

---

**Supplementary information**

---

**Suicide risk and mortality among patients with cancer**

---

In the format provided by the authors and unedited

# Suicide risk and mortality among patients with cancer

## Supplement

Michael Heinrich, M.Sc.<sup>1</sup>, Luisa Hofmann<sup>1</sup>, Hansjörg Baurecht, PhD<sup>2</sup>, Peter M. Kreuzer, MD<sup>1</sup>, Helge Knüttel, PhD<sup>3</sup>, Michael F. Leitzmann, MD, DrPH<sup>2</sup>, and Corinna Seliger, MD, PhD<sup>4</sup>

### **Author affiliations:**

<sup>1</sup>Department of Psychiatry and Psychotherapy, University of Regensburg, Regensburg, Germany

<sup>2</sup>Department of Epidemiology and Preventive Medicine, University of Regensburg, Regensburg, Germany

<sup>3</sup>University Library, University of Regensburg, Regensburg, Germany.

<sup>4</sup>Department of Neurology, University Hospital Heidelberg, Heidelberg, Germany

**Corresponding author\* and reprint requests:** Dr. Corinna Seliger, Department of Neurology, University Hospital Heidelberg, Heidelberg, Germany; Corinna.Seliger-Behme@med.uni-heidelberg.de; 0049-6221-56-36873

## Subjects and Methods

### *Literature search and data source*

Our search strategy comprised three key concepts which were combined with the Boolean operator “AND”: suicide AND cancer AND epidemiological studies. For each of these concepts, relevant subject headings and text words were chosen to maximize the sensitivity of the search. Starting with a primary search strategy developed for Embase, subject headings and syntax were adapted for the other databases. For the suicide concept, we employed terms drawn from three Cochrane reviews<sup>1-3</sup>, for the cancer concept we employed terms from a Cochrane review<sup>4</sup>; the filter for epidemiological studies is adapted from Larney et al.<sup>5</sup>. While we had no opportunity for peer review of the search strategies, we strove to conform to the recommendations in the PRESS guideline.<sup>6</sup> No restriction regarding publication date was applied. Search results were limited to publications in English language. We searched the data sources Embase (Ovid), MEDLINE (Ovid), PsycInfo (EBSCOhost), Science Citation Index Expanded & Social Sciences Citation Index (simultaneously, Web of Science), CINAHL (EBSCOhost) and Google Scholar. We updated the searches by rerunning the strategies on February 19<sup>th</sup>, 2021. The full search strategies with exact dates of searching are documented in Supplementary Table 5. We screened the reference lists of included articles for additional studies. Additionally, the authors searched their personal files. We did not search study registries, nor did we contact other authors or experts to identify additional studies.

### *Data extraction and assessment of study quality*

All records from the database searches were imported into Endnote reference management software (Version X9). In a first step, deduplication of records was performed according to the method developed and published by Bramer et al.<sup>7</sup>. In subsequent steps, first all titles and

abstracts and then full texts were screened for relevance according to the pre-defined inclusion criteria.

Extracted data were organized in worksheets using Microsoft® Excel Version 16.

### *Statistical analysis*

As outcome measure, we used SMRs as RR estimates. We calculated study specific effect estimates by  $\log(RR_i)$  with standard error  $s_i = d_i / 1.96$ , where  $d_i$  represented the maximum of  $[\log(\text{upper } 95\% \text{CI} = \text{bound of } RR_i) - \log(RR_i)]$  and  $[\log(RR_i) - \log(\text{lower } 95\% \text{CI} = \text{bound of } RR_i)]$ . When SMRs were not available, we calculated SMR values based on the observed and expected numbers of suicides with reference to the general population of the country in which the study was performed. Pooled SMRs were calculated by separate addition of the observed cases and the expected cases of each subgroup. We performed stratified analyses and random effects meta-regression to evaluate whether suicide rates among patients with cancer differed according to gender, geographic region, ethnicity, marital status, cancer site, cancer prognosis, and cancer stage. In addition, we stratified studies by year of recruitment using a threshold of the year 2000, a time point of major improvements in therapy for many cancer types (e.g., targeted therapy, immunotherapy).<sup>8</sup> Random-effects meta-regression was used based on the assumption that the subgroup effects being estimated in the different studies are not identical. Heterogeneity among risk estimates was assessed using Q-statistics and  $I^2$  statistics. Potential publication bias was investigated using funnel plots for qualitative assessment, as well as Begg's correlation and Egger's regression tests for quantitative assessment, both with a significance level of 0.1. Subgroup analyses were corrected for multiple testing.<sup>9</sup> For potentially overlapping studies, we carried out sensitivity analyses by including only the studies with the largest set of patients for each database, time period and cancer site. All statistical analyses were carried out using R statistical software, the metafor packages, with a 2-sided 5% significance level. Correction for multiple testing in subgroup analyses was addressed by using

