

Supplementary appendix

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

Supplement to: Leuraud K, Richardson DB, Cardis E, et al. Ionising radiation and risk of death from leukaemia and lymphoma in radiation-monitored workers (INWORKS): an international cohort study. *Lancet Oncol* 2015; published online June 22. [http://dx.doi.org/10.1016/S2352-3026\(15\)00094-0](http://dx.doi.org/10.1016/S2352-3026(15)00094-0).

Figure A1. Distribution of cumulative red bone marrow doses among workers. INWORKS, 1943–2005.

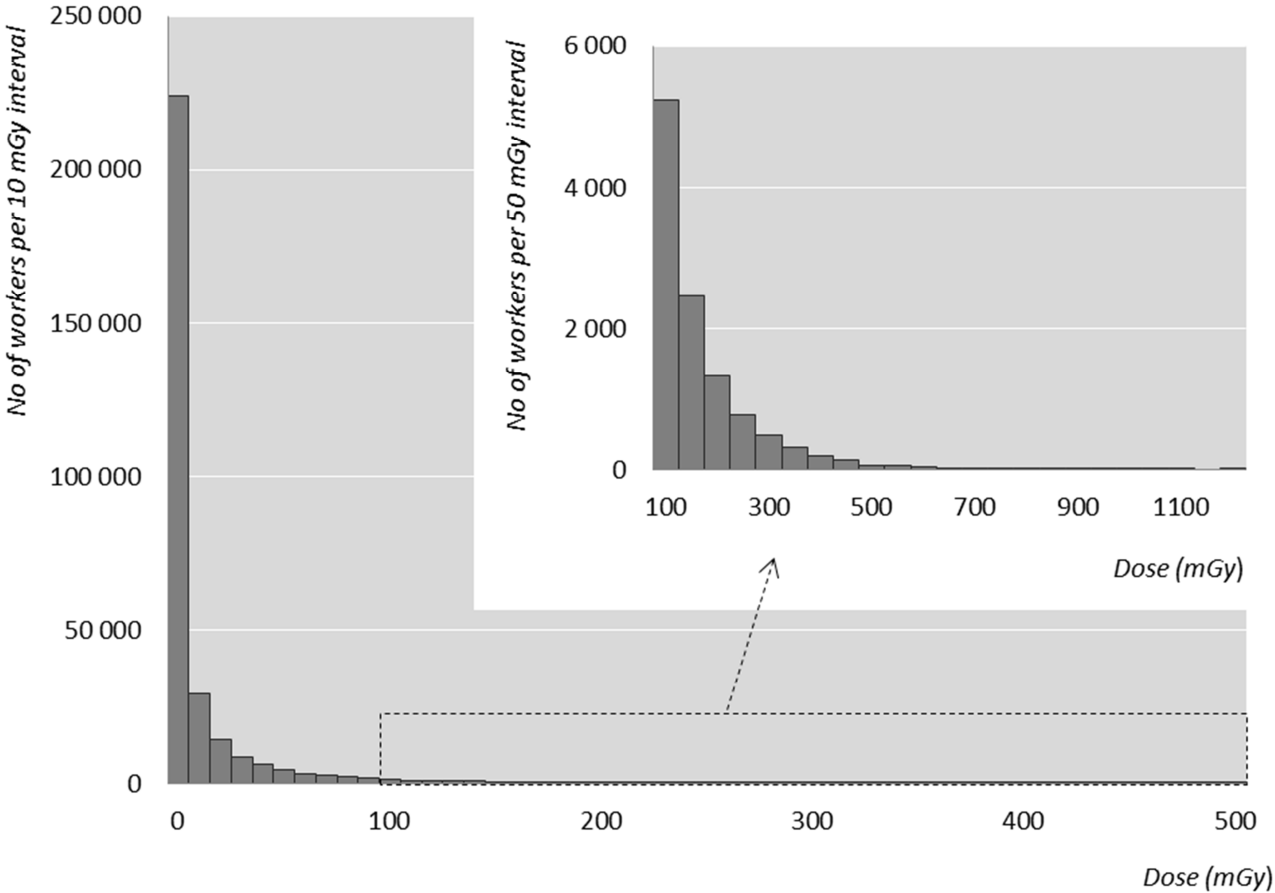


Table A1. List of International Classification of Diseases (ICD) codes for causes of death studied in INWORKS, based on observed deaths.

