

AN UPDATE OF THE FREQUENCY AND TYPE OF DIAGNOSTIC X-RAY EXAMINATIONS IN POLAND

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Abstract. This paper presents the results of a survey concerning x-ray diagnostic examinations in Poland, as the main source of radiation risk to the general population. The methods of data collection and processing were similar to that used for the previous national survey (1986). In 1995, 27,600,000 diagnostic x-ray examinations were performed in Poland (6,200,000 more than in 1986). The number of examinations per 1,000 inhabitants increased from 572 to 715 during those nine years.

The age and gender structure of examined patients is discussed extensively, the numbers for 1986 and 1995 are compared. Special attention is paid to the proportion of children and adolescents in the total number of patients examined.

The obtained results are also compared with the numerical data concerning other countries.

INTRODUCTION

In all the countries advanced in technology, the majority of radiation exposures of the general population from artificial sources result from medical application of ionizing radiation.

Special attention is paid to x-ray examinations, as the most widespread application of medical exposure.

The last national survey of x-ray diagnostics in Poland was based on the 1986 data. It was estimated that 21,400,000 x-ray examinations were performed within a one-year period, i.e. 572 examinations per 1,000 inhabitants (1).

This number may have been altered in recent years as a result of some changes in the needs and organization of health care in Poland, as well as in the technological advancement of radiology imaging procedures.

The aim of the present study was to determine the number of diagnostic x-ray examinations performed in Poland in 1995, together with the age and gender distribution of patients, and to compare the results with the respective values obtained from the previous national survey.

MATERIALS AND METHODS

Information on the number and type of x-ray examinations was collected by a questionnaire mailed to the clinics and outpatient departments performing x-ray examinations. As opposed to the previous survey (1986), covering the whole country, the survey of 1995 was limited to 14 (out of 49) voivodships, about one third of Poland. As concluded in the previous survey, a share of specialistic examinations in the total number of x-ray examinations is related to the level of industrialisation in a given region. All the 49 voivodships were divided into four groups according to their industrial progress (the level of the industrial progress was estimated as the ratio of industrial workers to the total working population).

Consequently, about one third of the voivodships from each group was selected for the survey. The voivodships in individual groups were chosen at random. Such a method of selection guaranteed that the sample of voivodships covered by the survey was representative for the entire country with regard to x-ray diagnostics.

The number of inhabitants in the voivodships chosen for this study constituted 37% of the total population of Poland.

The questionnaire form contained information about the type of x-ray examination, indicating the projection and the number of exposures as well as the age and gender of patients.

The dates of inquiry were selected with regard to seasonal variations in the number of x-ray examinations during particular months of the year, and possible alterations to the type of examinations during particular days of the week.

The details concerning the methods of data sampling were as described previously (1).

Out of 914 diagnostic x-ray facilities to which the questionnaire forms were mailed in 1995, the answers were received from 667 laboratories (73%).

All the collected data were entered into the data base, using a specially prepared computer code, and then were analysed with the same method as the one used in 1986 (1).

Two sources of error can be possibly attributed to the method applied for the data collection:

- the evaluation of one-year period on the basis of data that covered only 5 working days,
- the evaluation based on the data obtained from only 73% of the laboratories examined.

The first source of error was analysed in detail during the previous survey by comparing the real one-year data, registered in documents of x-ray facilities, with the evaluated questionnaire data (1). Such a comparison was performed for a representative group of x-ray facilities in the Łódź voivodship. As the credibility of data collected by means of the questionnaire was judged to be independent of the time of examination as well as of the number of districts covered by the survey, the value of previously estimated error (i.e. $\Delta_1 = 7\%$) was adopted as valid for the present study.

The second source of error was related to the number of examined x-ray laboratories and to the fraction of the returned questionnaires. Thus, this component of the error was computed again in the present study being equal $\Delta_2 = 7.3\%$.

Since two sources of the error were not correlated with each other, the mean percent error was computed as $\sqrt{\Delta_1^2 + \Delta_2^2}$ and equalled $\pm 10\%$.

RESULTS

It was estimated that 27,600,000 x-ray examinations were performed in Poland in 1995 (6,200,000 more than in 1986). The number of examinations per 1,000 inhabitants increased from 572 to 715 (a 25% increase).

The distributions of x-ray examinations in 1986 and 1995 are compared in Table 1. The proportions of males and females in the total number of patients did not differ significantly between both surveys:

1986 — 53%/47% males/females,

1995 — 52%/48% males/females.