the false discovery rate (FDR) method and is presented as q-values.<sup>9</sup> CIs and SMRs were calculated using the Mid-P exact method<sup>10</sup> implemented in R<sup>11</sup>, Versions 4.0.2 and 4.1.1.

To combine study results, we estimated overall effects using random-effects models with individual study weights  $w_i = 1/(s_i^2 + \tau^2)$ , where  $s_i^2$  represented the standard error of the study specific effect estimates and  $\tau^2$  the restricted maximum-likelihood estimate (REML) of the between study variance<sup>12</sup>.

A Wald chi-square test was used for meta-regression tests in subgroup analysis.

Heterogeneity among risk estimates was assessed using Q-statistics and  $I^2$  statistics. Potential publication bias was investigated using funnel plots for qualitative assessment, as well as Begg's<sup>13</sup> and Egger's tests<sup>14</sup> for quantitative assessment.

All statistical analyses were carried out using R statistical software, the metafor<sup>12</sup> and Evaluate<sup>15</sup> packages, with a 2-sided 5% significance level.

## Tables

**Supplementary Table 1: Characteristics of the retrospective cohort studies included in the systematic review and meta-analysis (n = 46,952,813 cases) on suicide rates in patients with cancer, by date of publication.** Abbreviations: n.a., data not available; M, male patients; F, female patients; MF, male and female patients; PY, person-years; Data in bold and italic letters were calculated by the authors.

First author	Year	Country	Time of recruitment	SMR (95% CI)
Louhivuori	1979	Finland	1955-1965	<b><i>1.39 (1.07 - 1.76)</i></b>
Allebeck	1989	Sweden	1962-1979	<b><i>1.83 (1.71 - 1.95)</i></b>
Allebeck	1991	Sweden	1975-1985	<b><i>2.50 (2.12 - 2.94)</i></b>
Levi	1991	Switzerland	1976-1987	2.58 (1.95 - 3.38)
Crocetti	1998	Tuscany, Italy	1985-1994	2.36 (1.69 - 3.20)
Tanaka	1999	Osaka, Japan	1978-1994	1.35 (0.99 - 1.79)
Innos	2003	Estonia	1983-1998	<b><i>1.09 (0.95 - 1.26)</i></b>
Hem	2004	Norway	1960-1997	1.48 (1.37 - 1.61)
Miccinesi	2004	Central Italy	1985-1999	<b><i>1.93 (1.58 - 2.33)</i></b>
Björkenstam	2005	Sweden	1965-1999	2.05 (1.76 - 2.37)
Yousaf	2005	Denmark	1971-2000	<b><i>1.55 (1.47 - 1.64)</i></b>
Muff Christensen	2006	Denmark	1971-1999	<b><i>1.09 (0.97 - 1.23)</i></b>
Schairer	2006	USA, Sweden, Denmark, Finland, Norway	1953-2001	1.37 (1.28 - 1.47)
Dormer	2008	West Australia	1981-2002	1.61 (1.36 - 1.92)
Misono	2008	USA	1973-2002	1.88 (1.83 - 1.93)
Fang	2009	USA	1979-2004	1.40 (1.20 - 1.60)
Robinson	2009	South East England	1996-2005	1.36 (1.16 - 1.58)
Ahn	2010	Korea	1993-2005	2.00 (1.91 - 2.08)
Bill-Axelson	2010	Sweden	1997-2006	1.51 (1.26 - 1.80)
Mahdi	2011	USA	1988-2007	1.40 (1.20 - 1.70)
Turaga	2011	USA	1995-2015	10.80 (9.20 - 12.70)
Alanee	2012	USA	1995-2008	1.20 (1.10 - 2.10)
Nasseri	2012	USA	1997-2006	1.97 (1.86 - 2.08)
Beard	2013	USA	1973-2001	1.45 (1.06 - 1.98)
Njei	2013	USA	1990-2009	4.30 (3.30 - 5.50)
Smailyte	2013	Lithuania	2001-2009	<b><i>1.41 (1.23 - 1.60)</i></b>
Urban	2013	USA	1973-2008	4.95 (4.68 - 5.24)
Oberaigner	2014	Tyrol	1991-2010	1.86 (1.57 - 2.19)
Kam	2015	USA	1973-2011	3.21 (2.18 - 4.23)
Klaasen	2015	USA	1988-2010	<b><i>1.54 (1.48 - 1.60)</i></b>
Vyssoki	2015	Austria	1983-2000	1.23 (1.19 - 1.28)
Klaasen	2016	USA	1988-2010	2.71 (2.02 - 3.62)
Siracuse	2016	USA	1973-2013	2.43 (1.58 - 3.28)
Sugawara	2016	USA	1998-2011	4.07 (3.18 - 5.13)
Bowden	2017	USA	1973-2013	3.21 (2.80 - 3.67)
Kaceniene	2017	Lithuania	1993-2012	1.31 (1.21 - 1.41)
Lin	2017	Taiwan	1985-2007	2.47 (2.38 - 2.57)

