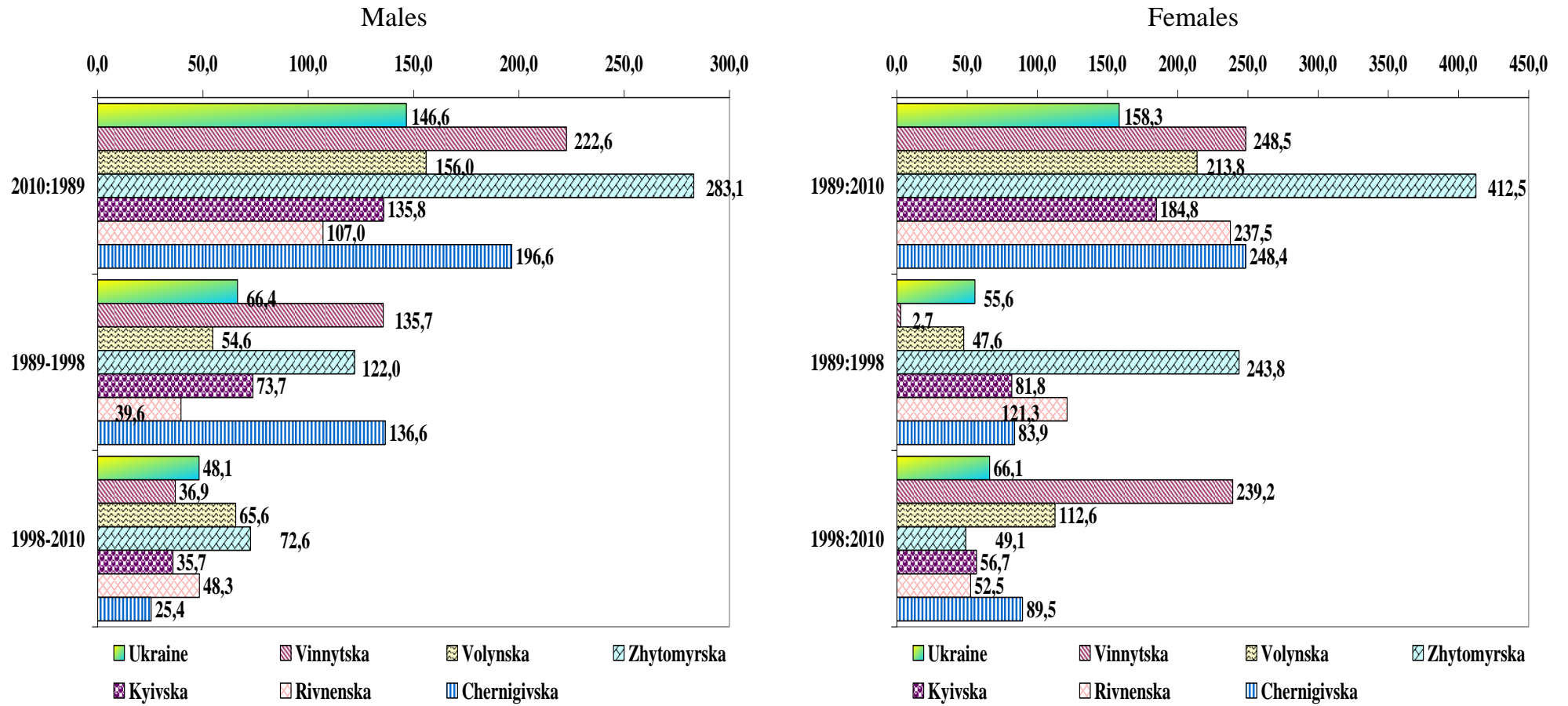


Figure 4. Increment of kidney cancer incidence rate, %

