Table 2.3. Cohort studies of gamma radiation and cancer

Reference, location, name of study	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/ deaths	ERR/Sv (90% CI)	Adjustment for potential confounders	Comments
Preston *et al*. (2004), Hiroshima and Nagasaki, Japan Life Span Study	Cohort of 86 611 atomic bomb survivors who were within 10 km of the hypocenters of the bombs and have DS02 dose estimates; alive as of Oct 1, 1950; mortality follow-up through Dec 31, 2000	DS02 Dosimtetry system, based on reported survivor location and shielding	Solid cancer (ICD-9 codes 140–199) Leukaemia (ICD-9 codes 204–209)	0–4 Sv	10127 296	0.42 (0.33, 0.51)	Age,sex, city, year of birth	Solid cancer mortality dose–response averaged over sex, for attained age 70 years, after exposure at age 30 years.
Preston *et al*. (2007), Hiroshima and Nagasaki, Japan Life Span Study	Cohort of 105 427 atomic bomb survivors who have DS02 dose estimates and were alive and not known to have had cancer as of Jan 1, 1958; cancer incidence follow-up through Dec 31, 1998	DS02 Dosimtetry system, based on reported survivor location and shielding	Solid cancer (ICD-10 codes C00-C89)	0–4 Sv	17 448	0.47 (0.40, 0.54)	Age, sex, city, year of birth, location at time of bombing	Solid cancer incidence dose–response averaged over sex, for attained age 70 years, after exposure at age 30 years. The ERR/Sv was about 60% higher for women than for men.
Preston *et al*. (2008), Hiroshima and Nagasaki, Japan Life Span Study	2542 atomic bomb survivors who were in utero at the time of the bombings and 15 388 survivors who were < 6 years old at the time of the bombings. All survivors had to have DS02 dose estimates and be alive and not known to have had cancer as of Jan 1, 1958; cancer incidence follow-up through Dec 31, 1999	DS02 Dosimtetry system, based on reported survivor location and shielding	Solid cancer (ICD-10 codes C00-C89)	0–4 Sv	1216	1.9 (95% CI:1.4, 2.6)	Age, sex,	

Table 2.3. Cohort studies of gamma radiation and cancer

Reference, location, name of study	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/ deaths	ERR/Sv (90% CI)	Adjustment for potential confounders	Comments
Bauer *et al*. (2005), Semipalatinsk Historical Cohort	Cohort of 19 545 inhabitants of villages in the Semipalatinsk region; mortality follow-up from 1960 through 1999. 9 850 inhabitants of exposed villages and 9 604 inhabitants of comparison villages.	Estimates of external and internal doses based on dose reconstruction.	Solid cancers (ICD-9 codes 140–200) All inhabitants. Inhabitants of exposed villages		889 Not reported	1.77 (95% CI: 1.35, 2.27) 0.81 (0.46, 1.33)	Age, sex	The ERR tended to increase with age at exposure.
Cardis *et al*. (2007), 15-countries 15-Country Collaborative Study of Cancer Risk among Radiation Workers	Cohort of 407 391 nuclear industry workers who were monitored for external radiation and worked at least 1 year in the nuclear industry; cancer mortality follow-up through Dec 31, 1998	Individual monitoring for external radiation exposure, based on personal dosimeters	Cancer other than leukaemia (ICD-9 codes 140–200) Leukaemia excl. CLL		6519 196	0.97 (90% CI: 0.28,1.77) 1.93 (<0, 7.14)	Age, sex, year of birth, socioeconomic status, duration of employment	
Muirhead *et al*. (2009), United Kingdom, National Registry for Radiation Workers Cohort	Cohort of 174 541 workers who were monitored for external radiation and agreed to participate in the NRRW; cancer mortality and incidence follow-up through Dec 31, 2001	Individual monitoring for external radiation exposure, based on personal dosimeters	All cancer mortality All cancer incidence		7684 11 165	0.279 (0.02, 0.56) 0.281 (0.006, 0.53)	Age, sex, calendar period, industrial classification and first employer	

