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# 40 Jahre Tschernobyl – Mythen und Fakten

23.04.2026

Dr. med. Alex Rosen
IPPNW Deutschland

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# 40 Jahre Tschernobyl

**Themen des Vortrags:**

- Die Folgen der Katastrophe
- Aktuelle Situation vor Ort
- Bedeutung für die Anti-AKW Bewegung

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# 40 Jahre Tschernobyl

## Die Folgen der Katastrophe

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**Mythen:**

Die Atomkatastrophe von Tschernobyl führte nur zu 30 direkten Todesfällen: 2 durch die Explosion und 28 bei den Liquidatoren durch Akute Strahlenkrankheit

Es gab etwa 5.000 Fälle von gut behandelbarem SD-Krebs, sonst aber keine messbaren Folgen.

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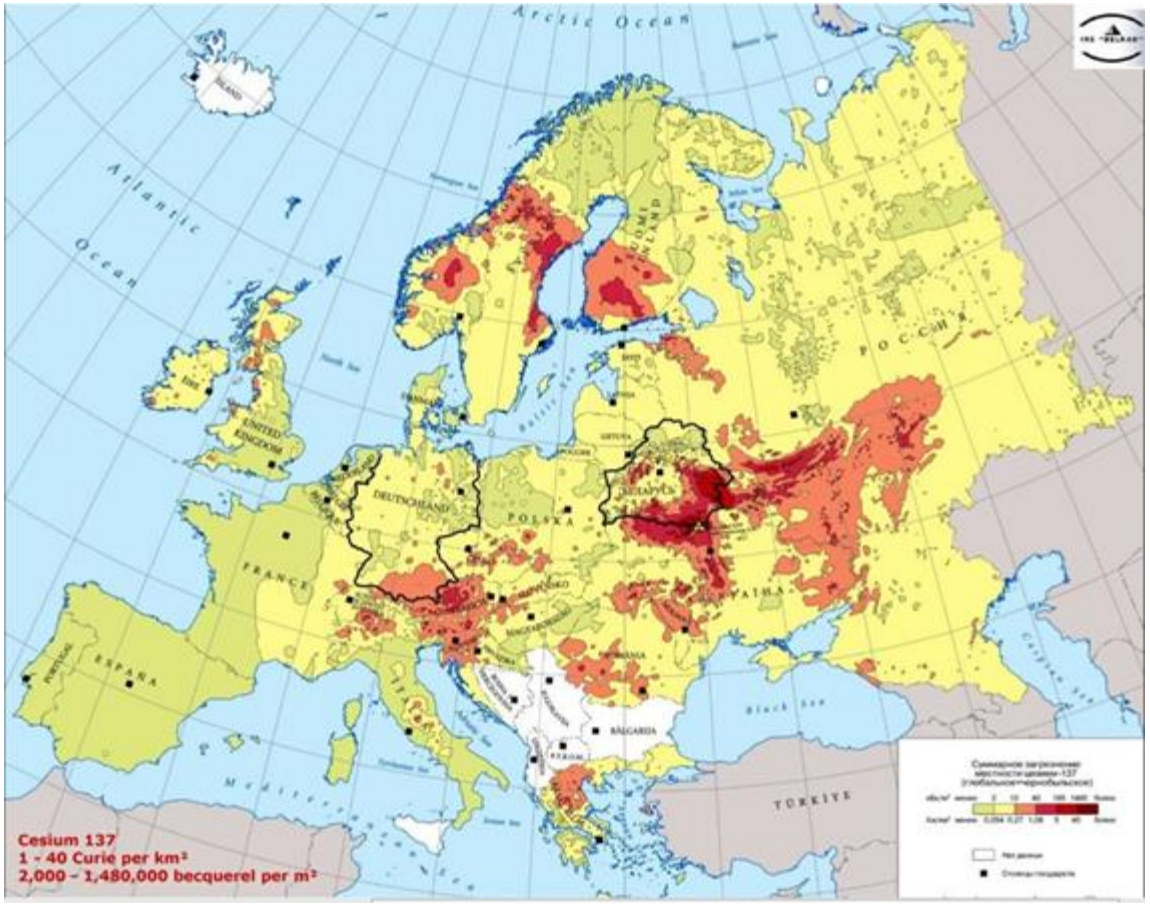
# 40 Jahre Tschernobyl

**Fakten:**

- Liquidatoren
- Lokalbevölkerung
- Europäische Bevölkerung



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## Die Liquidatoren

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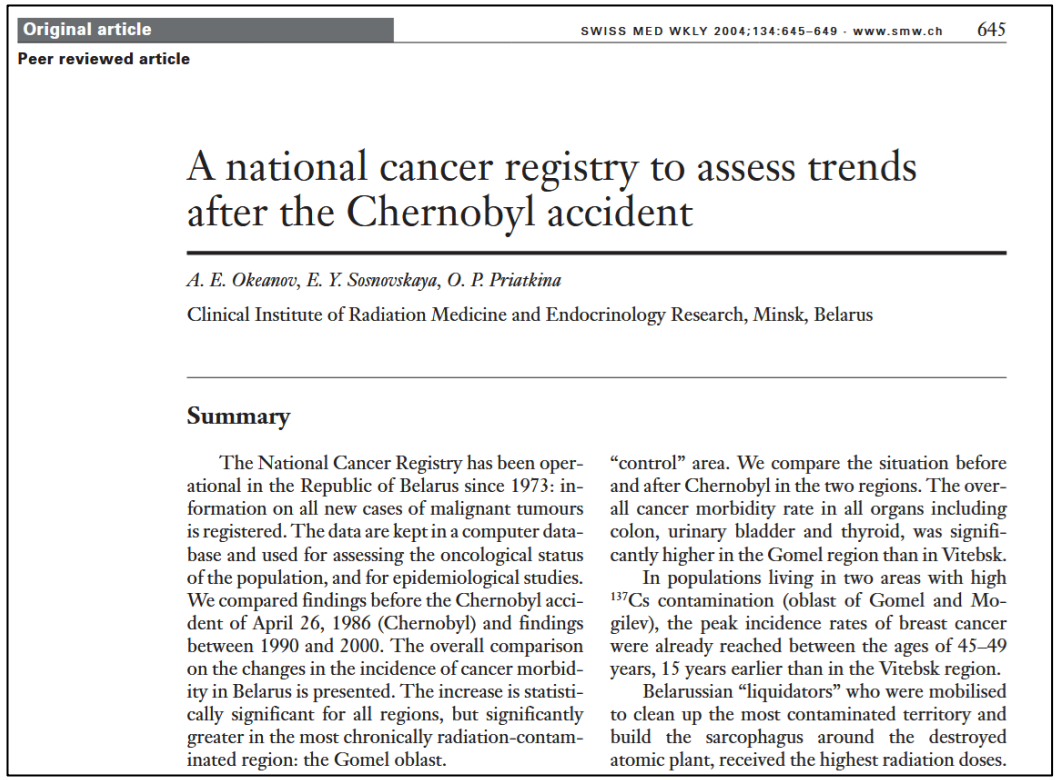
Krebsfälle bei Liquidatoren
Signifikant erhöhtes Risiko für alle Krebserkrankungen in rund 72.000 Liquidatoren im Vergleich zu den Bewohnern von Vitebsk im Weißrussischen Krebsregister



Original article
Peer reviewed article
SWISS MED WKLY 2004;134:645–649 · www.smw.ch 645

## A national cancer registry to assess trends after the Chernobyl accident

*A. E. Okeanov, E. Y. Sosnovskaya, O. P. Priatkina*
Clinical Institute of Radiation Medicine and Endocrinology Research, Minsk, Belarus

**Summary**

The National Cancer Registry has been operational in the Republic of Belarus since 1973: information on all new cases of malignant tumours is registered. The data are kept in a computer database and used for assessing the oncological status of the population, and for epidemiological studies. We compared findings before the Chernobyl accident of April 26, 1986 (Chernobyl) and findings between 1990 and 2000. The overall comparison on the changes in the incidence of cancer morbidity in Belarus is presented. The increase is statistically significant for all regions, but significantly greater in the most chronically radiation-contaminated region: the Gomel oblast. "control" area. We compare the situation before and after Chernobyl in the two regions. The overall cancer morbidity rate in all organs including colon, urinary bladder and thyroid, was significantly higher in the Gomel region than in Vitebsk.

In populations living in two areas with high $^{137}Cs$ contamination (oblast of Gomel and Mogilev), the peak incidence rates of breast cancer were already reached between the ages of 45–49 years, 15 years earlier than in the Vitebsk region.

Belarussian "liquidators" who were mobilised to clean up the most contaminated territory and build the sarcophagus around the destroyed atomic plant, received the highest radiation doses.

Okeanov, A. "A National Cancer Registry to assess after the Chernobyl accident". Swiss Med Weekly, 134: 645 – 649. 2004

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# 40 Jahre Tschernobyl

Erhöhtes Risiko für Leukämien und Non-Hodgkin Lymphomen in Liquidatoren.

