

Erratum to: Risk of cancer incidence before the age of 15 years after exposure to ionising radiation from computed tomography: results from a German cohort study

L. Krille^{1,2} · S. Dreger³ · R. Schindel¹ · T. Albrecht⁴ · M. Asmussen⁵ · J. Barkhausen⁶ · J. D. Berthold⁷ · A. Chavan⁸ · C. Claussen⁹ · M. Forsting¹⁰ · E. A. L. Gianicolo^{1,11} · K. Jablonka¹² · A. Jahnen¹³ · M. Langer¹⁴ · M. Laniado¹⁵ · J. Lotz¹⁶ · H. J. Mentzel¹⁷ · A. Queißer-Wahrendorf¹⁸ · O. Rompel¹⁹ · J. Schlick²⁰ · K. Schneider²¹ · M. Schumacher²² · M. Seidenbusch²¹ · C. Spix²³ · B. Spors²⁴ · G. Staatz²⁵ · T. Vogl²⁶ · J. Wagner²⁷ · G. Weisser²⁸ · H. Zeeb³ · M. Blettner¹

Published online: 13 June 2017
© Springer-Verlag Berlin Heidelberg 2017

**Erratum to: Radiat Environ Biophys (2015)
54:1–12
DOI 10.1007/s00411-014-0580-3**

When performing an additional follow up of our cohort study [1], [2] we discovered two errors.

The online version of the original article can be found under doi:10.1007/s00411-014-0580-3.

✉ M. Blettner
blettner@uni-mainz.de

L. Krille
KICTSubmission@gmail.com

- ¹ Institute of Medical Biostatistics, Epidemiology and Informatics, University Medical Center Mainz, Obere Zahlbacher Straße 69, 55131 Mainz, Germany
- ² International Agency for Research on Cancer, 69372 Lyon, France
- ³ Leibniz - Institute for Prevention Research and Epidemiology – BIPS, Research Focus Health Sciences Bremen, University of Bremen, 28359 Bremen, Germany
- ⁴ Institut für Radiologie und Interventionelle Therapie, Vivantes, Klinikum Neukölln, 12351 Berlin, Germany
- ⁵ Städtisches Klinikum Karlsruhe, Zentralinstitut für Bildgebende Diagnostik, 76133 Karlsruhe, Germany
- ⁶ Klinik für Radiologie und Nuklearmedizin, Campus Lübeck, Universitätsklinikum Schleswig Holstein, 23538 Lübeck, Germany
- ⁷ Institut für Diagnostische und Interventionelle Radiologie, Medizinische Hochschule Hannover, 30625 Hannover, Germany

First, Table 1 and Table 2 included 44,584 patients who were eligible for the study but did not fulfil all criteria for the analysis. However, for the final analysis only 39,184 persons and 63,214 CT examinations were included. Tables 1 and 2 with the numbers of persons included in the analysis are given below.

Secondly, we found one case of lymphoma which was wrongly included twice in the analysis as the child was treated in three hospitals. The total number of cases that

⁸ Institut für Diagnostische & Interventionelle Radiologie, Klinikum Oldenburg GmbH, 26133 Oldenburg, Germany

⁹ Abt. für Diagnostische und Interventionelle Radiologie, Universitätsklinikum Tübingen, 72076 Tübingen, Germany

¹⁰ Institut für Diagnostische und Interventionelle Radiologie und Neuroradiologie, Universitätsklinikum Essen, 45147 Essen, Germany

¹¹ Institute of Clinical Physiology, National Research Council, 73100 Lecce, Italy

¹² Klinik für Radiologische Diagnostik und Nuklearmedizin, Klinikum Bremen-Mitte, 28177 Bremen, Germany

¹³ Centre de Recherche Public Henri Tudor, 1855 Luxembourg, Luxembourg

¹⁴ Klinik für Radiologie, Universitätsklinikum Freiburg, 79106 Freiburg, Germany

¹⁵ Institut und Poliklinik für Radiologische Diagnostik, Universitätsklinikum Carl Gustav Carus Dresden, 01307 Dresden, Germany