<b>Simpson</b>	2017	USA	1973 -2013	1.58 (1.18 - 2.11)
<b>Kumar</b>	2017	USA	2000-2013	<i>1,37 (1,30 - 1,40)</i>
<b>Anderson</b>	2018	USA	2000-2014	1.91 (1.79 - 2.04)
<b>Henson</b>	2018	England	1995-2015	1.20 (1.16 - 1.25)
<b>Osazuwa-Peters</b>	2018	USA	1973-2014	<b>2.74 (2.57 - 2.91)</b>
<b>Rahouma</b>	2018	USA	1973-2013	1.57 (1.53 - 1.61)
<b>Saad</b>	2018	USA	2000-2015	<b>1.42 (1.38 - 1.46)</b>
<b>Smith</b>	2018	New South Wales, Australia	1997-2007	1.70 (1.26 - 2.25)
<b>Kaceniene</b>	2018	USA	1998-2012	<i>2.17 (1.60 - 2.95)</i>
<b>Dulskas</b>	2019	Lithuania	1998-2012	1.62 (1.27 - 2.06)
<b>Zaorsky</b>	2019	USA	1973-2014	4.44 (4.33 - 4.55)
<b>Abdel-Rahman</b>	2019	USA	2000-2010	1.29 (1.25 - 1.33)
<b>Anderson</b>	2019	USA	1973-2015	1.23 (1.13 - 1.34)
<b>Guo</b>	2019	USA	1973-2015	1.83 (1.59 - 2.10)
<b>Kim</b>	2019	Germany	1993-2009	1.63 (1.01 - 2.50)
<b>Low</b>	2019	USA	1973-2015	5.80 (4.25 - 7.74)
<b>Patasius</b>	2019	Lithuania	2003-2012	1.23 (0.93 - 1.63)
<b>Chen</b>	2020	USA	1975-2016	2.26 (1.78 - 2.84)
<b>Oh</b>	2020	South Korea	2000-2016	<b>1.61 (1.56 - 1.66)</b>
<b>Patasius</b>	2020	Lithuania	2000-2011	1.01 (0.85 - 1.20)
<b>Ravaioli</b>	2020	Italy	1996-2014	1.50 (1.30 - 1.80)
<b>Saad</b>	2020	USA	2000-2016	<b>1.63 (1.26 - 2.07)</b>
<b>Shen</b>	2020	USA	1980-2016	7.64 (6.28 - 9.21)
<b>Zhai</b>	2020	USA	2014-2015	1.75 (1.04 - 2.77)
<b>Harashima</b>	2021	Japan	01.01.2016-30.06.2016	2.68 (2.26 - 3.16)

<b>First author</b>	<b>Gender</b>	<b>Cancer site</b>	<b>Study population</b>	<b>Suicide cases</b>	<b>Cases per 100,000 PY</b>	<b>Follow-up [PY]</b>
<b>Louhivuori</b>	MF	Multiple sites	28,857	63	23.50	n.a.
<b>Allebeck</b>	MF	Multiple sites	424,127	963	n.a.	n.a.
<b>Allebeck</b>	MF	Multiple sites	59,845	144	n.a.	n.a.
<b>Levi</b>	MF	All sites except non-melanoma skin cancer	24,166	55	n.a.	57,614
<b>Crocetti</b>	MF	All sites except non-melanoma skin cancer	27,123	41	45.99	89,158
<b>Tanaka</b>	MF	Multiple sites	23,979	48	n.a.	109,374
<b>Innos</b>	MF	Multiple sites	65,419	197	n.a.	192,078
<b>Hem</b>	MF	Multiple sites	490,245	589	n.a.	2,536,152