Kesmiene et al. “Risk of hematological malignancies among Chernobyl liquidators“. Radiat Res; 170(6): 721–735. 2008

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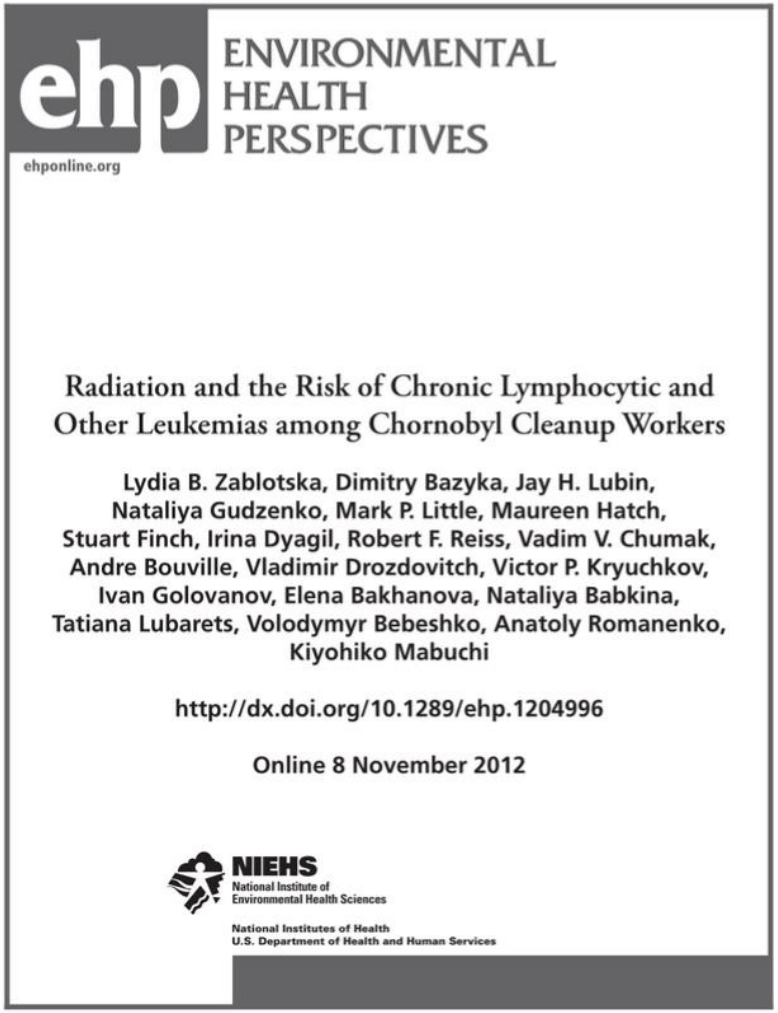
Fall-Kontroll-Studie
> 110.000 ukrainische Liquidatoren

Signifikante Assoziation zwischen Strahlenexposition und dem Risiko einer Chronisch-lymphatischen Leukämie


ehp ENVIRONMENTAL HEALTH PERSPECTIVES
ehponline.org

Radiation and the Risk of Chronic Lymphocytic and Other Leukemias among Chornobyl Cleanup Workers

Lydia B. Zablotska, Dimitry Bazyka, Jay H. Lubin, Nataliya Gudzenko, Mark P. Little, Maureen Hatch, Stuart Finch, Irina Dyagil, Robert F. Reiss, Vadim V. Chumak, Andre Bouville, Vladimir Drozdovitch, Victor P. Kryuchkov, Ivan Golovanov, Elena Bakhanova, Nataliya Babkina, Tatiana Lubarets, Volodymyr Bebeshko, Anatoly Romanenko, Kiyohiko Mabuchi

http://dx.doi.org/10.1289/ehp.1204996

Online 8 November 2012

NIEHS National Institute of Environmental Health Sciences
National Institutes of Health
U.S. Department of Health and Human Services

Zablotska et al. „Radiation and the risk of Chronic Lymphocytic and Other Leukemias Chornobyl Cleanup workers“ EPH Volume 121(1): 59-65. 2013

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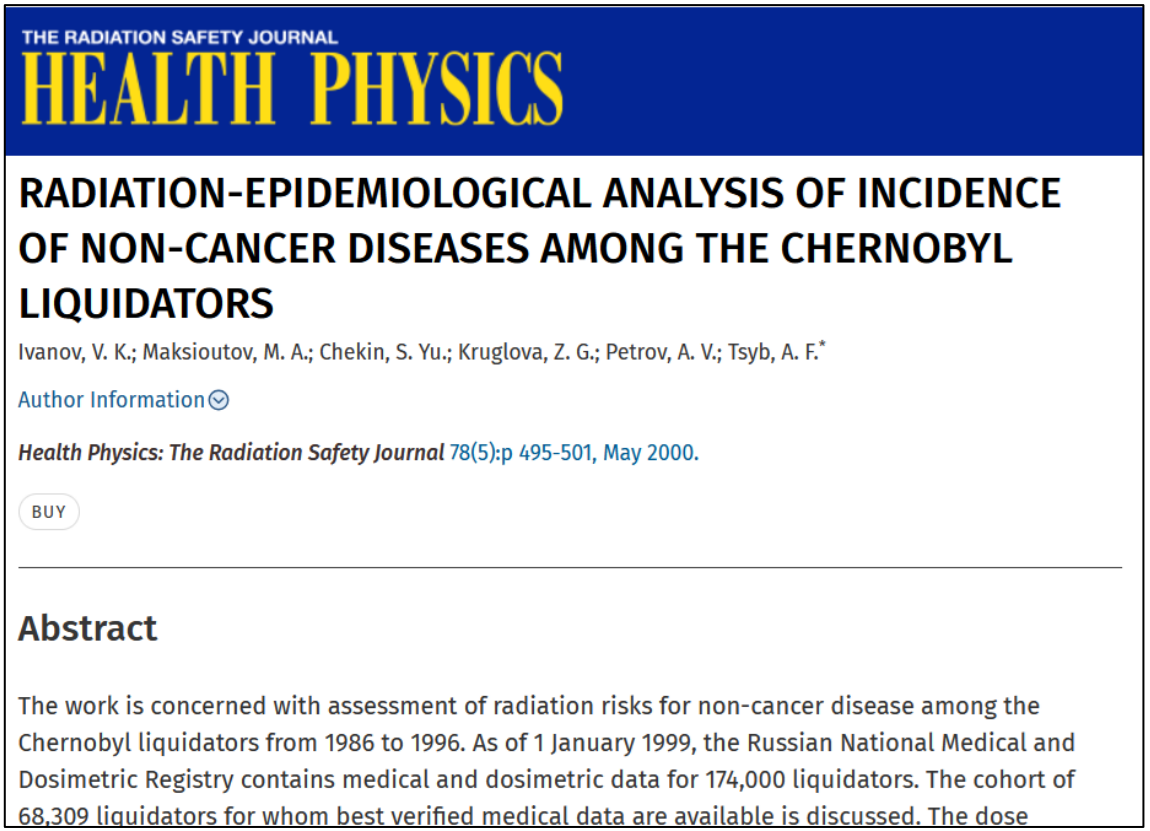
Signifikante Zunahme von Herz-Kreislauferkrankungen bei russischen Liquidatoren

40% erhöhtes Risiko



THE RADIATION SAFETY JOURNAL
HEALTH PHYSICS

## RADIATION-EPIDEMIOLOGICAL ANALYSIS OF INCIDENCE OF NON-CANCER DISEASES AMONG THE CHERNOBYL LIQUIDATORS

Ivanov, V. K.; Maksioutov, M. A.; Chekin, S. Yu.; Kruglova, Z. G.; Petrov, A. V.; Tsyb, A. F.*

Author Information

*Health Physics: The Radiation Safety Journal* 78(5):p 495-501, May 2000.

BUY

### Abstract

The work is concerned with assessment of radiation risks for non-cancer disease among the Chernobyl liquidators from 1986 to 1996. As of 1 January 1999, the Russian National Medical and Dosimetric Registry contains medical and dosimetric data for 174,000 liquidators. The cohort of 68,309 liquidators for whom best verified medical data are available is discussed. The dose

Ivanov, VK et al. „Radiation-epidemiological analysis of the incidence of non-cancer diseases among Chernobyl liquidators“ Health Physics: The Radiation Safety Journal 78(5):p 495-501. 2000.

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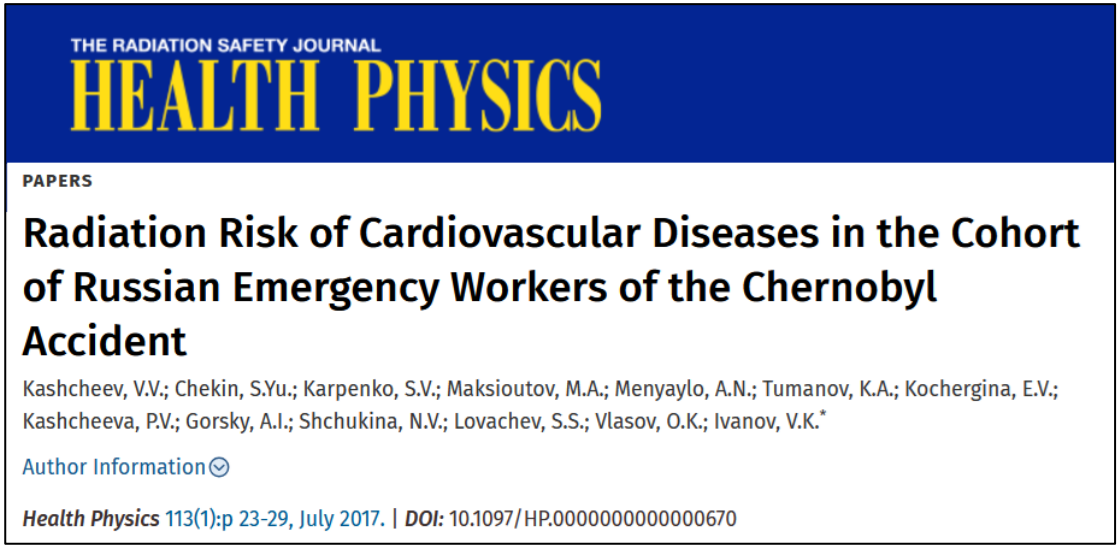
Risiko für kardiovaskuläre und zerebrovaskuläre Erkrankungen statistisch signifikant abhängig von der Aufenthaltsdauer am Unfallort und der Strahlendosis (russische Liquidatoren)


THE RADIATION SAFETY JOURNAL
HEALTH PHYSICS

PAPERS

**Radiation Risk of Cardiovascular Diseases in the Cohort of Russian Emergency Workers of the Chernobyl Accident**

Kashcheev, V.V.; Chekin, S.Yu.; Karpenko, S.V.; Maksioutov, M.A.; Menyaylo, A.N.; Tumanov, K.A.; Kochergina, E.V.; Kashcheeva, P.V.; Gorsky, A.I.; Shchukina, N.V.; Lovachev, S.S.; Vlasov, O.K.; Ivanov, V.K.*

Author Information

*Health Physics* 113(1):p 23-29, July 2017. | *DOI:* 10.1097/HP.0000000000000670


Kashcheev et al. „Radiation Risk of Cardiovascular Disease in the Cohort of Russian Emergency Workers of the Chernobyl Accident“. Health Physics 2017 Jul;113(1):23-29.