¹⁶ Institut für Diagnostische und Interventionelle Radiologie, Universitätsmedizin Göttingen, 37075 Göttingen, Germany

Table 1 Number of individuals excluded and included into the analyses and characteristics of included individuals by sex, final exposure frequency and year of birth

Characteristics	Individuals	
	Number	Percent
Recorded total	82,971	
Not included	43,787	
Included	39,184	100.0
Sex		
Boys	22,984	58.7
Girls	16,155	41.2
Unknown	45	0.1
Exposure frequency		
One CT	27,534	70.3
Two or more CTs	11,650	29.7
Birth cohort		
1966–1990	6790	17.3
1991–2000	22,672	57.9
2001–2008	9722	24.8

should be correctly included in the analysis is 38 (not 39), the corresponding number of lymphoma is 10 (not 11). Consequently the estimates for “all cancer” and “lymphoma” changed slightly, whereas results for leukaemia, CNS, and other solid tumours are not altered (new

Table 2 Number and proportion of individuals by exposed body regions and by final exposure frequency

Individuals	Exposure frequency	
	One CT	More than one CT
Individuals	27,534 100.0%	11,650 100.0%
Exposed body regions ^a		
Head	69.6%	49.1%
Neck	2.8%	0.7%
Chest	9.7%	7.9%
Abdomen	3.9%	1.8%
Pelvis	1.1%	0.5%
Extremities	4.7%	1.7%
Multiple regions	5.3%	37.4%
Not classifiable	2.8%	0.9%
Missing	0.2%	0.0%
At least one head CT	69.6%	76.8%

^a Based on all included CTs received by individual persons

tables are given below). Accordingly the numbers in Tables 3, 4, 5, 6 and 7 changed and the number of person years slightly decreased from 161,407.41 to 161,406.65.

Additionally we would like to correct the name of one author. It should be J. Schlick and not I. Schlick.

¹⁷ Institut für Diagnostische und Interventionelle Radiologie, Sektion Kinderradiologie, Universitätsklinikum Jena, 07740 Jena, Germany

¹⁸ Zentrum für Kinder- und Jugendmedizin, Universitätsmedizin Mainz, 55131 Mainz, Germany

¹⁹ Radiologisches Institut, Universitätsklinikum Erlangen, 91054 Erlangen, Germany

²⁰ Institut für Radiologie und Neuroradiologie, Klinikum Nürnberg Süd, 90471 Nuremberg, Germany

²¹ Klinikum der Universität München, Dr. von Haunersches Kinderspital, Institut für Klinische Radiologie, 80337 Munich, Germany

²² Klinik für Neuroradiologie, Neurozentrum, Universitätsklinik Freiburg, 78106 Freiburg, Germany

²³ German Childhood Cancer Registry, University Medical Center Mainz, 55131 Mainz, Germany

²⁴ Kinderradiologie, Standort Campus Virchow Klinikum, Charité - Universitätsmedizin Berlin, 13353 Berlin, Germany

²⁵ Klinik und Poliklinik für diagnostische und interventionelle Radiologie, Sektion Kinderradiologie, Universitätsmedizin Mainz, 55131 Mainz, Germany

²⁶ Institut für Diagnostische und Interventionelle Radiologie, Klinikum der Johann Wolfgang Goethe-Universität Frankfurt/Main, 60590 Frankfurt, Germany

²⁷ Institut für Radiologie und Interventionelle Therapie, Vivantes, Klinikum im Friedrichshain, 10249 Berlin, Germany

²⁸ Institut für Klinische Radiologie und Nuklearmedizin, Universitätsklinikum Mannheim, 68167 Mannheim, Germany

Table 3 Availability of radiology reports or medical data from the German Childhood Registry for cancer cases and randomly drawn non-cases and distribution of persons with data indicating early cancers or higher risk for cancer after 2 years' latency