<b>Miccinesi</b>	MF	All sites except non-melanoma skin cancer	90,197	102	n.a.	308,526
<b>Björkenstam</b>	MF	Multiple sites	1,031,919	2,112	n.a.	2,587,152
<b>Yousaf</b>	MF	All sites except non-melanoma skin cancer	564,508	1,241	n.a.	2,232,541
<b>Christensen</b>	MF	Non-melanoma skin cancer	91,310	284	n.a.	647,886
<b>Schairer</b>	F	Breast	723,810	836	n.a.	5,598,156
<b>Dormer</b>	MF	Multiple sites	121,533	129	n.a.	543,696
<b>Misono</b>	MF	Multiple sites	3,594,750	5,838	31.40	18,604,308
<b>Fang</b>	M	Prostate	342,497	148	50.00	n.a.
<b>Robinson</b>	MF	Multiple sites	417,572	166	n.a.	n.a.
<b>Ahn</b>	MF	Multiple sites	816,295	2,065	68.70	3,007,294
<b>Bill-Axelson</b>	M	Prostate	77,439	128	48.30	n.a.
<b>Mahdi</b>	F	Gynecologic system	252,235	100	8.3	1,207,278
<b>Turaga</b>	MF	Pancreas (excluding neuroendocrine tumors)	36,221	30	135.50	22,145
<b>Alanee</b>	M	Testicular	23,381	30	26.00	126,762
<b>Nasseri</b>	MF	Multiple sites	1,123,528	1,168	n.a.	4,630,551
<b>Beard</b>	M	Stage I Seminoma	9,193	39	n.a.	121,037
<b>Njei</b>	MF	Hepatocellular carcinoma	51,331	31	51.40	60,325
<b>Smailyte</b>	MF	Multiple sites	137,320	215	n.a.	308,980
<b>Urban</b>	MF	Lung	871,230	1,184	80.90	n.a.
<b>Oberaigner</b>	MF	All sites except non-melanoma skin cancer	53,803	144	n.a.	285,038
<b>Kam</b>	MF	Head and neck	350,413	857	37.86	2,263,376
<b>Klaasen</b>	MF	Urogenital system	1,239,522	2,263	n.a.	7,307,377
<b>Vyssoki</b>	MF	Multiple sites	915,303	2,877	n.a.	14,532,682
<b>Klaasen</b>	MF	Urothelial carcinoma	n.a.	439	37	1,178,000
<b>Siracuse</b>	MF	Bone and soft tissue	23,620	52	32	164,455



<b>Sugawara</b>	MF	Stomach	65,535	68	34.60	109,597
<b>Bowden</b>	MF	Stomach	n.a.	210	61.02	344,134
<b>Kaceniene</b>	MF	Multiple sites	273,511	654	n.a.	n.a.
<b>Lin</b>	MF	Multiple sites	916,337	2,543	59.10	4,300,953
<b>Simpson</b>	M	Penis	6,155	13	38	34,197
<b>Kumar</b>	MF	Multiple sites	1,486,140	1,495	n.a.	6,346,155
<b>Anderson</b>	MF	Digestive system	856,293	881	32.77	2,688,837
<b>Henson</b>	MF	All sites except non-melanoma skin cancer	4,722,099	2,491	n.a.	22,036,669
<b>Osazuwa-Peters</b>	MF	Head and neck	205,658	1,036	100.10	931,349
<b>Rahouma</b>	MF	Lung, prostate, breast, colorectal	3,640,229	6,661	27.50	n.a.
<b>Saad</b>	MF	Multiple sites	4,671,989	5,007	n.a.	n.a.
<b>Smith</b>	M	Prostate	51,924	49	25.00	196,146
<b>Kaceniene</b>	MF	Lung cancer	19,781	41	n.a.	n.a.
<b>Dulskas</b>	MF	Colorectal	19,409	67	n.a.	85,506
<b>Zaorsky</b>	MF	All invasive cancers	8,651,569	13,311	28.58	n.a.
<b>Abdel-Rahman</b>	MF	Multiple sites	3,149,235	4,382	n.a.	n.a.
<b>Anderson</b>	MF	Multiple sites	249,021	540	17.28	n.a.
<b>Guo</b>	MF	Kidney	171,819	207	21.83	948,272
<b>Kim</b>	MF	Hodgkin lymphoma	12,202	19	20.01	94,972
<b>Low</b>	MF	Neuroendocrine tumors	29,981	46	n.a.	n.a.
<b>Patasius</b>	M	Prostate	8,908	49	n.a.	n.a.
<b>Chen</b>	MF	Hepatocellular carcinoma	102,567	70	43.61	160,501
<b>Oh</b>	MF	Multiple sites	2,707,520	4,350	n.a.	n.a.
<b>Patasius</b>	M	Prostate	25,786	135	n.a.	n.a.
<b>Ravaioli</b>	MF	Multiple sites	127,042	158	25.00	618,054
<b>Saad</b>	MF	Central nervous system	87,785	64	n.a.	n.a.
<b>Shen</b>	MF	Kaposi's sarcoma	21,405	110	n.a.	95,396