Kashcheev et al. „ Radiation-epidemiological Study of Cerebrovascular Diseases in the Cohort of Russian Recovery Operation Workers of the Chernobyl Accident. “Health Physics 2016 Aug;111(2):192-7

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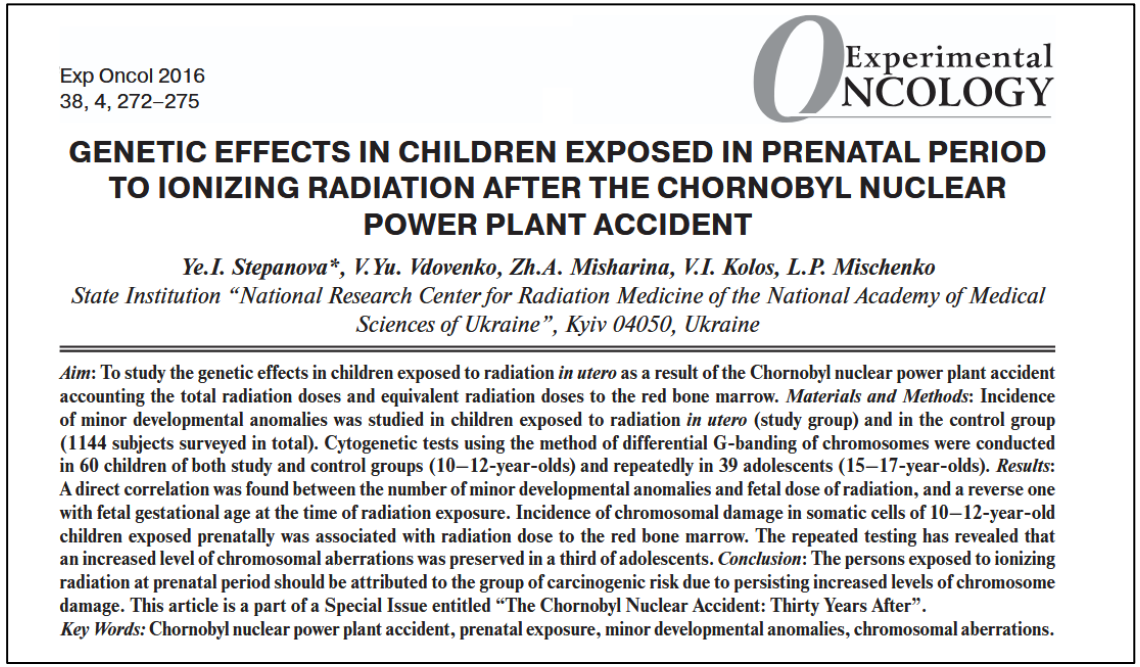
Direkte Korrelation von Entwickungsstörungen zur pränatalen Strahlenexposition

Erhöhte Rate an chromosomalen Fehlbildungen bei 10-12 Jährigen die in utero strahlenexponiert waren

Stepanova YI et al. „Genetic effects in children exposed in prenatal period to ionizing radiation after the Chornobyl nuclear power plant accident“ Exp Oncol. 2016 Dec;38(4):272-275



Exp Oncol 2016
38, 4, 272–275

Experimental ONCOLOGY

## GENETIC EFFECTS IN CHILDREN EXPOSED IN PRENATAL PERIOD TO IONIZING RADIATION AFTER THE CHORNOBYL NUCLEAR POWER PLANT ACCIDENT

*Ye.I. Stepanova*, V.Yu. Vdovenko, Zh.A. Misharina, V.I. Kolos, L.P. Mischenko*
*State Institution "National Research Center for Radiation Medicine of the National Academy of Medical Sciences of Ukraine", Kyiv 04050, Ukraine*

***Aim***: To study the genetic effects in children exposed to radiation *in utero* as a result of the Chornobyl nuclear power plant accident accounting the total radiation doses and equivalent radiation doses to the red bone marrow. ***Materials and Methods***: Incidence of minor developmental anomalies was studied in children exposed to radiation *in utero* (study group) and in the control group (1144 subjects surveyed in total). Cytogenetic tests using the method of differential G-banding of chromosomes were conducted in 60 children of both study and control groups (10–12-year-olds) and repeatedly in 39 adolescents (15–17-year-olds). ***Results***: A direct correlation was found between the number of minor developmental anomalies and fetal dose of radiation, and a reverse one with fetal gestational age at the time of radiation exposure. Incidence of chromosomal damage in somatic cells of 10–12-year-old children exposed prenatally was associated with radiation dose to the red bone marrow. The repeated testing has revealed that an increased level of chromosomal aberrations was preserved in a third of adolescents. ***Conclusion***: The persons exposed to ionizing radiation at prenatal period should be attributed to the group of carcinogenic risk due to persisting increased levels of chromosome damage. This article is a part of a Special Issue entitled "The Chornobyl Nuclear Accident: Thirty Years After".
***Key Words:*** Chornobyl nuclear power plant accident, prenatal exposure, minor developmental anomalies, chromosomal aberrations.

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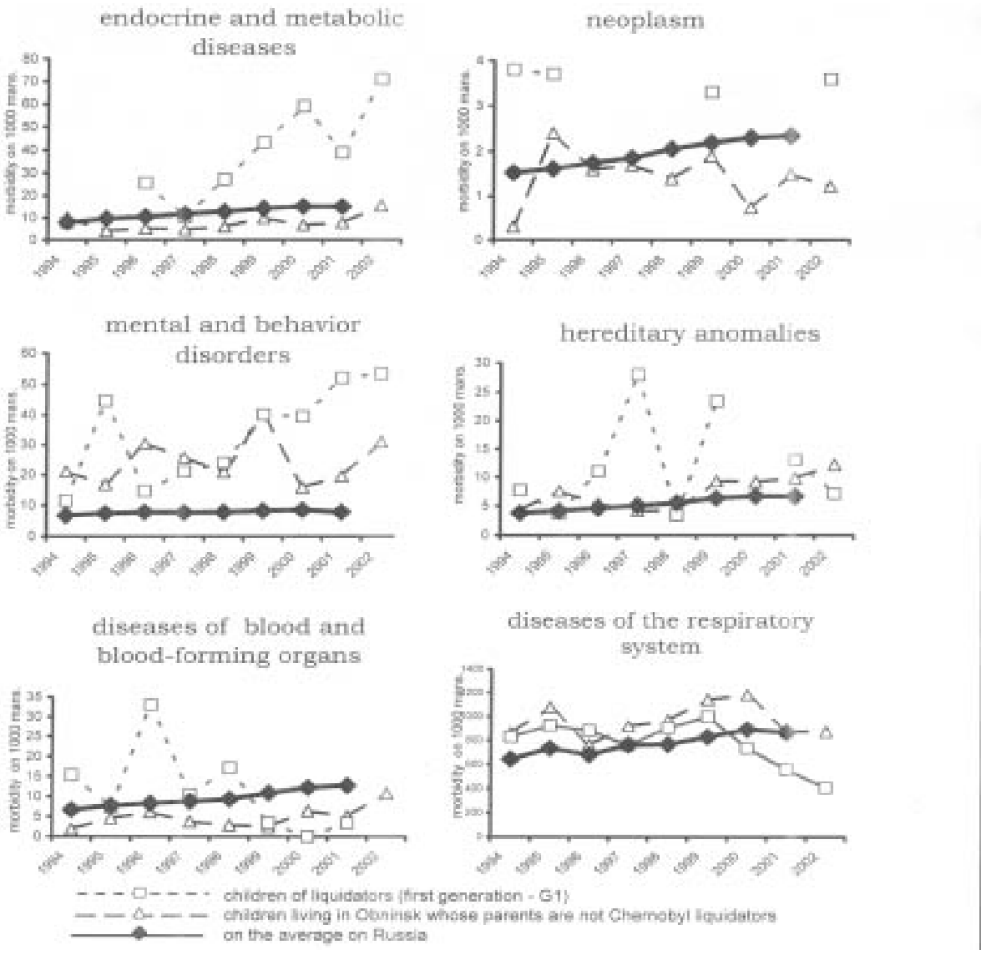
300 Kinder von russischen Liquidatoren (3-14 Jahre) zeigten erhöhte Raten an Fehlbildungen und Erkrankungen des Knochenmarks, der Schilddrüse und der Stoffwechselorgane




Tsyb AF et al. „General characterization of health in first-generation offspring born to liquidators of the Chernobyl NPP accident consequences“. Int. J. Rad. Med. 6(1-4), 116-121. 024

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7 x mehr Genmutationen in Kindern von Liquidatoren, die nach Tschernobyl gezeugt wurden im Vergleich zu älteren Geschwistern

Weinberg HS at al. “Molecular Changes in the Offspring of Liquidators Who Emigrated to Israel from the Chernobyl Disaster Area” Vol. 105, Supplement 6: Radiation and Human Health (Dec. 1997), pp. 1479-1481

## Molecular Changes in the Offspring of Liquidators Who Emigrated to Israel from the Chernobyl Disaster Area

Hava-Shifra Weinberg,[1] Eviatar Nevo,[1] Abraham Korol,[1] Tzion Fahima,[1] Gad Rennert,[2] and Semion Shapiro[2]

[1]Institute of Evolution, University of Haifa, Mount Carmel, Haifa, Israel; [2]National Kupat Holim Cancer Control Center, Carmel Medical Center and Technion Faculty of Medicine, Haifa, Israel

The primary goal of this research was to reveal *de novo* mutations in the liquidators (cleanup personnel) who emigrated to Israel from the Chernobyl disaster area. We used genome fingerprinting simple sequence repeat-anchored polymerase chain reaction (PCR) amplification and random amplified polymorphic DNA PCR (RAPD PCR). The methodology involved a combination of RAPD PCR, polyacrylamide gel electrophoresis, and silver staining, with arbitrarily primed PCR. Use of microsatellite markers appears to be the most promising technique for high sensitivity analysis. The analysis involved DNA isolated from the blood of experimental and control subjects (involving both offspring who were born before or after the disaster and their parents). Our studies have reproducibly detected new bands that appeared in the children born after the disaster. No such bands appeared in the children born in the same family before the accident or in the children of control families who had not been exposed to radiation. — *Environ Health Perspect* 105(Suppl 6):1479–1481 (1997)

Key words: Chernobyl, *de novo* mutations, liquidators, RAPD PCR, AP PCR, PAGE, silver staining

### Introduction

The Chernobyl accident occurred in April 1986 (*1,2*). Radiation events such as the atomic bomb on Hiroshima and Nagasaki reportedly have not yielded genetic defects (*3–5*). Recently, Dubrova et al. (*6*)

power plant created a different type of long-term exposure to low radiation doses (P Montague, unpublished data), although Bauchinger et al. (*9*) report that there is no absolute definition of a small dose of ioniz-

and after the disaster and their parents). Because of the small size of the experiment and control samples, tools enabling simultaneous testing of hundreds of genomic regions must be used. DNA fingerprinting based on mini- or microsatellite markers may be a suitable molecular genetic tool to address this problem.

