Abstract

Assessment of radiation exposure to Korean population by diagnostic medical radiation

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Diagnostic radiography is used as an important tool of modern medicine to diagnose various diseases or injuries in patients. Worldwide, the public radiation dose is increasing as is the use of diagnostic radiography. Therefore, the necessity for the management of patient dose by diagnostic radiography at the national level has emerged. This article summarized the results of a Korea Disease Control and Prevention Agency (KDCA) study on the assessment of radiation doses in the Korean population by medical radiation. In the KDCA study, the total number of examinations were 370 million in 2019. The fraction was high in the order of general radiography (270 million), dental radiography (37 million) and interventional procedures (35 million). The collective dose was 125,000 man·mSv in 2019. The annual effective dose per capita was 2.42 mSv in 2019. The effective dose per capita was high in the order of computed tomography (0.94 mSv), general radiography (0.69 mSv), interventional procedures (0.62 mSv). This article recommended that the results be used as part of a national resource database and be used in policy establishment to develop a domestic radiation safety management system. In addition, the results could contribute to increasing the benefits of diagnostic radiography and ultimately reducing the public radiation dose.

Keywords: Diagnostic radiography, Radiation dose, Effective dose, Collective dose

	Usage (Hundred million)			
Survey year	Diagnostic medical radiological examinations	Dental radiology	Nuclear medicine	Total
1988	13.8	3.4	0.235	17.4
1993	16.0	-	0.24	16.2
2000	19.1	5.2	0.325	24.6
2008	31.4	4.8	0.327	36.6

Table 1. Global surveys of medical radiation usage



Figure 1. Annual effective dose (mSv) per capita for the United States population



Figure 2. Trends in mean ESD* (mGy) for general radiography in the United Kingdom (UK) *ESD: entrance surface dose

Table 2. Example of classification system of computed tomography

Large category	Medium category	Included examination	
	Skull		
	Face and skull		
Skull	Paranasal sinus		
Skull	Orbit	 With contrast Without contrast 	
	Temporal bone		
	Others	Limited CT	
Neck	Neck	 Other examinations 	
Spine	Spine	- Double CT	
Whole spine	Whole spine	- Triple CT - 3D CT etc	
Upper limb	Upper limb		
Lower limb	Lower limb		
Chest	Chest, Chest high resolution		
Abdomen and pelvis	Abdomen and pelvis		
	Skull		
	Neck		
	Chest		
Intervention	Abdomen and pelvis	 Industing interventional propoduras 	
Intervention	Spine	- inducting interventional procedures	
	Whole spine		
	Upper limb		
	Lower limb		
Bone densitometry	Quantitative computerized tomography bone densitometry	• QCT • PQCT	

Table 3. Number of examinations in general radiography

Type of examination	Number of examinations	Fraction (%)
Skull	7,043,056	2.6
Neck	522,392	0.2
Chest	62,483,749	23.3
Abdomen	13,374,504	5.0
Clavicle	813,038	0.3
Shoulder	16,599,737	6.2
Cervical spine	15,019,749	5.6
Thoracic spine	1,875,545	0.7
Lumbar spine	26,213,936	9.8
Whole spine	1,651,994	0.6
Pelvis	5,084,709	1.9
Hip joint	3,606,872	1.3
Cervicothoracic spine	225,452	0.1
Thoracolumbar spine	1,942,742	0.7
Lumbosacral spine	4,323,168	1.6
Sacral coccyx	624,813	0.2
Sacroiliac joint	72,592	0.0
Upper limb	34,459,967	12.9
Lower limb	69,492,055	25.9
Child's whole body	139,198	0.1
Bone densitometry	2,235,908	0.8
Total	267,805,176	100.0

Table 4. Number of examinations in computed tomography

Type of examination	Number of examinations	Fraction (%)
Skull	2,465,058	20.7
Neck	359,940	3.0
Chest	3,294,092	27.6
Abdomen and Pelvis	4,068,010	34.1
Spine	884,027	7.4
Whole spine	43,110	0.4
Upper limb	287,899	2.4
Lower limb	430,762	3.6
Intervention	173	0.0
Bone densitometry	87,490	0.7
Total	11,920,561	100.0

Table 5. Number of examinations in dental radiography

Type of examination	Number of examinations	Fraction (%)
Intraoral radiography	22,060,495	59.5
Panorama	14,201,163	38.3
Cephalo	32,365	0.1
Cone Beam CT	778,766	2.1
Total	37,072,789	100.0

Table 6. Number of examinations in mammography

Type of examination	Number of examinations	Fraction (%)
Mammography	19,872,202	100.0
Galactography	268	0.0
Total	19,872,470	100.0

Table 7. Number of examinations in fluoroscopy

Type of examination	Number of examinations	Fraction (%)
Digestive system	1,052,956	54.5
Biliary system	12,005	0.6
Myelography	221,212	11.4
Nephrography	165,260	8.6
Cystourethrography	70,526	3.6
Arthrography	132,077	6.8
Lymphangiography	262	0.0
Other fluoroscopy	278,426	14.4
Total	1,932,724	100.0

Table 8. Number of examinations in angiography

Type of examination	Number of examinations	Fraction (%)
Skull artery	120,541	23.5
Thoracic artery	17,323	3.4
Abdominal/Pelvic artery	69,808	13.6
Upper limb artery	32,710	6.4
Lower limb artery	20,304	4.0
Coronary artery	221,419	43.1
Vertebral artery	400	0.1
Skull vein	401	0.1
Thoracic vein	9,855	1.9
Abdominal/Pevic vein	8,563	1.7
Upper limb vein	9,996	1.9
Lower limb vein	2,186	0.4
Total	513,506	100.0

Table 9. Number of examinations in interventional procedures

Type of procedures	Number of examinations	Fraction (%)
Skull nerve block	1,402,893	4.0
Thoracic/Abdominal nerve block	529,348	1.5
Pelvic nerve block	6,905,541	19.7
Spinal nerve block	13,709,491	39.1
Limb nerve block	8,065,100	23.0
Neurodestructive procedure	3,265	0.0
Endoscopic retrograde cholangio pancteatogram (ERCP)	3,766,074	10.8
Skull vascular interventional procedures	31,122	0.1
Percutaneous transluminal coronary angioplasty (PTCA)	98,496	0.3
Thoracic vascular interventional procedures (etc)	276,497	0.8
Abdominal vascular interventional procedures (Biliary system, urinary system)	68,824	0.2
Abdominal vascular interventional procedures (TIPS)	210	0.0
Abdominal vascular interventional procedures (etc)	94,668	0.3
Pelvic vascular interventional procedures	46,076	0.1
Limb vascular interventional procedures	33,540	0.1
Total	35,031,145	100.0



Figure 3. Fraction of usage of medical radiation examinations in Korea



Figure 4. (a) Collective effective dose of general radiography examinations (b) Effective dose per capita of general radiography examinations



Figure 5. Collective effective dose of computed tomography examinations, (b) Effective dose per capita of computed tomography examinations



Figure 6. Collective effective dose of dental radiography examinations, (b) Effective dose per capita of dental radiography examinations



Figure 7. Collective effective dose of mammography examinations, (b) Effective dose per capita of mammography examinations



Figure 8. (a) Collective effective dose of fluoroscopy examinations, (b) Effective dose per capita of fluoroscopy examinations



Figure 9. (a) Collective effective dose of angiography examinations, (b) Effective dose per capita of angiography examinations



Figure 10. (a) Collective effective dose of interventional procedures, (b) Effective dose per capita of interventional procedures



Figure 11. Effective dose of medical radiation examinations per capita in Korea