<b>Zhai</b>	MF	Bladder	24,074	18	n.a.	n.a.
<b>Harashima</b>	MF	Multiple sites	546,148	145	36.5	249,116
		Total study population	<b>&gt;46,952,813</b>	<b>69,398</b>		<b>&gt;107,961,796</b>

**Supplementary Table 2: NOS Scores of all included studies.** Four different authors evaluated study quality according to the Newcastle-Ottawa Scale (NOS). PMID: PubMed Identification number; DOI: digital object identifier.

<b>Newcastle-Ottawa Scale</b>							
<b>First Author</b>	<b>Year</b>	<b>PMID/DOI</b>	<b>Country</b>	<b>Time of recruitment</b>	<b>M.H.</b>	<b>L.H.</b>	<b>C.S. and H.J.B.</b>
<b>Abdel-Rahman</b>	2019	<a href="https://doi.org/10.1016/j.canep.2019.101601">https://doi.org/10.1016/j.canep.2019.101601</a>	USA	2000-2010	8	7	9
<b>Ahn</b>	2010	20696665	Korea	1993-2005	9	8	8
<b>Alanee</b>	2012	22624649	USA	1995-2008	8	8	8
<b>Allebeck</b>	1989	2760653	Sweden	1962-1979	8	8	8
<b>Allebeck</b>	1991	1780410	Sweden	1975-1985	9	9	9
<b>Anderson</b>	2018	29956393	USA	2000-2014	9	8	8
<b>Anderson</b>	2019	10.1002/cncr.32063	USA	1973-2015	8	8	9
<b>Beard</b>	2013	23633409	USA	1973-2001	8	8	8
<b>Bill-Axelsson</b>	2010	19914773	Sweden	1997-2006	9	8	8
<b>Björkenstam</b>	2005	16040462	Sweden	1965-1999	8	8	8
<b>Bowden</b>	2017	29184695	USA	1973-2013	9	8	9
<b>Chen</b>	2020	<a href="https://doi.org/10.1016/j.ejso.2020.10.001">https://doi.org/10.1016/j.ejso.2020.10.001</a>	USA	1975-2016	8	9	7
<b>Crocetti</b>	1998	9569062	Tuscany, Italy	1985-1994	8	7	7
<b>Dormer</b>	2008	18241168	West Australia	1981–2002	9	8	9
<b>Dulskas</b>	2019	30617411	Lithuania	1998-2012	8	9	8
<b>Fang</b>	2009	20124521	USA	1979-2004	8	8	8
<b>Guo</b>	2019	10.1002/cam4.2400	USA	1973-2015	7	8	7
<b>Harashima</b>	2021	doi: 10.1093/jjco/hyab001	Japan	01.01.2016-30.06.2016	8	9	8
<b>Hem</b>	2004	15483032	Norway	1960-1997	8	9	8
<b>Henson</b>	2018	30476945	England	1995-2015	8	9	9
<b>Innos</b>	2003	14522382	Estonia	1983-1998	8	8	8
<b>Kaceniene</b>	2017	28914692	Lithuania	1993-2012	7	8	7
<b>Kaceniene</b>	2018	10.1111/crj.12916	USA	1998-2012	8	7	9
<b>Kam</b>	2015	26562764	USA	1973-2011	9	8	9
<b>Kim</b>	2019	<a href="http://dx.doi.org/10.1097/HS9.000000000000183">http://dx.doi.org/10.1097/HS9.000000000000183</a>	Germany	1993-2009	9	9	9
<b>Klaasen</b>	2015	WOS:000354819900023	USA	1988-2010	9	8	9
<b>Klaasen</b>	2016	26680629	USA	1988-2010	9	8	9
<b>Kumar</b>	2017	<a href="https://doi.org/10.1176/appi.ajp-rj.2017.120104">https://doi.org/10.1176/appi.ajp-rj.2017.120104</a>	USA	2000-2013	7	8	7
<b>Levi</b>	1991	1987498	Switzerland	1976-1987	8	8	8
<b>Lin</b>	2017	28181332	Taiwan	1985-2007	7	8	8
<b>Louhivuori</b>	1979	433917	Finland	1955-1965	7	9	7
<b>Low</b>	2019	DOI: 10.1097/COC.0000000000000575	USA	1973-2015	9	8	9
<b>Mahdi</b>	2011	21561646	USA	1988-2007	9	8	8
<b>Miccinesi</b>	2004	15093582	Central Italy	1985-1999	9	8	9
<b>Misono</b>	2008	18695257	USA	1973-2002	9	9	9
<b>Muff Christensen</b>	2006	16679871	Denmark	1971-1999	8	8	9