Several molecular genetic methods for genome screening have been proposed for mutation detection (*11,12*). Genomic analysis based on polymerase chain reaction (PCR) appears to be the most promising technique for high sensitivity analysis (*13*). Recent advances in PCR applications make it possible to score individuals at a large number of loci. DNA fingerprinting by inter-simple sequence repeat (SSR) PCR can be used to identify the presence of the repeated elements targeted by the primers and to evaluate their distribution within different genomes. The examination of the amplification products of DNA from different individuals of the same species (including human) makes it possible to identify some individual-specific differences. These intraspecies polymorphisms open the possibility of using inter-SSR PCR as a system of multiple-locus DNA markers (*14*). random amplified polymorphic DNA (RAPD) is an attractive complement to the conventional DNA fingerprinting (*14*). RAPD includes the ease and rapidity of analysis, the use of a general set of universal primers, and a minimal amount of DNA. The profile of amplification products

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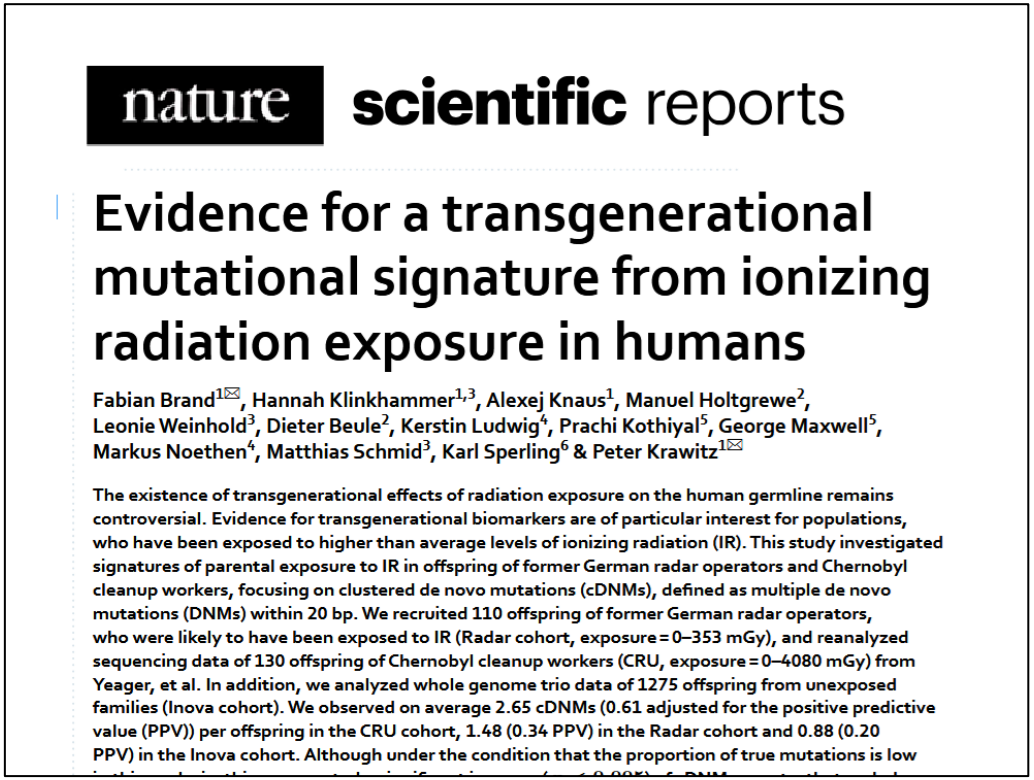
Signifikant höhere Rate an Genmutationen (cDNM) in Nachkommen von Liquidatoren (2,65 vs 0,88 pro Kind)

Brand F et al. „Evidence for a transgenerational mutational signature from ionizing radiation exposure in humans". Nature Scientific Reports June 2025; 15(1).



nature scientific reports

## Evidence for a transgenerational mutational signature from ionizing radiation exposure in humans

Fabian Brand[1✉], Hannah Klinkhammer[1,3], Alexej Knaus[1], Manuel Holtgrewe[2], Leonie Weinhold[3], Dieter Beule[2], Kerstin Ludwig[4], Prachi Kothiyal[5], George Maxwell[5], Markus Noethen[4], Matthias Schmid[3], Karl Sperling[6] & Peter Krawitz[1✉]

The existence of transgenerational effects of radiation exposure on the human germline remains controversial. Evidence for transgenerational biomarkers are of particular interest for populations, who have been exposed to higher than average levels of ionizing radiation (IR). This study investigated signatures of parental exposure to IR in offspring of former German radar operators and Chernobyl cleanup workers, focusing on clustered de novo mutations (cDNMs), defined as multiple de novo mutations (DNMs) within 20 bp. We recruited 110 offspring of former German radar operators, who were likely to have been exposed to IR (Radar cohort, exposure = 0–353 mGy), and reanalyzed sequencing data of 130 offspring of Chernobyl cleanup workers (CRU, exposure = 0–4080 mGy) from Yeager, et al. In addition, we analyzed whole genome trio data of 1275 offspring from unexposed families (Inova cohort). We observed on average 2.65 cDNMs (0.61 adjusted for the positive predictive value (PPV)) per offspring in the CRU cohort, 1.48 (0.34 PPV) in the Radar cohort and 0.88 (0.20 PPV) in the Inova cohort. Although under the condition that the proportion of true mutations is low

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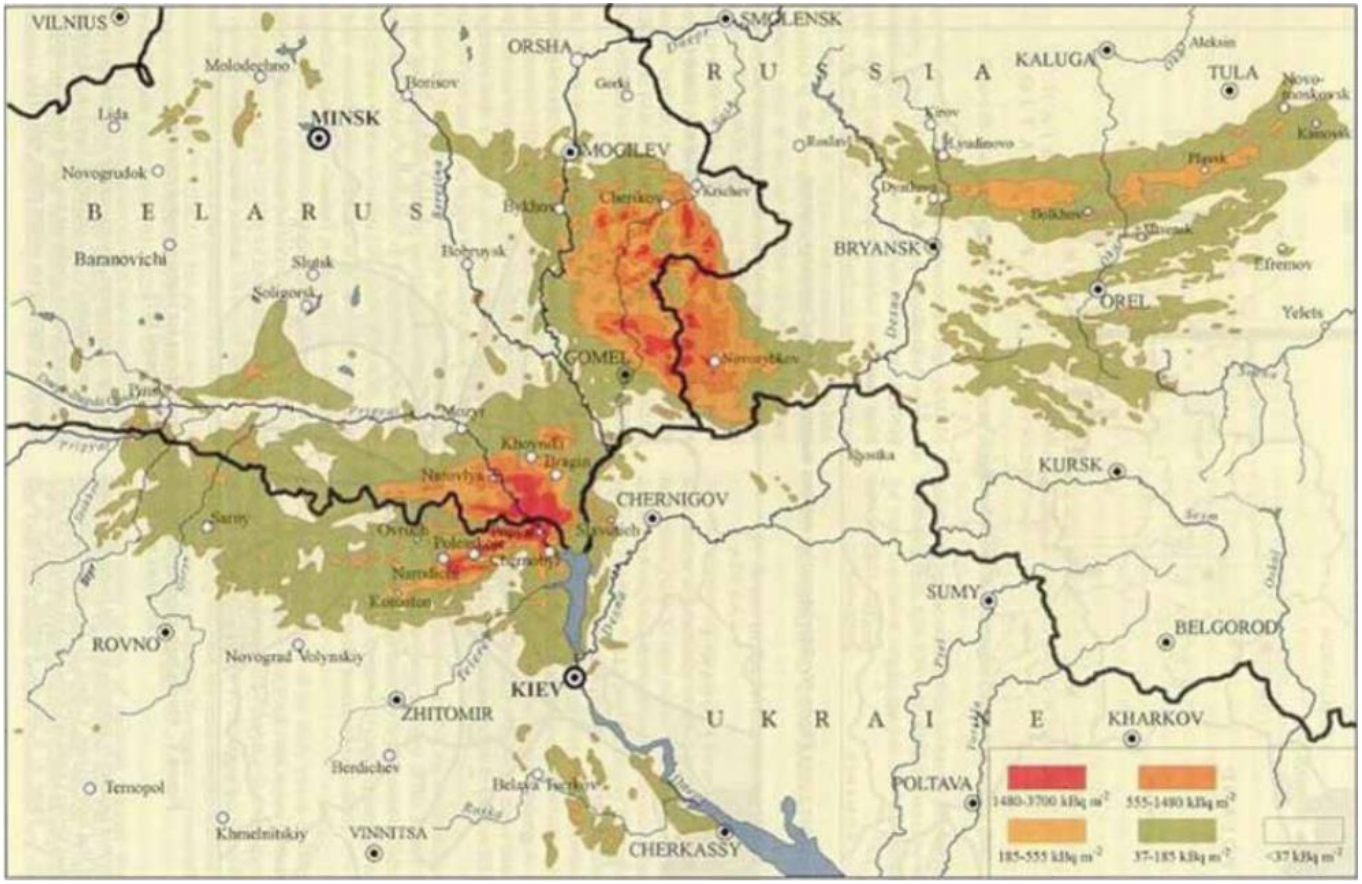