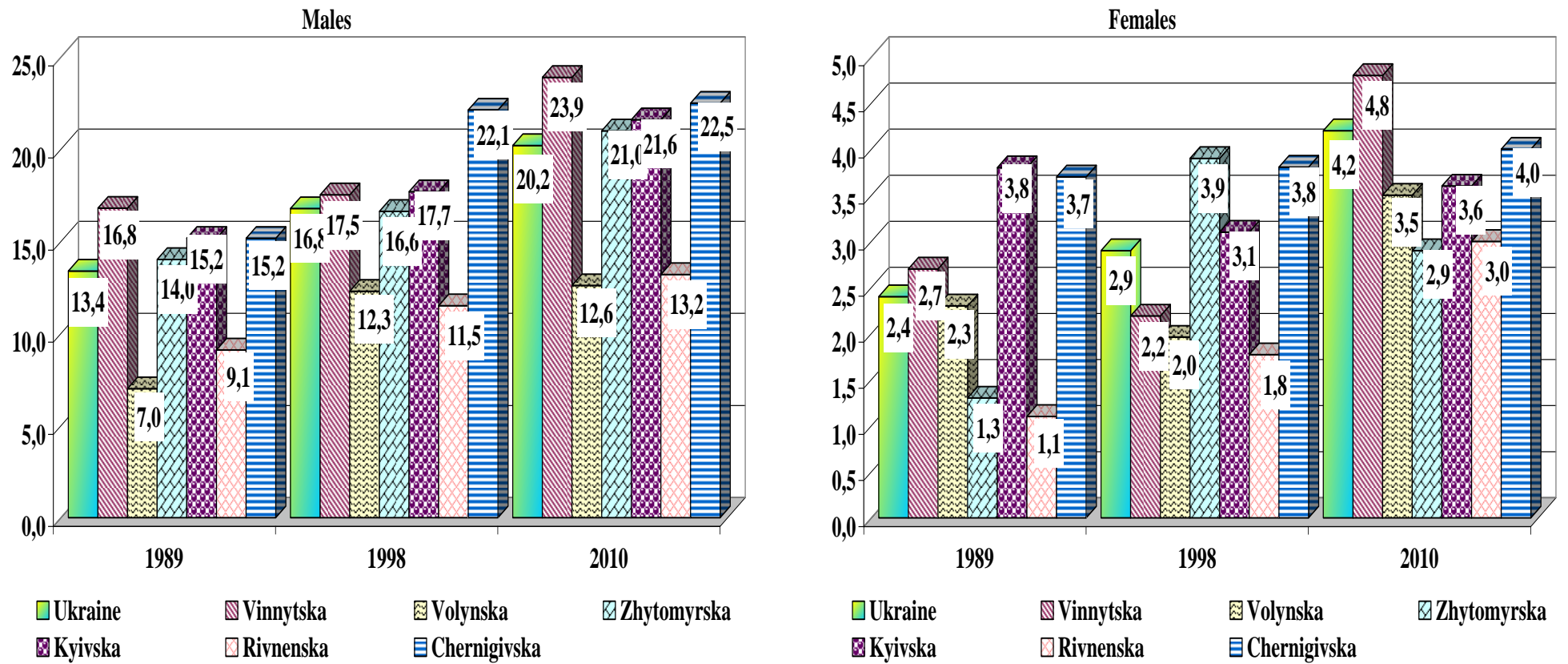


Figure 5. Bladder cancer incidence rates, per 100,000 of population of the corresponding sex