<b>Nasseri</b>	2012	2012-30407-006	USA	1997-2006	9	7	7
<b>Njei</b>	2013	368634538	USA	1990-2009	9	8	9
<b>Oberaigner</b>	2014	25015541	Tyrol	1991-2010	8	7	9
<b>Oh</b>	2020	DOI: 10.1002/cam4.2813	South Korea	2000-2016	8	7	8
<b>Osazuwa-Peters</b>	2018	29884411	USA	1973-2014	9	8	9
<b>Patasius</b>	2019	DOI: 10.1002/pon.5186	Lithuania	2003-2012	8	7	9
<b>Patasius</b>	2020	DOI: 10.1097/CEJ.0000000000000573	Lithuania	2000-2011	7	8	7
<b>Rahouma</b>	2018	30174721	USA	1973-2013	9	8	9
<b>Ravaioli</b>	2020	<a href="https://doi.org/10.1016/j.ejca.2019.08.019">https://doi.org/10.1016/j.ejca.2019.08.019</a>	Romagna, Italy	1996-2014	8	8	8
<b>Robinson</b>	2009	19471277	South East England	1996-2005	9	7	9
<b>Saad</b>	2018	30613943	USA	2000-2015	9	8	9
<b>Saad</b>	2020	doi:10.1001/jamanetworkopen.2020.3862	USA	2000-2016	7	8	7
<b>Schairer</b>	2006	17018788	USA, Sweden, Denmark, Finland, Norway	1953-2001	8	9	9
<b>Shen</b>	2020	DOI: 10.12659/MSM.920711	USA	1980-2016	9	8	9
<b>Simpson</b>	2017	29126815	USA	1973 -2013	8	8	8
<b>Siracuse</b>	2016	27896676	USA	1973-2013	8	9	9
<b>Smailyte</b>	2013	23809215	Lithuania	2001-2009	8	8	8
<b>Smith</b>	2018	29897979	New South Wales, Australia	1997-2007	8	7	8
<b>Sugawara</b>	2016	27307574	USA	1998-2011	8	9	9
<b>Tanaka</b>	1999	10543251	Osaka, Japan	1978-1994	9	8	9
<b>Turaga</b>	2011	20824626	USA	1995-2015	8	9	8
<b>Urban</b>	2013	23681288	USA	1973-2008	8	8	8
<b>Vyssoki</b>	2015	25661393	Austria	1983-2000	8	9	9
<b>Yousaf</b>	2005	15756279	Denmark	1971-2000	8	9	9
<b>Zaorsky</b>	2019	30643135	USA	1973-2014	9	8	9
<b>Zhai</b>	2020	<a href="https://doi.org/10.1186/s12885-020-07655-x">https://doi.org/10.1186/s12885-020-07655-x</a>	USA	2014-2015	8	9	9

**Supplementary Table 3: Sample sizes of subgroups analyzed in the present study.** The sample sizes represent the minimum number, as data were not available for some of the included subgroups.