Persons	Cancer cases by cancer type					Non-cases		
	All		Leukaemia ^a	Lymphoma ^b	CNS tumours ^c	Solid cancers ^d	Random sample	
Total	44		12	11	8	13	138	
Radiology reports not available	9		5	1	2	1	10	
Radiology reports available	35	100.0%	7	10	6	12	128	100.0%
Cancer	6	17.1%	0	1	1	4	0	0.0%
PTLD	4	11.4%	0	4	0	0	0	0.0%
Symptoms	1	2.9%	0	0	0	1	2	1.6%
Syndromes	3	8.6%	0	1	1	1	0	0.0%
Suspicion	0	0.0%	0	0	0	0	4	3.1%
None of above	22	60.0%	7	4	4	6	122	95.3%

The results are displayed hierarchically: a person being assigned in one group could not be assigned to any of the following. Cancer = a cancer disease was present at time of first examination, PTLN = a Post-Transplant Lymphoproliferative Disorder was diagnosed, Symptoms = Symptoms for a cancer disease were noted but did not necessarily imply the existence of cancer, Syndromes = diseases linked to elevated cancer risk were diagnosed, Suspicion = the CT was performed due to suspicion of cancer

^a ICC3: Ia, Ib, Id; ^b ICC3: IIa–IIc; ^c ICC3: IIIb, IIIc, IIIe; ^d ICC3: Iva, IXa, IXd, Xa, Xc, XIb, ICC3 = International Classification of Childhood Cancer, 3rd edition (Steliarova-Foucher et al. 2005)

Table 4 Number of observed cancer cases by cancer type for inclusion based on the German Childhood Cancer Registry and after the use of additional medical data for 2 years' latency

Observed cases	Cancer type				
	All	Leukaemia ^a	Lymphoma ^b	CNS tumours ^c	Solid cancers ^d
Identified through GCCR	44	12	11	8	13
Included in analyses	38	12	10	7	9
Excluding high risk group	30	12	5	6	7

Identified through GCCR = all cases diagnosed at least two years after the first known CT, Included in analyses = included cases after review of the radiology reports and medical files from the GCCR, Excluding high risk group = included cases after review of the radiology reports and medical files from the GCCR except those at high risk

^a ICC3: Ia, Ib, Id; ^b ICC3: IIa–IIc; ^c ICC3: IIIb, IIIc, IIIe; ^d ICC3: Iva, IXa, IXd, Xa, Xc, XIb, ICC3 = International Classification of Childhood Cancer, 3rd edition (Steliarova-Foucher et al. 2005)

Table 5 SIRs for all cancer, leukaemia, lymphoma, CNS tumours and solid cancer separately including and excluding persons at high risk for cancer after 2 years' latency

Cancer type	All included cases ^a			Excluding persons at high risk ^b		
	Obs.	Exp.	SIR (95% CI)	Obs.	Exp.	SIR (95% CI)
All cancers	38	20.9	1.82 (1.29–2.50)	30	20.1	1.49 (1.01–2.13)
Leukaemia	12	7.0	1.72 (0.89–3.01)	12	6.7	1.79 (0.92–3.12)
Lymphomas	10	3.4	2.96 (1.42–5.45)	5	3.2	1.54 (0.50–3.59)
CNS tumours	7	5.2	1.35 (0.54–2.78)	6	5.0	1.20 (0.44–2.61)
Solid cancers	9	5.4	1.68 (0.77–3.19)	7	5.2	1.36 (0.55–2.80)

Obs. observed, Exp. expected, SIR standardised incidence ratio, 95% CI 95% confidence interval

^a All included cases after review of the radiology reports and medical files from the GCCR

^b All included cases after review of the radiology reports and medical files from the GCCR except those at high risk

Table 6 SIRs by exposure frequency for all cancer, leukaemia, lymphoma, CNS tumours and solid cancer including persons at high risk for cancer after two years' latency