## Die Lokalbevölkerung

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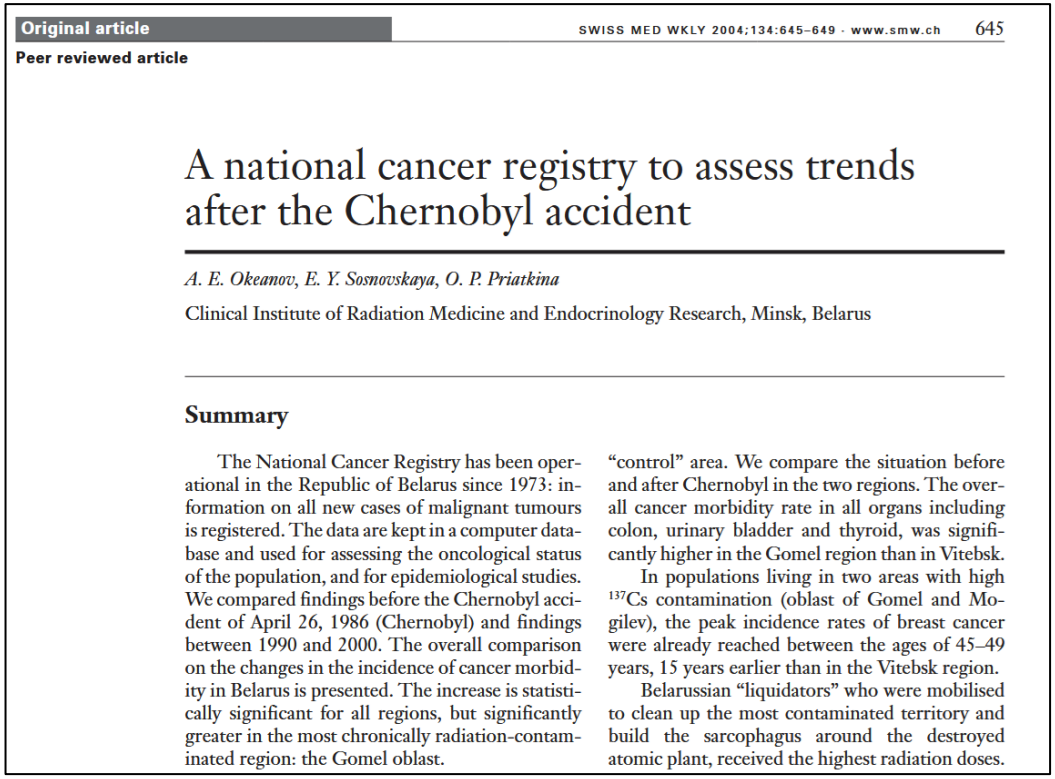
Signifikanter Anstieg der Krebsrate um 39,8 Prozent im Weißrussischen Krebsregister

In höher belasteten Regionen deutlich höhere Zunahme (z.B. Gomel)

v.a. Darm-, Lungen-, Blasen- und Schilddrüsenkrebs.

Okeanov, AE et al. „A national cancer registry to assess trends after Chernobyl accident“, Swiss Medical Weekly, 134: 645-649. 2004



Original article
Peer reviewed article
SWISS MED WKLY 2004;134:645–649 · www.smw.ch 645

## A national cancer registry to assess trends after the Chernobyl accident

*A. E. Okeanov, E. Y. Sosnovskaya, O. P. Priatkina*

Clinical Institute of Radiation Medicine and Endocrinology Research, Minsk, Belarus

**Summary**

The National Cancer Registry has been operational in the Republic of Belarus since 1973: information on all new cases of malignant tumours is registered. The data are kept in a computer database and used for assessing the oncological status of the population, and for epidemiological studies. We compared findings before the Chernobyl accident of April 26, 1986 (Chernobyl) and findings between 1990 and 2000. The overall comparison on the changes in the incidence of cancer morbidity in Belarus is presented. The increase is statistically significant for all regions, but significantly greater in the most chronically radiation-contaminated region: the Gomel oblast.

"control" area. We compare the situation before and after Chernobyl in the two regions. The overall cancer morbidity rate in all organs including colon, urinary bladder and thyroid, was significantly higher in the Gomel region than in Vitebsk.

In populations living in two areas with high $^{137}Cs$ contamination (oblast of Gomel and Mogilev), the peak incidence rates of breast cancer were already reached between the ages of 45–49 years, 15 years earlier than in the Vitebsk region.

Belarussian "liquidators" who were mobilised to clean up the most contaminated territory and build the sarcophagus around the destroyed atomic plant, received the highest radiation doses.

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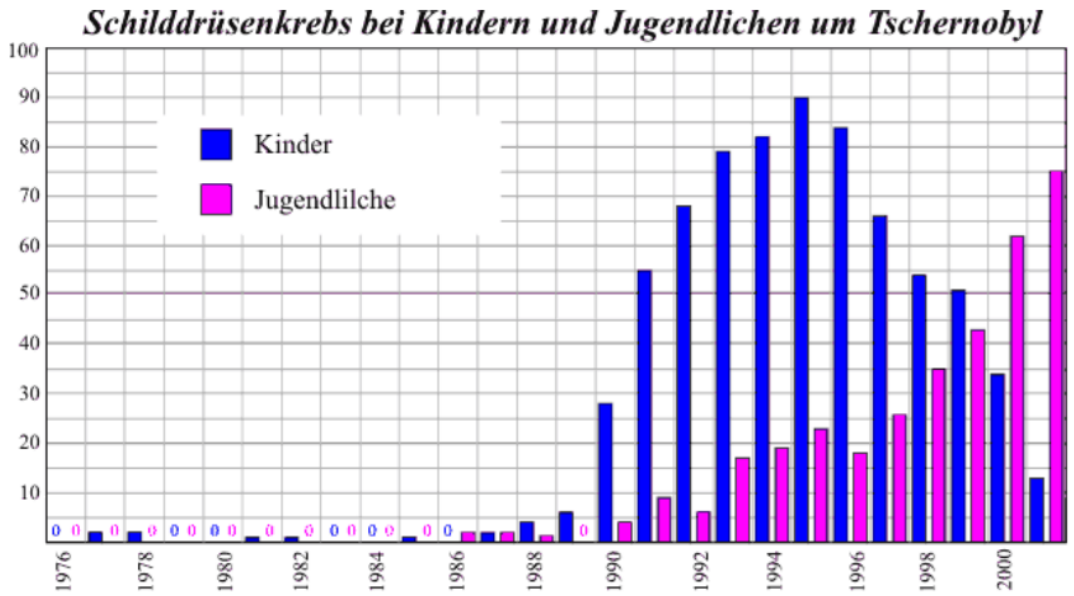
Deutlicher Anstieg der Inzidenz von SD-Krebs in Kindern und Jugendlichen in Weißrussland




Lengfelder E et al. “Ten-year Chernobyl aid programmes of the Otto Hug Strahleninstitut-MHM: treatment and research projects on thyroid cancer in Belarus”. International Congress Series
Volume 1234, May 2002, Pages 201-204

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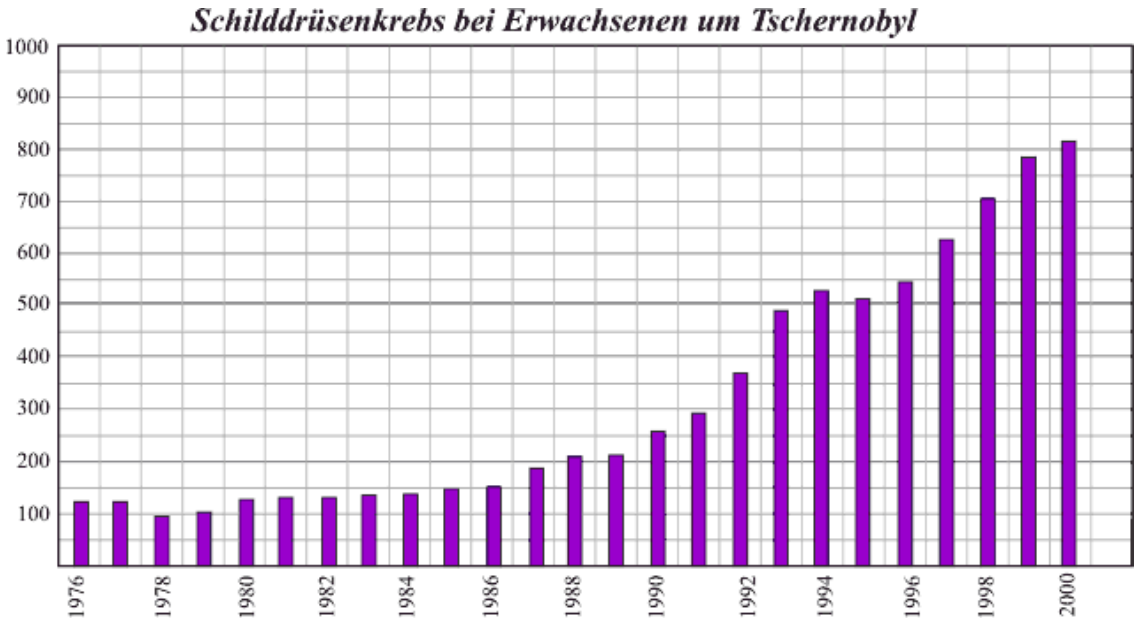
Ebenfalls Anstieg der Inzidenz von SD-Krebs in Erwachsenen in Weißrussland




Lengfelder E et al. “Ten-year Chernobyl aid programmes of the Otto Hug Strahleninstitut-MHM: treatment and research projects on thyroid cancer in Belarus”. International Congress Series
Volume 1234, May 2002, Pages 201-204