	<b>N° studies</b>	<b>N° studies with available sample sizes</b>	<b>Patient sample size</b>
<b>All studies</b>	28	28	22,407,690
<b>Total men</b>	29	18	>9,112,332
<b>Total women</b>	31	17	>9,848,649
<b>Australia</b>	2	2	>173,457
<b>Asia</b>	4	4	>4,193,984
<b>Europe</b>	16	16	>8,922,075
<b>USA</b>	7	7	>9,118,174
<b>Late stage cancer</b>	12	6	>1,824,399
<b>Early stage cancer</b>	12	6	>6,286,888
<b>Recruitment after 2000</b>	4	1	>59,292
<b>Recruitment before 2000</b>	13	10	>3,373,045
<b>Other ethnicity</b>	4	4	652,794
<b>Asian ethnicity</b>	2	2	58,246
<b>African-American ethnicity</b>	4	4	925,049
<b>Caucasian ethnicity</b>	6	6	11,007,230
<b>Unmarried cancer patients</b>	5	3	>3,323,977
<b>Married cancer patients</b>	5	3	>4,793,806
<b>Later than 1 year after diagnosis</b>	15	4	>5,771,651
<b>Within 1 year after diagnosis</b>	17	6	>3,051,013

**Supplementary Table 4: Studification matrix for comparison of the present systematic review and meta-analysis with previous meta-analyses on the topic of suicide in patients with cancer.** Entries marked in green are available for the respective meta-analysis.

<b>Databases</b>	<b><u>Heinrich et al. 2022</u></b>	Harris/Barracough 1994	Amiri et al. 2019	Ravaioli et al. 2020	Brunckhorst et al. 2020	Du et al. 2020	Guo et al. 2020
Embase (Ovid)	4,724						
MEDLINE (Ovid) / PubMed	2,468						
Web of Science	1,950						
PsycInfo (EBSCOhost)	1,143						
CINAHL (EBSCOhost)	1,503						
Google Scholar	400						
Scopus							
China National Knowledge Infrastructure							
<b>Total records</b>	<b>12,193</b>	<b>235</b>	<b>9,095</b>	<b>223</b>	<b>5,467</b>	<b>7,381</b>	<b>235</b>
<b>Deadline for literature search</b>	<b>2021-02-19</b>	<b>1992</b>	<b>2018-07-01</b>	<b>2017-11-06</b>	<b>2020-05-26</b>	<b>2020-05-20</b>	<b>2020-04-30</b>
	<b><u>Heinrich et al. 2022</u></b>	Harris/Barracough 1994	Amiri et al. 2019	Ravaioli et al. 2020	Brunckhorst et al. 2020	Du et al. 2020	Guo et al. 2020
<b>Meta-regression analysis</b>							

<b>Risk subgroups</b>		<b><u>Heinrich et al. 2022</u></b>	Harris/Barracough 1994	Amiri et al. 2019	Ravaioli et al. 2020	Brunckhorst et al. 2020	Du et al. 2020	Guo et al. 2020
Women	incl. gender-specific subgroups							
Men	incl. gender-specific subgroups							
Cancer prognosis								
Cancer stage								
Cancer sites					Prostate cancer only		Bladder cancer only	
Asia								
Australia								
Europe								
USA								
Time after diagnosis								
Year of recruitment								
Ethnicity								
Marital status								

<b>Included studies</b>	<b><u>Heinrich et al. 2022</u></b>	Harris/Barracough 1994	Amiri et al. 2019	Ravaioli et al. 2020	Brunckhorst et al. 2020	Du et al. 2020	Guo et al. 2020
Abdel-Rahman et al. 2019							
Ahn et al. 2010							
Alanee et al. 2012							
Allebeck et al. 1989							
Allebeck et al. 1991							
Anderson et al. 2018							
Anderson et al. 2019							
Beard et al. 2013							
Bill-Axelsson et al. 2010							
Björkenstam et al. 2005							
Bowden et al. 2017							
Chen et al. 2020							
Crocetti et al. 1998							
Dormer et al. 2008							
Dulskas et al. 2018							
Fang et al. 2009							
Guo et al. 2019							
Harashima et al. 2021							
Hem et al. 2004							
Henson et al. 2018							
Innos et al. 2003							
Kaceniene et al. 2017							
Kaceniene et al. 2018							
Kam et al. 2015							
Kim et al 2019							
Klaasen et al. 2015							
Klaasen et al. 2016							
Kumar et al. 2017							