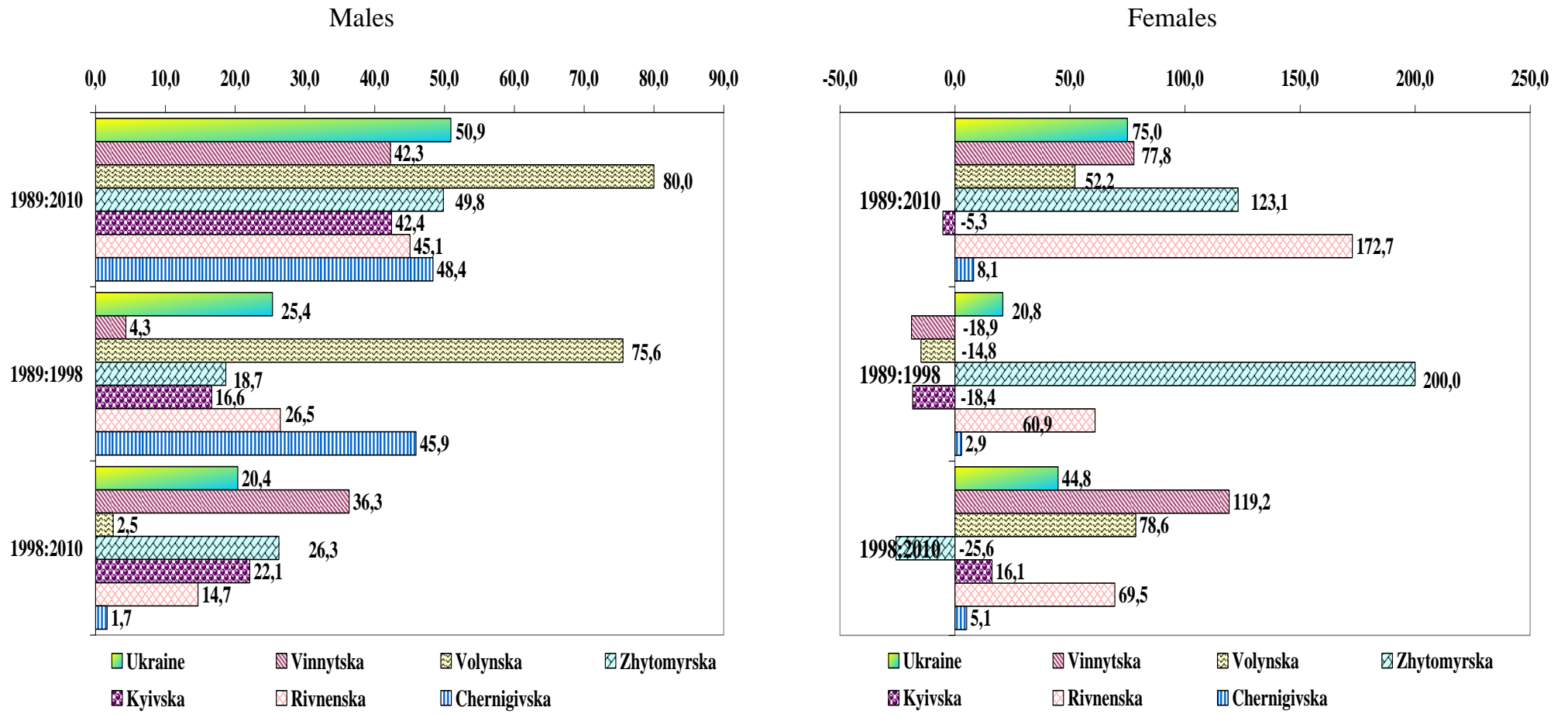


Figure 6. Increment of bladder cancer incidence rate, %

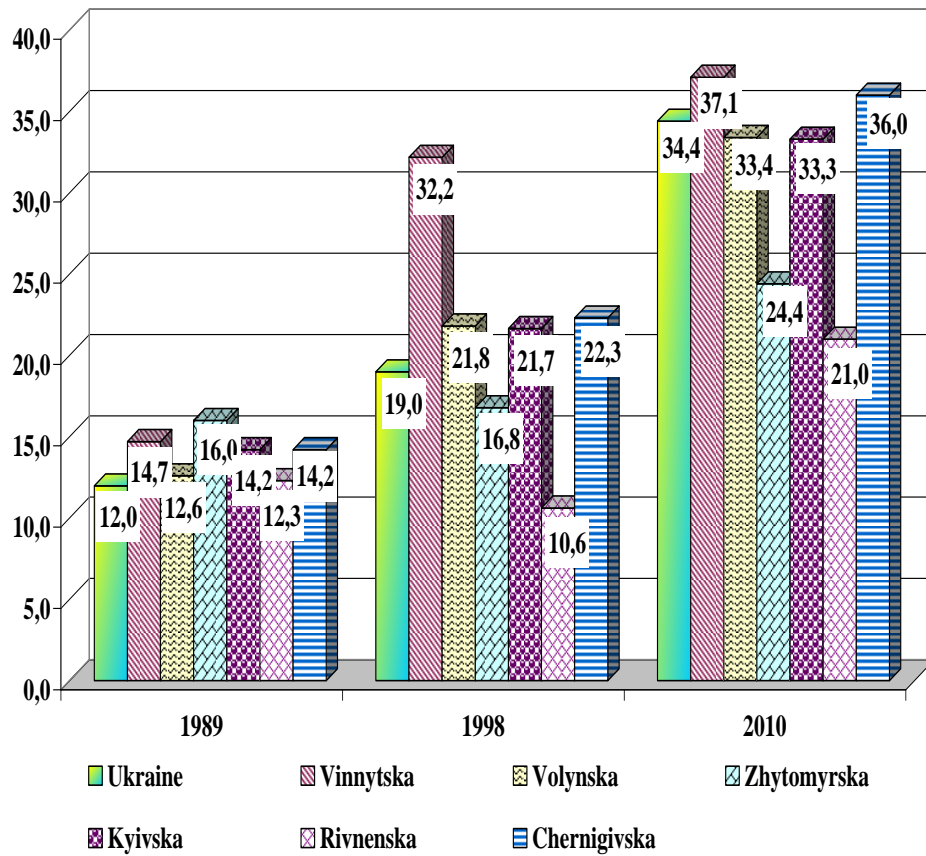


Figure 7. Prostate cancer incidence rates, per 100,000 of male population.