Table 2.3. Cohort studies of gamma radiation and cancer

Reference, location, name of study	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/ deaths	ERR/Sv (90% CI)	Adjustment for potential confounders	Comments
Matanoski *et al*. (2008), USA US Shipyard Workers Study	A sample of workers based on radiation dose at termiation; 28 000 workers with ≥ 5 mSv, 10 462 with < 5 mSv, and 33 353 non-nuclear workers. Mortality follow-up through Dec 31, 1982	Individual monitoring for external radiation exposure, based on personal dosimeters	Leukaemia, Lymphopoietic cancers, Lung Mesothelioma		54 147 641 36	RR 2.41 (95%CI: 0.5, 23.8) RR 2.94 (95%CI: 1.0, 12.0) RR 1.26 (95%CI: 0.9, 1.9) RR 1.61 (95% CI: 0.4, 9.7)	Age, sex, year of birth,	
Richardson and Wing (2007), South Carolina, USA Savannah River Site Study	Cohort of 407 391 nuclear industry workers who were monitored for external radiation and worked at least 1 year in the nuclear industry; cancer mortality follow-up through Dec 31, 1998	Individual monitoring for external radiation exposure, based on personal dosimeters	Leukaemia excl. CLL		62	ERR/10mSV 0.08 (0.01, 0.20)	Age, sex, year of birth, socioeconomic status, employment status	
Gilbert *et al*. (2004), Mayak Study	Cohort of 21 790 workers; mortality follow-up through Dec 31, 2000	Individual monitoring for external radiation exposure, and estimates of internal dose	Lung Cancer		655	Males 0.017 (95% CI:0.052, 0.320) Females 0.32 (< 0, 1.3)	Age, sex, calendar period	Dose response was larger for females than for males

Table 2.3. Cohort studies of gamma radiation and cancer

Reference, location, name of study	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/ deaths	ERR/Sv (90% CI)	Adjustment for potential confounders	Comments
Shilnikova *et al*. (2003), Mayak Study	Cohort of 21 557 workers; mortality follow-up through Dec 31, 1997	Individual monitoring for external radiation exposure, and estimates of internal dose	Solid Cancer		1730	0.15 (95% CI:0.09, 0.20)	Age, sex, calendar period	Dose response for solid cancers was concave downward with an estimated linear coefficient of 0.3 per grey (90% CI: 0.18; 0.43), which is about twice that suggested by the linear model
			Leukaemia excl. CLL		66	0.99 (0.45, 2.12)		
Langner *et al*. (2004), Europe, ESCAPE	Cohort of 19 184 male commercial airline pilots; cancer mortality follow-up through Dec 31, 1996/1997	Cumulative hours and cumulative dose	Solid cancer mortality		1842			
			Leukaemia					
Ostroumova *et al*. (2008), Southrern Urals, the Russian Federation Techa River Study	Cohort of 9 908 people who resided in villages along the Techa River near the Mayak facility; cancer incidence follow-up through Dec 31, 2004	Techa River Dosimetry System 2000	Breast cancer		109	5.0 (95% CI: 0.80–12.76)	Age, sex, year of birth,	
Krestinina *et al*. (2007), Southern Urals, the Russian Federation Techa River Study	Cohort of 17 4 533 people who resided in villages along the Techa River near the Mayak facility; cancer incidence follow-up through Dec 31, 2002	Techa River Dosimetry System 2000	Solid cancer		1836	1.0 (95% CI:0.3,1.9)	Age, sex, year of birth, socioeconomic status, employment status	

Table 2.3. Cohort studies of gamma radiation and cancer

Reference, location, name of study	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/ deaths	ERR/Sv (90% CI)	Adjustment for potential confounders	Comments
Krestinina *et al*. (2005), Southern Urals, the Russian Federation Techa River Study	Cohort of 17 4 533 people who resided in villages along the Techa River near the Mayak facility; cancer mortality follow-up through Dec 31, 2002	Techa River Dosimetry System 2000	Solid cancer mortality Leukaemia		1842	0.92 (95% CI:0.2, 1.7)	Age, sex, year of birth, socioeconomic status, employment status	
Hwang *et al*. (2008), Taiwan, China, 60Co Study	Cohort of 6 242 people who resided in apartments constructed with 60Co-contaminated reinforcing steel and had completed exposure assessments; cancer incidence follow-up from 1983 through Dec 31, 2005	Taiwan, China Cumulative Dose System	All cancer Leukaemia excl. CLL		117 6	**HR/100 mSv** 1.04 (0.97, 1.08) 1.19 (1.01–1.31)	Time on study, sex, year of Birth,	
Nair *et al*. (2009), Kerala, India Karunagappally cohort study	Cohort of 69 958 people aged 30–84 year who resided in Kerala, India, in an area known for high background radiation from thorium containing monazite sand; cancer incidence follow-up through Dec 31, 2005	Estimated based on outdoor and indoor dosimetry of each household	Cancer excluding leukaemia Leukaemia		1379 30	**ERR/Gy** –0.13 (95% CI: –0.58, 0.46) 5.84 (95% CI: -∞, 344.3)	Sex, attained age, follow-up interval, bidi smoking, education, occupation	