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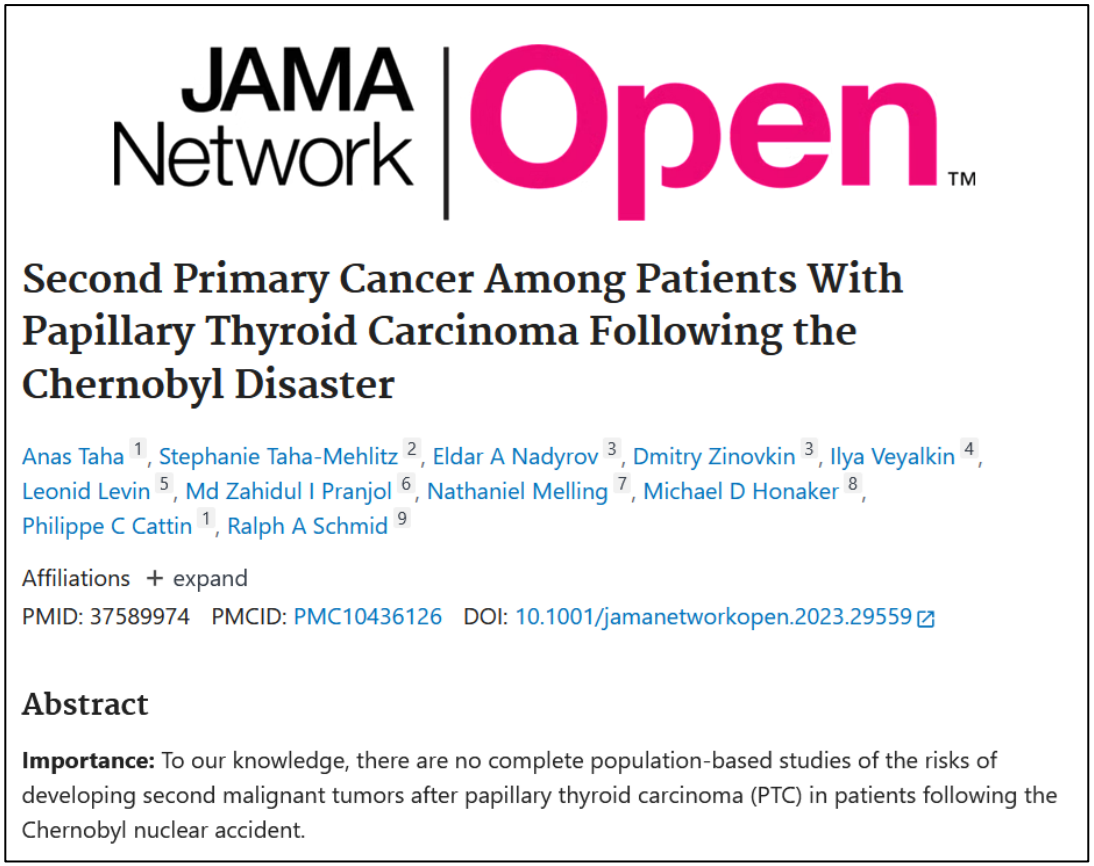
# 40 Jahre Tschernobyl

Signifikanter Anstieg der Inzidenz sekundärer Tumore in einer Kohorte von 30.000 Menschen mit primärem Schilddrüsenkrebs in Weißrussland

Taha et al. „Second Primary Cancer Among Patients With Papillary Thyroid Carcinoma Following the Chernobyl Disaster". JAMA Netw Open 2023 August 1;6(8).



JAMA Network | Open™

## Second Primary Cancer Among Patients With Papillary Thyroid Carcinoma Following the Chernobyl Disaster

Anas Taha [1], Stephanie Taha-Mehlitz [2], Eldar A Nadyrov [3], Dmitry Zinovkin [3], Ilya Veyalkin [4], Leonid Levin [5], Md Zahidul I Pranjol [6], Nathaniel Melling [7], Michael D Honaker [8], Philippe C Cattin [1], Ralph A Schmid [9]

Affiliations + expand

PMID: 37589974 PMCID: PMC10436126 DOI: 10.1001/jamanetworkopen.2023.29559

### Abstract

**Importance:** To our knowledge, there are no complete population-based studies of the risks of developing second malignant tumors after papillary thyroid carcinoma (PTC) in patients following the Chernobyl nuclear accident.

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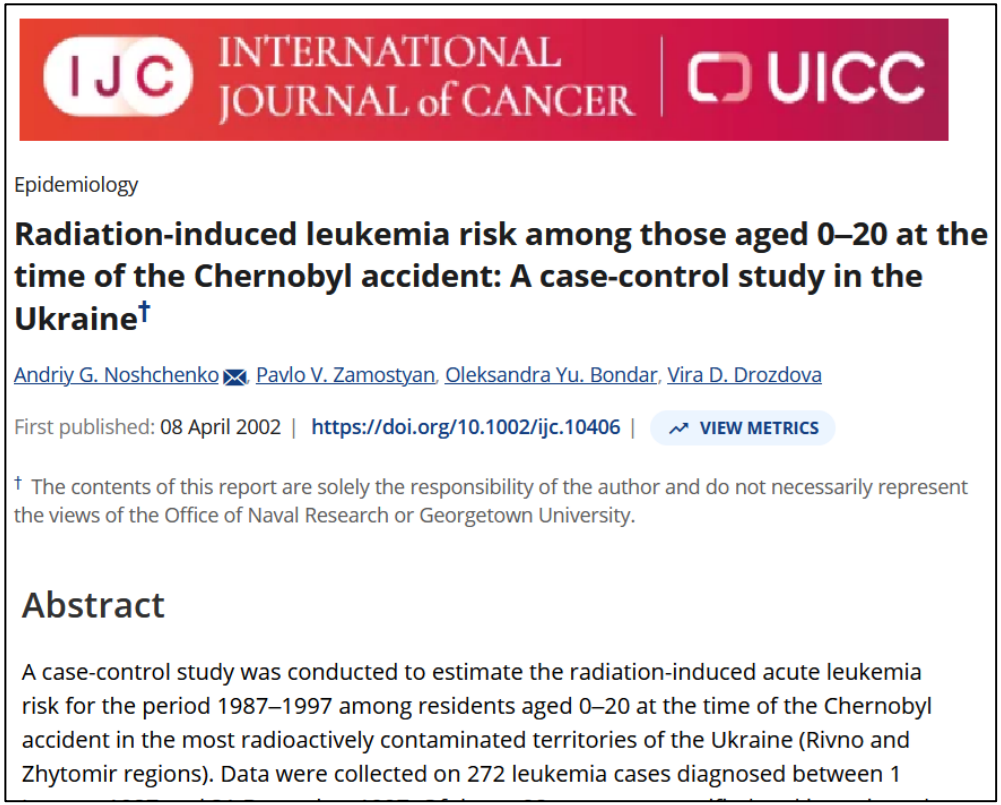
# 40 Jahre Tschernobyl

Relatives Risiko für ALL in belasteten Gebieten um den Faktor 3,4 erhöht

Direkte Korrelation zur Strahlenbelastung

Noshchenko, AG et al. „Radiation-induced Leukemia risk among those aged 0-20 at the time of the Chernobyl accident: a case-control study“ Int. J.Cancer 2002, 99,609-618.



IJC INTERNATIONAL JOURNAL of CANCER | UICC

Epidemiology

**Radiation-induced leukemia risk among those aged 0–20 at the time of the Chernobyl accident: A case-control study in the Ukraine†**

Andriy G. Noshchenko, Pavlo V. Zamostyan, Oleksandra Yu. Bondar, Vira D. Drozdova

First published: 08 April 2002 | https://doi.org/10.1002/ijc.10406 | VIEW METRICS

† The contents of this report are solely the responsibility of the author and do not necessarily represent the views of the Office of Naval Research or Georgetown University.

## Abstract

A case-control study was conducted to estimate the radiation-induced acute leukemia risk for the period 1987–1997 among residents aged 0–20 at the time of the Chernobyl accident in the most radioactively contaminated territories of the Ukraine (Rivno and Zhytomir regions). Data were collected on 272 leukemia cases diagnosed between 1

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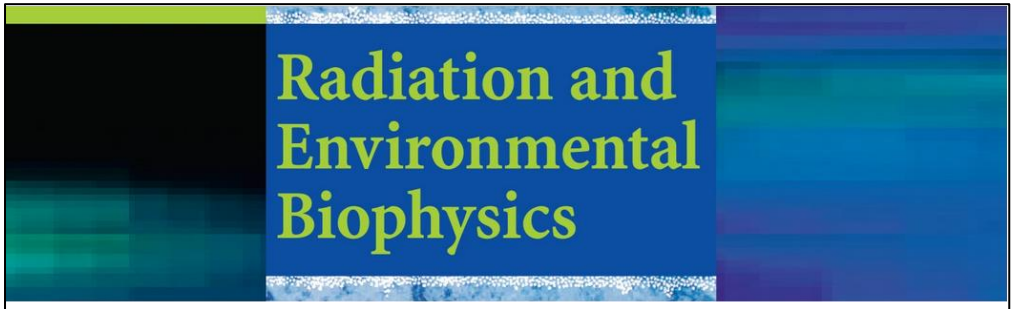
Risikoanstieg für Leukämie bei Kindern in den drei stark kontaminierten Regionen der Ukraine um rund 60% (CI 36-86%) in der Zeit 1987-2000 im Vergleich zu 1980-1986.

Liubarets TF et al. “Childhood leukemia in Ukraine after the Chornobyl accident”. Radiation and Environmental Biophysics 2019 Nov;58(4):553-562.




T. F. Liubarets ✉, Y. Shibata, V. A. Saenko, V. G. Bebeshko, A. E. Prysyazhnyuk, K. M. Bruslova, M. M. Fuzik, S. Yamashita & D. A. Bazyka

## Abstract

This population-based ecological study analyzes the prevalence of childhood leukemia in Ukraine before and after the Chornobyl nuclear power plant accident, based on the contamination status of the territory, time period, gender, and age. Three regions—Zhytomyr, Kyiv (except Kyiv city), and Chernihiv were included as areas contaminated by radioactive $^{137}Cs$ from 1 to 15 Ci/km$^2$ with annual effective doses exceeding 1.0 mSv, and Sumy region as the control (non-contaminated) area with $^{137}Cs$ contamination less than 1 Ci/km$^2$ and effective doses less than 0.5 mSv per year. The integrated database of the National Research Centre for Radiation Medicine used in the present study included 1085 childhood leukemia cases. Two aggregated periods were used for analysis: 1980–1986 (pre-accident) and 1987–2000 (post-accident). ICD-9 codes for leukemia (204–208.9)