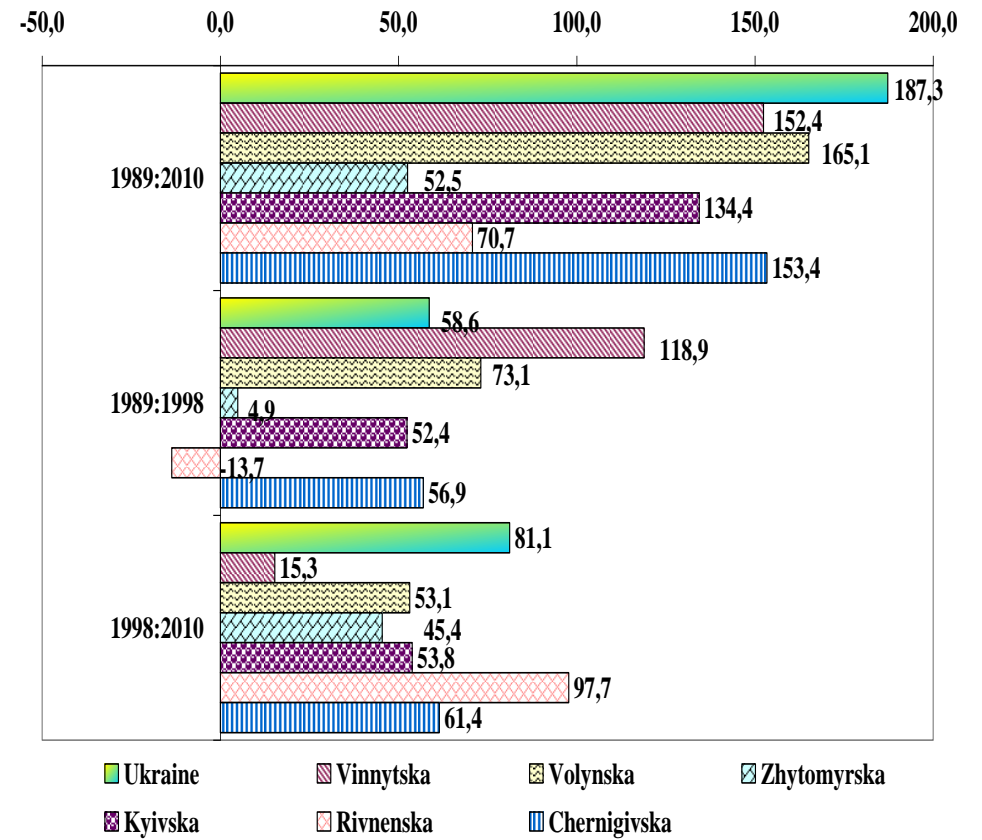


Figure 8. Increment of prostate cancer incidence rate, %.