Table 1. The number of x-ray examinations in Poland in 1986 and 1995

Type of examinations	1986		1995	
	Annual number in thousands	% of total number	Annual number in thousands	% of total number
Basic x-ray examinations:				
— head	1620	7.6	1770	6.4
— dental	1200	5.6	2840	10.3
— photofluorography of chest	5860	27.5	6990	25.3
— remaining chest exam.	4870	22.8	5760	20.9
abdomen and GI tract	1330	6.2	910	3.3
— stomach and duodenum	400	1.9	400	1.4
— barium enema	46	0.2	90	0.3
genitourinary system	340	1.6	300	1.1
urography	310	1.5	230	0.8
spine	2540	11.8	3620	13.1
upper limbs	1380	6.5	2160	7.8
lower limbs	2045	9.6	2570	9.3
— hip-joint radiography	450	2.1	580	2.1
Basic exam.-on the whole	21200	99.4	26900	97.5
In this number: exam with fluoroscopies	2000	9.4	590	2.2
Specialistic examinations:				
— with contrast application (angiographies etc.)	84	0.4	110	0.4
— CT	38	0.2	170	0.6
— interventional radiology	—	—	32	0.1
— mammography	—	—	280	1.0
— bone densitometry	—	—	37	0.1
Specialistic exam.-on the whole	120	0.6	630	2.3
x-ray examinations — on the whole	21400	100	27600	100

The percentages of patients from particular age groups for a given type of x-ray examinations are presented in Table 2. A comparison of these data with those of 1986 (1) yielded the following findings:

(1) the percentage of adult patients subjected to x-ray examinations generally increased;

(2) the percentage of newborns receiving hip joint radiography decreased from 29.2% in 1986 to 13.0% in 1995;

(3) the percentage of adolescent patients receiving photofluorography of the chest also decreased from 11% in 1986 to 1% in 1995;

(4) the percentage of newborns subjected to computed tomography (CT) increased from 0.4% in 1986 to 2.3% in 1995;

(5) the percentage of newborns increased in the group of specialistic examinations with the contrast (0.4% in 1986 and 3.5% in 1995).

Table 2. Age structure of patients subjected to diagnostic x-ray examinations in Poland in 1995

Type of examinations	Percentage share of the age groups					
	< 1	1-4	5-9	10-14	15-19	Adults
Basic x-ray examination						
– on the whole	0.5	0.6	0.9	1.9	2.4	93.7
In this number:						
– chest photofluorography	0	0	0	0	1.0	99.0
– remaining chest exam.	1.0	1.3	1.3	2.5	2.8	91.1
– dental	0	0	1.5	5.0	5.0	88.5
– abdomen and GI tract	1.0	0.3	0.8	0.5	1.3	96.1
– urinary system	7.3	9.0	10.0	9.0	1.0	63.7
– cystography	20.0	25.0	26.0	20.0	1.0	8.0
– spine radiographs	1.2	1.0	3.4	5.2	5.0	84.2
– hip joint radiography	13.0	6.0	3.0	3.0	4.0	71.0
Specialistic examinations with contrast	3.5	0.3	0	1.1	0	95.1
CT	2.3	1.3	2.5	2.8	1.9	89.3
X-ray examinations						
– on the whole	1.0	1.0	1.9	3.6	4.8	87.7

Table 3. The number of x-ray examinations per 1,000 inhabitants

Age group	Female		Male	
	1986	1995	1986	1995
< 1	527	657	449	521
1-4	124	131	130	145
5-9	155	169	174	188
10-14	220	286	235	298
15-19	543	394	543	442
20-24	502	782	562	854
25-29	515	675	669	851
30-34	609	702	693	819
35-39	711	830	798	947
40-44	869	895	1010	997
45-49	894	1282	1005	1278
50-54	843	1301	982	1354
55-59	703	962	941	1191
60-64	671	940	970	1079
65-69	570	714	875	862
70-74	444	586	809	775
> 75	313	988	534	1375



The highest share of newborns in examinations analyzed in 1995 was found for cystography.

The average age of patients subjected to x-ray examinations in Poland in 1995 was 40 years, and did not change as compared with the 1986 data.

The number of examinations per 1,000 inhabitants of both genders is presented in Table 3, which also includes the comparison of the 1986 and 1995 data. These data show that the patients aged 45–55 were most frequently examined radiologically. In comparison with the 1986 data, a significant increase could be observed in the number of females over 45, and patients of both genders over 75 years of age.

DISCUSSION

Having compared the results obtained from the present analysis with those of 1986 (1) the following inferences can be made:

- the types of the most frequently performed examinations (i.e. photofluorography, other chest radiographs and spine radiographs) did not change significantly,
- the number of abdomen and GI tract examinations was significantly lower,
- the number of examinations with fluoroscopy was also significantly lower,
- despite its increase (from 0.6% to 2.3%) the share of specialistic examinations in the total number of examinations was still very low,
- a significant increment could be seen in the numbers of CT and mammographic examinations.