	ICD revision			
	7 1955–1964	8 1965–1978	9 1979–1999	10 ≥ 2000
Leukaemia excluding chronic lymphocytic leukaemia	-	204·0, 205·0, 205·1, 205·9, 206·0, 206·9, 207·0, 207·9	204·0, 204·2, 205·0, 205·1, 205·9, 206·0, 206·9, 207·0, 207·2, 207·8, 208·0, 208·1, 208·2, 208·9	C91·0, C92·0, C92·1, C92·5, C92·7, C92·9, C93·0, C94·0, C94·2, C95·0, C95·1, C95·9
Acute myeloid leukaemia^a	-	205·0, 206·0	205·0, 206·0, 207·0, 207·2	C92·0, C92·5 C93·0, C94·0, C94·2
Chronic myeloid leukaemia^a	-	205·1	205·1	C92·1
Acute lymphoblastic leukaemia^a	-	204·0	204·0	C91·0
Hodgkin's lymphoma	201	201	201·0, 201·2, 201·9	C81·9
Non Hodgkin lymphoma	202·1	200·0, 200·1, 202·2, 202·9	200·0, 200·1, 200·2, 200·8, 202·0, 202·1, 202·3, 202·4, 202·8, 202·9, 273·3	C82·9, C83·0, C83·1, C83·3, C83·4, C83·6, C83·7, C83·8, C83·9, C84·0, C84·5, C85·0, C85·1, C85·7, C85·9, C88·0, C91·4, C96·9
Multiple Myeloma	-	203	203·0, 203·1	C90·0

^a in ICD 7, acute myeloid, chronic myeloid, and acute lymphoblastic types of leukaemia cannot be separated.

Table A2: Distribution of deaths caused by leukaemia, lymphoma, or multiple myeloma and relative risk (RR) of death by categories of cumulative red bone marrow dose. INWORKS, 1943–2005.

Dose, in mGy		0–5	5–50	50–100	100–200	200–300	300+	
2-year lag		Person-years	5,314,830	2,298,942	344,476	185,811	49,361	27,707
		Mean dose*	1.0	17.2	70.0	137.9	241.2	407.5
Leukaemia excluding CLL	Deaths	281	171	37	22	14	6	
	RR	1.00	1.01	1.30	1.19	2.30	1.70	
	(90% CI)		(0.86–1.19)	(0.97–1.73)	(0.82–1.73)	(1.46–3.62)	(0.85–3.36)	
Chronic myeloid leukaemia	Deaths	54	23	10	5	4	4	
	RR	1.00	0.71	1.87	1.49	3.50	5.92	
	(90% CI)		(0.46–1.07)	(1.05–3.35)	(0.68–3.27)	(1.46–8.35)	(2.45–14.30)	
Acute myeloid leukaemia	Deaths	138	81	17	11	6	1	
	RR	1.00	0.99	1.18	1.18	1.93	0.52	
	(90% CI)		(0.78–1.25)	(0.77–1.82)	(0.70–1.98)	(0.96–3.86)	(0.10–2.72)	
Acute lymphoblastic leukaemia^a	Deaths	11	16	2	0	1	0	
	RR	1.00	2.68	2.19		1.29		
	(90% CI)		(1.39–5.16)	(0.61–7.88)		(0.22–7.38)		
CLL^b	Deaths	59	64	10	2	3	0	
	RR	1.00	1.59	1.37	0.41		1.13	
	(90% CI)		(1.17–2.15)	(0.77–2.41)	(0.13–1.35)		(0.42–3.02)	
10-year lag		Person-years	6,165,280	1,636,650	240,632	127,949	33,323	17,290
		Mean dose*	0.6	17.1	69.9	137.8	240.9	404.6
Multiple myeloma	Deaths	169	84	21	11	2	6	
	RR	1.00	0.82	1.11	0.91	0.5	2.41	
	(90% CI)		(0.65–1.02)	(0.76–1.64)	(0.54–1.52)	(0.15–1.61)	(1.21–4.81)	
Non Hodgkin lymphoma	Deaths	399	224	36	39	7	5	
	RR	1.00	1.01	0.91	1.52	0.86	1.07	
	(90% CI)		(0.87–1.16)	(0.68–1.22)	(1.15–2.01)	(0.46–1.61)	(0.51–2.24)	
Hodgkin's lymphoma^b	Deaths	72	22	4	5	1	0	
	RR	1.00	0.92	1.13	2.34		1.02	
	(90% CI)		(0.60–1.42)	(0.47–2.69)	(1.06–5.17)		(0.19–5.48)	

RR estimated from a log-linear model relative to <5 mGy category. *weighted by person-years. CLL=chronic lymphocytic leukaemia. CI=Wald-type confidence interval. ^a categories above 100 mGy are merged. ^b categories above 200 mGy are merged.

Table A3. Impact of alternative lag assumptions. Excess relative risk per Gray (ERR per Gy) for categories of death in relation to cumulative red bone marrow dose. INWORKS, 1943–2005.