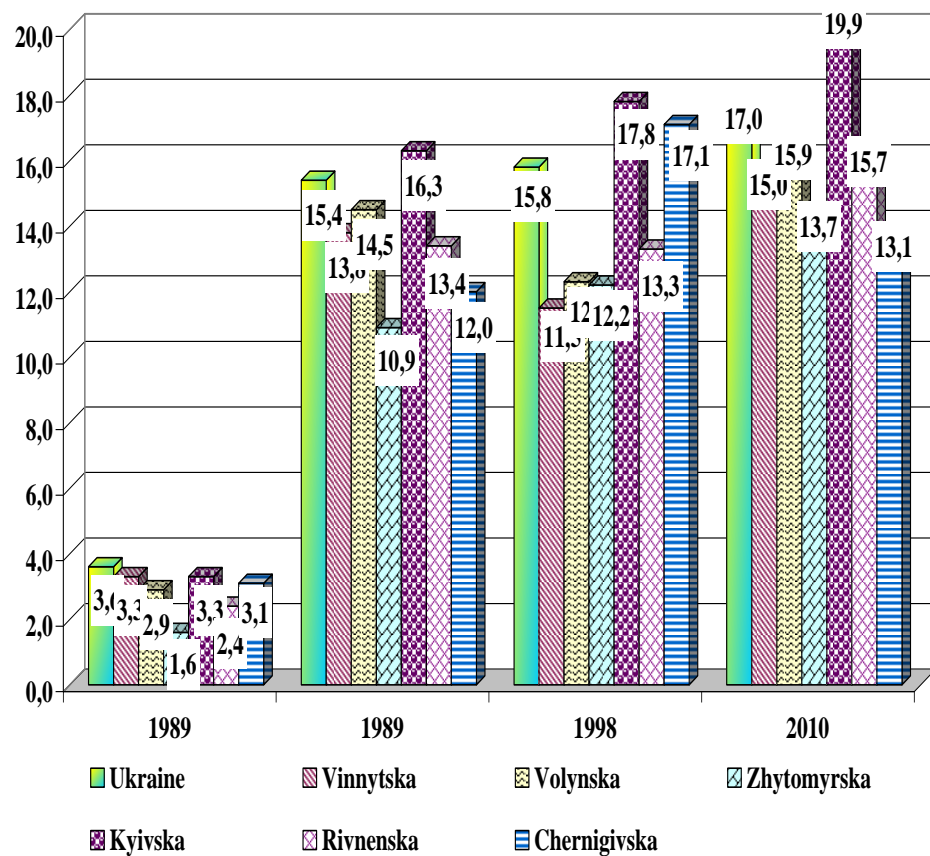


Figure 9. Ovary cancer incidence rates, per 100,000 of female population.

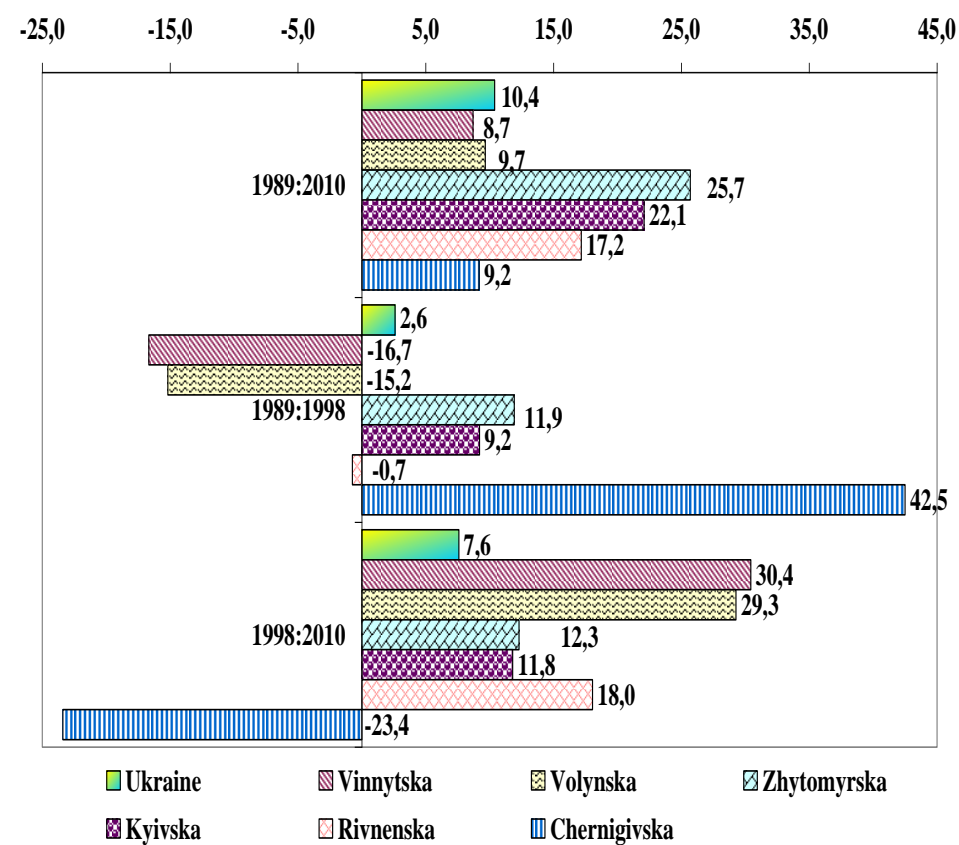


Figure 10. Increment of ovary cancer incidence rate, %.