The comparisons were made between our results and those of other countries, categorized as health-care level I (Tables 4 and 5).

Belgium, France, Netherlands, West Germany and Norway ('stable' countries) were chosen as the countries comparable to Poland in geographical terms, but not

Table 4. The number of x-ray examinations per 1,000 inhabitants in Poland and several countries of health-care level I

Country	Year	Total number (without dental)	Dental
Belgium	1985–1990	1290	288
France	"	990	n.d.
Netherlands	"	530	411
Norway	"	620	833
West Germany	"	1030	264
Czechoslovakia	"	920	85
Romania	"	470	42
Russia	"	990	80
POLAND	1986	540	32
	1995	642	73

n.d. – no data

Apart from Poland (the author's data), all the remaining data are taken from the UNSCEAR 1993 Report (2).



Table 5. Mean annual number of x-ray examinations per 1. 000 inhabitants in different countries

Country	Year	Chest		Spine	Upper GI tract	Urography	Angiography	Mammography	CT
		Radiography	Photofluor.						
Belgium	1985-1990	240	n.d.	84	21	13	8.5	32	50
France	"	340	n.d.	92	10	16	8.6	34	n.d.
Netherlands	"	160	0	30	8.0	11	3.3	13	14
Norway	"	140	44	35	13	12	5.8	18	24
West Germany	"	210	n.d.	130	29	32	18	54	35
Japan	"	440	95	66	156	13	2.7	1.1	97
Czechoslovakia	"	200	110	17	24	9.1	3.3	2.8	4.3
Russia	"	69	570	9.2	40	13	n.d.	1.3	n.d.
Romania	"	24	140	10	51	8.2	1.7	1.7	4.4
POLAND	1986	130	157	68	34	8.2	2.2	n.d.	1.0
	1995	145	181	94	21	5.9	2.8	7.3	4.4

n.d. - no data

Apart from Poland (the author's data), all the remaining data are taken from the UNSCEAR 1993 Report (2).

affected by similar sociological, political and economic transition. Czechoslovakia, Romania, Russia and Poland ('transforming' countries) were analysed as the countries affected by such transition during the last ten years. The overall frequency of examinations per 1,000 inhabitants for 'stable' countries was compared with those for 'transforming' countries, and a low contribution of dental examinations in the second group (excluding Germany) was found.

More detailed comparisons of frequency were performed for particular types of x-ray examinations (Table 5), where the data for Japan are also included. Comparing the frequencies of particular examinations in 'transforming' and 'stable' European countries, the following observations are worthy of mention:

(1) more frequent performance of photofluorography of the chest in 'transforming' countries;

(2) less frequent performance of mammography and CT in 'transforming' countries;

(3) the frequencies of other examinations (listed in Table 5) differ from country to country, depending of individual needs of a particular population.

The structure of x-ray examinations in Japan, the only non-European country, is significantly different and may be characterised by:

- high frequency of photofluorographies,
- very high frequency of upper GI tract examinations,
- very high frequency of CT procedures (approximately two times higher than in 'stable' European countries), and
- low frequency of angiography and mammography (at the level of 'transforming' European countries).

The data for Poland appear to be similar to those for Czechoslovakia, except for photofluorography and spine examinations more frequent in Poland.

Comparing the 1986 and 1995 Polish data on the mean annual numbers per 1,000 inhabitants (Table 1), the following remarks emerge:

- the increase in the number of spine examinations, CT, and, unfortunately, photofluorography; and
- the decrease in the frequency of urography and upper GI tract examinations (probably due to increased use of the ultrasound).

Comparing the Polish data with those of other countries (Tables 4 and 5), it can be seen that:

- the total number of examinations is rather low, and this is especially true for dental examinations,
- the frequency of photofluorographies and spine radiographs is high,
- the number of CT examinations is still very low.

CONCLUSIONS

1. In Poland, about 27,600,000 diagnostic x-ray examinations were estimated for 1995. Patients of both genders, aged ± 40 years were in the majority.
2. Out of the total number of x-ray examinations performed in Poland in 1995, children under 10 constituted about 4%, which means that over 1,000,000 children are annually subjected to various x-ray examinations.
3. The participation of adolescents in the total number of x-ray examinations was nearly 8.5%, equalling above 2,300,000 x-ray examinations per year.

4. The largest proportion of children among the examined patients underwent:
 - (a) cystography and
 - (b) hip joints radiography,
5. Mass miniature radiography (i.e. photofluorography) still constitutes about 55% of the total of 12,750,000 chest radiographies per year.

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