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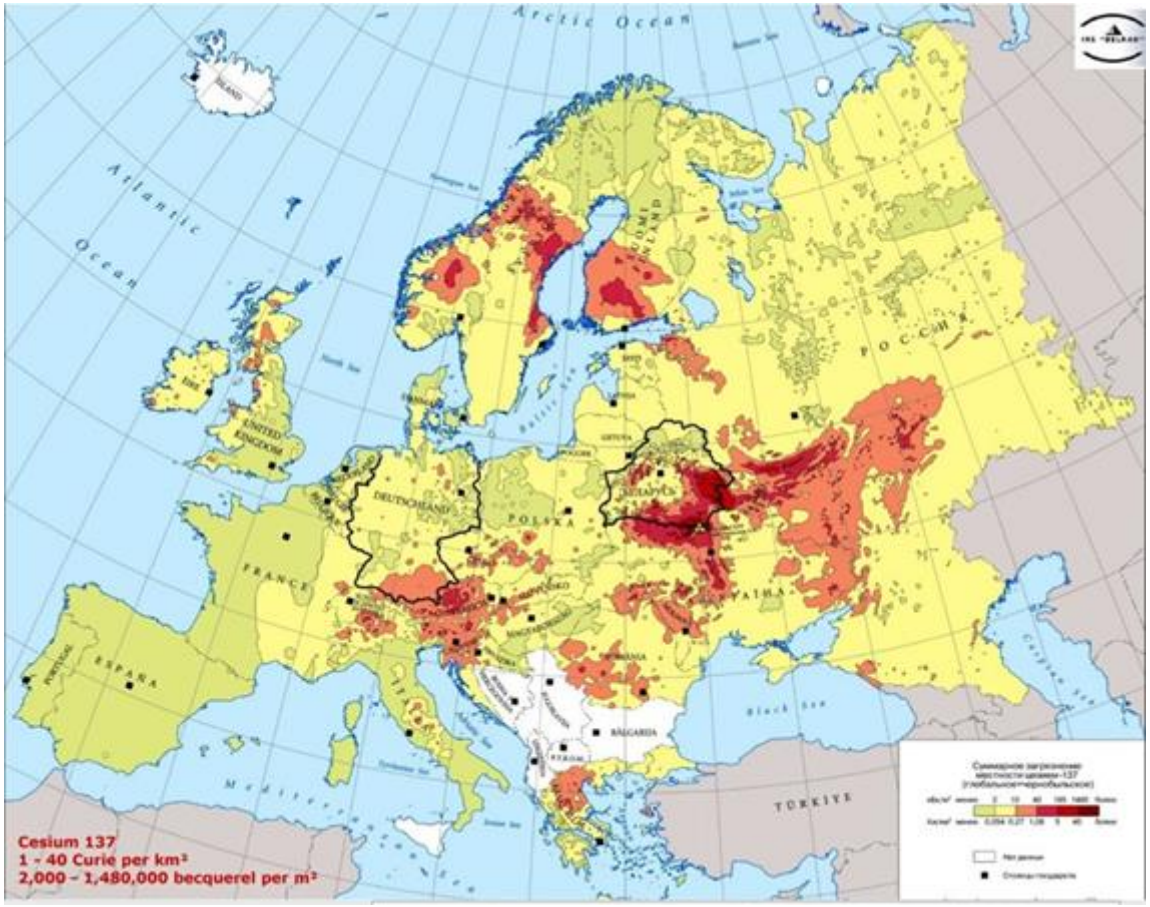
# 40 Jahre Tschernobyl




## Der Rest Europas

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# 40 Jahre Tschernobyl

Anstieg der Leukämieinzidenz
bei Kindern in Westdeutschland
zwischen Juli 1986 und
Dezember 1987
um den Faktor 1,5

Michaelis J et al. „Infant leukaemia after the Chernobyl accident, Nature, Vol. 387, 15 May 1997, S. 246

**Table 1 Cases of infant leukaemia**

| Region | 'Exposed' birth cohort (B) | | | 'Unexposed' birth cohorts (A+C) | | | | |
|---|---|---|---|---|---|---|---|---|
| | Cohort size | Number | Incidence rate | Cohort size | Number | Incidence rate | Rate ratio | 95% CI |
| Former FRG | 928,649 | 35 | 37.7 | 5,630,789 | 143 | 25.4 | 1.48 | 1.02–2.15 |
| Ground deposition (kBq m$^{-2}$ $^{137}$Cs) | | | | | | | | |
| < 6 | 696,402 | 29 | 41.6 | 4,230,847 | 96 | 22.7 | 1.84 | 1.21–2.78 |
| 6–10 | 111,807 | 1 | 8.9 | 684,113 | 24 | 35.1 | 0.25 | 0.03–1.89 |
| > 10 | 120,440 | 5 | 41.5 | 715,829 | 23 | 32.1 | 1.29 | 0.49–3.40 |

Incidence, rates and rate ratios of children with acute leukaemia in the first year of life for the 'exposed' (B) and 'unexposed' (A+C) birth cohorts in the former Federal Republic of Germany and in regions with different levels of contamination. Incidence rate per $10^5$ children.

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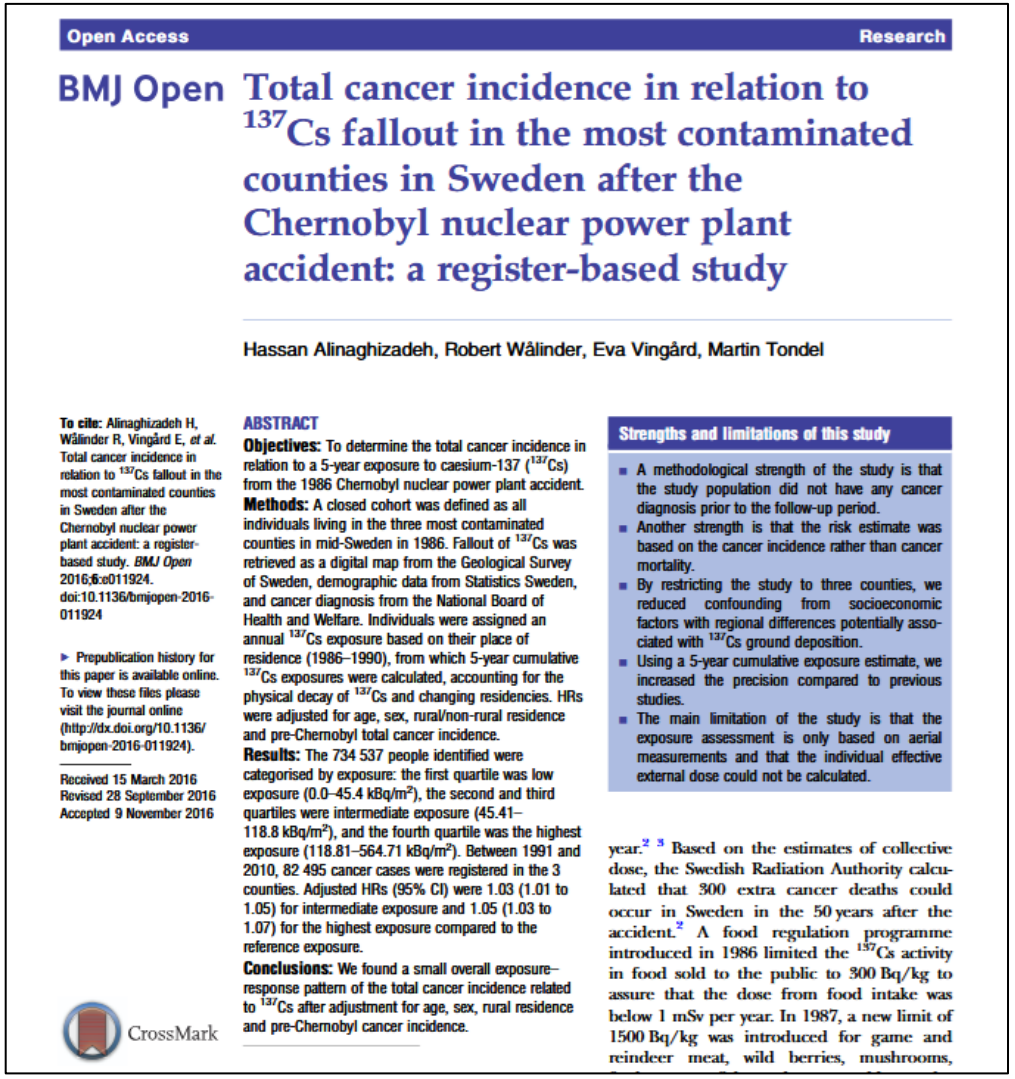
# 40 Jahre Tschernobyl

Krebsrisiko um 3 - 5% erhöht bei Menschen in den kontaminiertesten Landkreisen in Schweden mit signifikanter Dosis-Wirkungskurve



Open Access Research

BMJ Open

## Total cancer incidence in relation to $^{137}$Cs fallout in the most contaminated counties in Sweden after the Chernobyl nuclear power plant accident: a register-based study

Hassan Alinaghizadeh, Robert Wålinder, Eva Vingård, Martin Tondel

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► Prepublication history for this paper is available online. To view these files please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2016-011924).

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ABSTRACT

**Objectives:** To determine the total cancer incidence in relation to a 5-year exposure to caesium-137 ($^{137}$Cs) from the 1986 Chernobyl nuclear power plant accident.

**Methods:** A closed cohort was defined as all individuals living in the three most contaminated counties in mid-Sweden in 1986. Fallout of $^{137}$Cs was retrieved as a digital map from the Geological Survey of Sweden, demographic data from Statistics Sweden, and cancer diagnosis from the National Board of Health and Welfare. Individuals were assigned an annual $^{137}$Cs exposure based on their place of residence (1986–1990), from which 5-year cumulative $^{137}$Cs exposures were calculated, accounting for the physical decay of $^{137}$Cs and changing residencies. HRs were adjusted for age, sex, rural/non-rural residence and pre-Chernobyl total cancer incidence.

**Results:** The 734 537 people identified were categorised by exposure: the first quartile was low exposure (0.0–45.4 kBq/m$^2$), the second and third quartiles were intermediate exposure (45.41–118.8 kBq/m$^2$), and the fourth quartile was the highest exposure (118.81–564.71 kBq/m$^2$). Between 1991 and 2010, 82 495 cancer cases were registered in the 3 counties. Adjusted HRs (95% CI) were 1.03 (1.01 to 1.05) for intermediate exposure and 1.05 (1.03 to 1.07) for the highest exposure compared to the reference exposure.

**Conclusions:** We found a small overall exposure–response pattern of the total cancer incidence related to $^{137}$Cs after adjustment for age, sex, rural residence and pre-Chernobyl cancer incidence.