Cancer type	Number of CTs	Obs.	Exp.	SIR	95% CI
All cancers	One	25	15.2	1.64	(1.06–2.43)
	Two or more	13	5.7	2.29	(1.22–3.91)
Leukaemia	One	6	5.1	1.18	(0.43–2.57)
	Two or more	6	1.9	3.17	(1.16–6.90)
Lymphomas	One	9	2.5	3.67	(1.68–6.97)
	Two or more	1	0.9	1.08	(0.03–6.02)
CNS tumours	One	4	3.8	1.06	(0.29–2.71)
	Two or more	3	1.4	2.12	(0.44–6.18)
Solid cancers	One	6	3.9	1.54	(0.56–3.35)
	Two or more	3	1.5	2.07	(0.43–6.04)

Obs. observed, *Exp.* expected, *SIR* standardised incidence ratio, *95% CI* 95% confidence interval

Table 7 Comparison of the cohort composition and the risk estimates for leukaemia and CNS or brain tumours for three published epidemiological cohort studies on cancer risk after CTs in childhood and the presented study from Germany

	Epidemiological studies			
	Great Britain	Australia	Taiwan	Germany
Cohort				
Size	178,604	10,939,680	122,086	39,184
Exposed	178,604	680,211	24,418 (head CTs)	39,184
Age range	0–<22	0–<20	0–<18	0–<15
Follow-up period	1985–2008	1985–2007	1998–2008	1983–2010
Cases	209	3150	122	38 (44) ^a
Of exposed: only one CT	71% ^b	82%	93%	70%
Head CTs	57% ^c	59% ^d	100%	72% ^e
Leukaemia				
Cases	74	211	17	12
Risk estimate	RR: 3.18	IRR: 1.23	HR: 1.90	SIR: 1.72
95% CI	1.46–6.94	1.08–1.41	0.82–4.40	0.89–3.01
Comparison	0–5 vs. 30 mGy	CT vs. no CT	head CT vs. no CT	CT vs. no CT
Latency	2 years	1 year	2 years	2 years
Brain/CNS tumours				
Cases	135	283	30	7
Risk estimate	RR: 2.82	IRR: 2.13	HR: 2.56	SIR: 1.35
95% CI	1.33–6.03	1.88–2.41	1.44–4.45	0.54–2.78
Comparison	0–5 vs. 50 mGy	CT vs. no CT	head CT vs. no CT	CT vs. no CT
Latency	5 years	1 year	2 years	2 years

HR hazard ratio, *RR* relative risk, *SIR* standardised incidence ratio, *IRR* incidence rate ratio

^a (Before) and after review of the radiology reports

^b From all persons including cancer patients

^c From all CTs

^d From all first CT per person

^e Individuals receiving head CTs from all cohort members. Data on other studies derived from (Pearce et al. 2012; Pearce et al. 2012b; Mathews et al. 2013; Huang et al. 2014)

References

1. Krille L, Jahnen A, Mildenerger P, Schneider K, Weisser G, Zeeb H, Blettner M (2011) Computed tomography in children: multi-center cohort study design for the evaluation of cancer risk. *Eur J Epidemiol* 26(3):249–250
2. Krille L, Dreger S, Schindel R, Albrecht T, Asmussen M, Barkhausen J, Berthold J, Chavan A, Claussen C, Forsting M, Gianicolo E, Jablonka K, Jahnen A, Langer M, Laniado M, Lotz J, Mentzel H, Queißer-Wahrendorf A, Rompel O, Schlick I, Schneider K, Schumacher M, Seidenbusch M, Spix C, Spors B, Staatz G, Vogl T, Wagner J, Weisser G, Zeeb H, Blettner M (2015) Risk of cancer incidence before the age of 15 years after exposure to ionising radiation from computed tomography: results from a German cohort study. *Radiat Environ Biophys* 54:1–12