	Deaths	Dose, 2-y lagged			Dose, 10-y lagged		
		ERR per Gy	90% CI	LRT (p)	ERR per Gy	90% CI	LRT (p)
Leukaemia excluding CLL	531	2.96	1.17–5.21	8.85 (0.0029)	3.57	1.52–6.14	10.29 (0.0013)
Chronic myeloid leukaemia	100	10.45	4.48–19.65	14.13 (0.00017)	11.93	5.00–22.85	13.94 (0.00019)
Acute myeloid leukaemia	254	1.29	-0.82–4.28	0.86 (0.35)	1.89	-0.56–5.38	1.46 (0.23)
Acute lymphoblastic leukaemia	30	5.80	<0–31.57	0.86 (0.36)	5.35	<0–32.05	0.71 (0.40)
CLL	138	-1.06	<0–1.81	0.61 (0.44)	-0.85	<0–2.74	0.23 (0.63)
Multiple Myeloma	293	0.96	-0.77–3.33	0.71 (0.40)	0.84	-0.96–3.33	0.48 (0.49)
Non Hodgkin lymphoma	710	0.40	-0.75–1.82	0.28 (0.60)	0.47	-0.76–2.03	0.34 (0.56)
Hodgkin's lymphoma	104	1.14	<0–6.85	0.23 (0.63)	2.94	<0–11.49	0.75 (0.39)

ERR estimated under a linear model stratified on country, calendar period, sex, and age. CI=likelihood-based confidence interval. LRT=Likelihood ratio test statistic, 1 degree of freedom. CLL=chronic lymphocytic leukaemia. '<0' lower CI bound could not be estimated as it was on the boundary of the parameter space (-1/max dose). N.B. In our primary analyses, cumulative doses were lagged by 2 years for analyses of leukaemia mortality and by 10 years for analyses of lymphoma and multiple myeloma.

Table A4: Effect of adjustment for socioeconomic status (SES) or internal contamination on the excess relative risk per Gray (ERR per Gy) for main categories of death in relation to cumulative red bone marrow dose. INWORKS, 1943–2005.

	Deaths	Upon adjustment for SES		Upon adjustment for internal contamination
		ERR per Gy (90% CI)	ERR per Gy (90% CI)	ERR per Gy (90% CI)
Leukaemia excluding CLL^a	531	2.96 (1.17–5.21)	2.91 (1.11–5.17)	3.39 (1.39–5.93)
Multiple myeloma^b	293	0.84 (-0.96–3.33)	0.88 (-0.94–3.45)	0.91 (<0–3.64)
Non Hodgkin lymphoma^b	710	0.47 (-0.76–2.03)	0.53 (-0.74–2.13)	0.52 (-0.77–2.17)
Hodgkin’s lymphoma^b	104	2.94 (<0–11.49)	2.58 (<0–10.98)	2.32 (<0–10.90)

ERR estimated under a linear model stratified on country, calendar period, sex, and age. CI=likelihood-based confidence interval. CLL=chronic lymphocytic leukaemia. ^a 2-year lagged cumulative dose. ^b 10-year lagged cumulative dose. '<0' lower CI bound could not be estimated as it was on the boundary of the parameter space (-1/max dose). SES is defined by five categories: managers and engineers (66,806 workers), administrative staff (61,738 workers), skilled workers (142,184 workers), unskilled workers (31,876 workers), and uncertain (5,693 workers).

Table A5: Excess relative risk per Gray (ERR per Gy) excluding one country at-a-time for categories of death in relation to cumulative red bone marrow dose. INWORKS, 1943–2005.

	Deaths	ERR per Gy	90% CI
Leukemia excluding CLL^a			
excluding France (57)	474	2.95	1.13-5.24
excluding UK (164)	367	2.32	0.03-5.33
excluding USA (310)	221	3.68	1.09-7.29
Chronic myeloid leukemia^a			
excluding France (14)	86	9.45	3.76-18.44
excluding UK (39)	61	11.45	2.53-27.14
excluding USA (47)	53	11.37	3.89-24.79
Multiple myeloma^b			
excluding France (36)	257	1.30	-0.69-4.07
excluding UK (96)	197	3.32	0.27-7.64
excluding USA (161)	132	Not Converged	–
Non Hodgkin lymphoma^b			
excluding France (64)	646	0.72	-0.59-2.37
excluding UK (227)	483	-0.10	<0-1.99
excluding USA (419)	291	0.58	<0-2.88
Hodgkin's lymphoma^b			
excluding France (17)	87	4.06	<0-13.97
excluding UK (33)	71	6.41	<0-19.66
excluding USA (54)	50	Not converged	–

ERR estimated under a linear model stratified on country, calendar period, sex, and age. CI=likelihood-based confidence interval. CLL=chronic lymphocytic leukaemia. ^a 2-year lagged cumulative dose. ^b 10-year lagged cumulative dose. '<0' lower CI bound could not be estimated as it was on the boundary of the parameter space (-1/max dose).