**Strengths and limitations of this study**

- A methodological strength of the study is that the study population did not have any cancer diagnosis prior to the follow-up period.
- Another strength is that the risk estimate was based on the cancer incidence rather than cancer mortality.
- By restricting the study to three counties, we reduced confounding from socioeconomic factors with regional differences potentially associated with $^{137}$Cs ground deposition.
- Using a 5-year cumulative exposure estimate, we increased the precision compared to previous studies.
- The main limitation of the study is that the exposure assessment is only based on aerial measurements and that the individual effective external dose could not be calculated.

year.[2 3] Based on the estimates of collective dose, the Swedish Radiation Authority calculated that 300 extra cancer deaths could occur in Sweden in the 50 years after the accident.[2] A food regulation programme introduced in 1986 limited the $^{137}$Cs activity in food sold to the public to 300 Bq/kg to assure that the dose from food intake was below 1 mSv per year. In 1987, a new limit of 1500 Bq/kg was introduced for game and reindeer meat, wild berries, mushrooms,

Alinaghizadeh et al. „Total cancer incidence in relation to 137Cs fallout in the most contaminated counties in Sweden after the Chernobyl nuclear power plant accident: a register-based study". BMJ Open. 2016 Dec 20;6(12)

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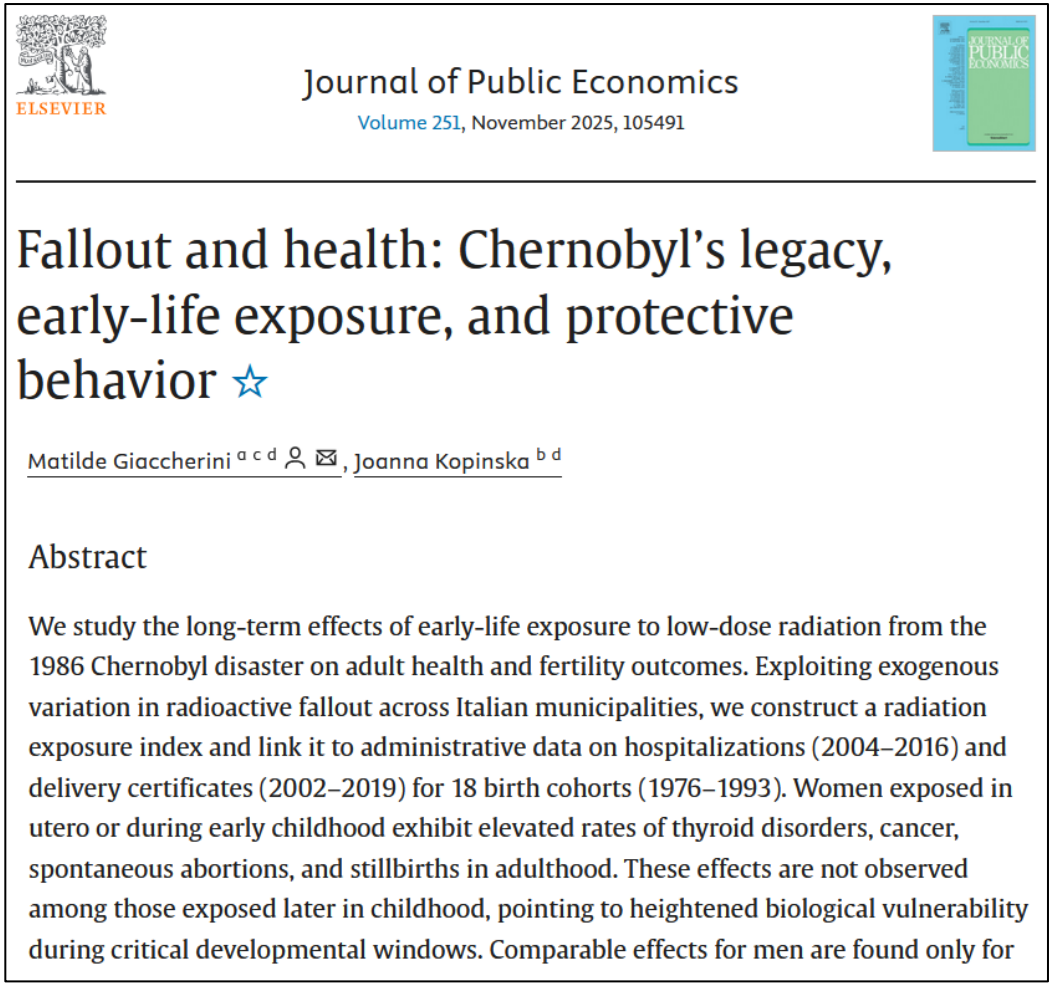
# 40 Jahre Tschernobyl

Erhöhte Raten von Schilddrüsenerkrankungen, Krebs, Spontanaborten und Fehlgeburten bei Frauen, die im Frühjahr 1986 und in Gemeinden mit höherem Fallout geboren wurden



ELSEVIER

Journal of Public Economics
Volume 251, November 2025, 105491

## Fallout and health: Chernobyl's legacy, early-life exposure, and protective behavior ☆

Matilde Giaccherini [a c d], Joanna Kopinska [b d]

Abstract

We study the long-term effects of early-life exposure to low-dose radiation from the 1986 Chernobyl disaster on adult health and fertility outcomes. Exploiting exogenous variation in radioactive fallout across Italian municipalities, we construct a radiation exposure index and link it to administrative data on hospitalizations (2004–2016) and delivery certificates (2002–2019) for 18 birth cohorts (1976–1993). Women exposed in utero or during early childhood exhibit elevated rates of thyroid disorders, cancer, spontaneous abortions, and stillbirths in adulthood. These effects are not observed among those exposed later in childhood, pointing to heightened biological vulnerability during critical developmental windows. Comparable effects for men are found only for

Giaccherini M & Kopinska J. „Fallout and health: Chernobyl's legacy, early-life exposure, and protective behavior". Journal of Public Economics, Volume 251, November 2025, 105491

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# 40 Jahre Tschernobyl

6.000 (3.400-72.000)
Schilddrüsenkrebsfälle in
Europa durch Tschernobyl

25.000 (11.000-59.000)
andere Krebsfälle in Europa

> 15.000 strahlenbedingte
Krebstodesfälle in Europa

Cardis, E et al. „Estimates of the cancer burden in Europe from radioactive fallout from the Chernobyl accident. Int J Cancer; 119: 1224-35. 2006

IJC International Journal of Cancer

## Estimates of the cancer burden in Europe from radioactive fallout from the Chernobyl accident

Elisabeth Cardis[1]*, Daniel Krewski[2], Mathieu Boniol[1], Vladimir Drozdovitch[1], Sarah C. Darby[3], Ethel S. Gilbert[4], Suminori Akiba[5], Jacques Benichou[6], Jacques Ferlay[1], Sara Gandini[7], Catherine Hill[8], Geoffrey Howe[9], Ausrele Kesminiene[1], Mirjana Moser[10], Marie Sanchez[1], Hans Storm[11], Laurent Voisin[1] and Peter Boyle[1]

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[11]Danish Cancer Society, Copenhagen, Denmark

**The Chernobyl accident, which occurred April 26, 1986, resulted in a large release of radionuclides, which were deposited over a very wide area, particularly in Europe. Although an increased risk of thyroid cancer in exposed children has been clearly demonstrated in the most contaminated regions, the impact of the accident on the risk of other cancers as well as elsewhere in Europe is less clear. The objective of the present study was to evaluate the human cancer burden in Europe as a whole from radioactive fallout from the accident. Average country- and region-specific whole-body and thyroid doses from Chernobyl were estimated using new dosimetric models and radiological data. Numbers of cancer cases and deaths possibly attributable to radiation from Chernobyl were estimated, applying state-of-the-art risk models derived from studies of other irradiated populations. Simultaneously, trends in cancer incidence and mortality were examined over time and by dose level. The risk projections suggest that by now Chernobyl may have caused about 1,000 cases of thyroid cancer and 4,000 cases of other cancers in Europe, representing about 0.01% of all incident cancers since the accident. Models predict that by 2065 about 16,000 (95% UI 3,400–72,000) cases of thyroid cancer and 25,000 (95% UI 11,000–59,000) cases of other cancers may be expected due to radiation from the accident, whereas**

Epidemiological studies focusing on the most contaminated regions of the 3 most affected countries have confirmed a causal relationship between the observed increased risk of thyroid cancer and exposure to radioactive iodines from the Chernobyl fallout among those who were children or adolescents when the accident happened.[3–5] Other types of cancer, including leukemia, have also been investigated,[1,6–17] but as yet no association with radiation exposure has been clearly demonstrated. Recent studies suggest a possible doubling of the risk of leukemia among Chernobyl cleanup workers[18] and a small increase in the incidence of premenopausal breast cancer[19] in the most contaminated districts (with average whole-body doses above 40 mSv), both of which appear to be related to radiation dose. These findings need confirmation in further epidemiological studies with careful individual dose reconstruction.

The full extent of the health impact of Chernobyl on the population is difficult to gauge. Ten years ago, Cardis and collaborators[20] estimated that about 9,000 deaths from cancers and leukemia might be expected over the course of a lifetime in the most exposed populations in Belarus, the Russian Federation and

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## Die aktuelle Lage vor Ort

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**Mythen:**

Die Lage in Tschernobyl ist durch den neuen Sarkophag (NSC) seit 2016 nun sicher. Ein erneutes Austreten von Radioaktivität ist nicht zu befürchten.

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**Der Rote Wald:**

Normale ODL: 0,05-0,2 µSv/h

ODL Roter Wald: 100-10.000 µSv/h

2020 Waldbrände

2022 Invasion durch russische Armee

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**14. Februar 2025**

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# 40 Jahre Tschernobyl

**Der Sarkophag:**

Schäden durch Drohneneinschlag
- 15 qm Loch durch Drohne
- Zahlreiche Brandnester
- Schäden am Ringraum
- Verlust der primären Schutzfunktion

Häufige Stromausfälle

Reparaturen schwierig

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# 40 Jahre Tschernobyl


# Die Bedeutung von Tschernobyl für die Anti-AKW Bewegung

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# Vielen Dank für Ihre Aufmerksamkeit