Levi et al. 1991							
Lin et al. 2017							
Louhivuori et al. 1978							
Low et al 2019							
Mahdi et al. 2011							
Miccinesi et al. 2004							
Misono et al. 2008							
Muff Christensen et al. 2006							
Nasseri et al. 2012							
Njei et al. 2013							
Oberaigner et al. 2014							
Oh et al 2020							
Osazuwa-Peters et al. 2018							
Patasius et al. 2019							
Patasius et al. 2020							
Ravaioli et al. 2020							
Rahouma et al. 2018							
Robinson et al. 2009							
Saad et al. 2019							
Saad et al. 2020							
Schairer et al. 2006							
Shen et al. 2020							
Simpson et al. 2017							
Siracuse et al. 2017							
Smailyte et al. 2013							
Smith et al. 2018							
Sugawara et al. 2016							
Tanaka et al. 1999							
Turaga et al. 2011							
Urban et al. 2013							
Vyssoki et al. 2015							
Yousaf et al. 2005							
Zaorsky et al. 2019							
Zhai et al. 2020							

**Supplementary Table 5: Search strategies.** Literature search was performed according to a linear search algorithm. In a first step, the single sets were created. Subsequently, the intersection of the sets 1 and 2 and of the sets 3 and 4 was found.

**Embase (Ovid)**

Database: Embase 1974 to 2021 February 17 (oemezd)

Date of last search: 2021-02-19

Records: 4,724

#	Search	Records	Remarks
1	exp suicidal behavior/ or suicid*.ti,ab,kw. Or (parasuicid* or “para suicid*”).ti,ab,kw. Or ((deliberat* or self*) adj1 (destruct* or harm* or injur* or mutilat* or poison* or killing)).ti,ab,kw.	145,162	suicide
2	exp neoplasm/ or (cancer* or tumor* or tumour* or neoplas* or malignan* or carcinoma* or adenocarcinoma* or choriocarcinoma* or leukemia* or leukaemia* or metasta* or sarcoma* or teratoma* or oncolog*).ti,ab,kw.	5,842,228	cancer
3	(prevalence or incidence or epidemiol* or survey or cohort or surveillance or “long-term” or longterm or “follow-up” or followup or case control or cross-sectional or crosssectional).ti,ab,kw. Or exp epidemiology/ or exp epidemiological data/ or observational study/ or cohort analysis/ or longitudinal study/ or exp case control study/	8,188,257	epidemiological studies
4	1 and 2	10,864	suicide AND cancer
5	3 and 4	5,023	suicide AND cancer AND epidemiological studies
6	limit 5 to english language	4,724	

## MEDLINE (Ovid)

Database: Ovid MEDLINE® ALL 1946 to February 17, 2021 (medall)

Date of last search: 2021-02-19

Records: 2,468

#	Search	Records	Remarks
1	exp suicide/ or suicid*.ti,ab,kf. or (parasuicid* or "para suicid*").ti,ab,kf. or ((deliberat* or self*) adj1 (destruct* or harm* or injur* or mutilat* or poison* or killing)).ti,ab,kf.	108,157	suicide
2	exp neoplasms/ or (cancer* or tumor* or tumour* or neoplas* or malignan* or carcinoma* or adenocarcinoma* or choriocarcinoma* or leukemia* or leukaemia* or metasta* or sarcoma* or teratoma* or oncolog*).ti,ab,kf.	4,588,020	cancer
3	(prevalence or incidence or epidemiol* or survey or cohort or surveillance or "long-term" or longterm or "follow-up" or followup or case control or cross-sectional or crossectional).ti,ab,kf. or exp epidemiologic methods/ or exp epidemiologic studies/ or exp sentinel surveillance/ or exp cohort studies/ or exp cross-sectional studies/ or exp longitudinal studies/ or exp follow-up studies/ or exp prospective studies/	8,316,083	epidemiological studies
4	1 and 2	6,507	suicide AND cancer
5	3 and 4	2,726	suicide AND cancer AND epidemiological studies
6	limit 5 to english language	2,468	

## Science Citation Index Expanded & Social Sciences Citation Index (Web of Science)

Database: Science Citation Index Expanded (SCI-EXPANDED) & Social Sciences Citation Index (SSCI); Data last updated: 2021-02-18

Date of last search: 2021-02-19

Records: 1,950

# 6	1,950	(#5) AND LANGUAGE: (English) <i>Indexes=SCI-EXPANDED, SSCI Timespan=All years</i>	Edit	<input type="checkbox"/>	<input type="checkbox"/>
# 5	2,045	#4 AND #3 <i>Indexes=SCI-EXPANDED, SSCI Timespan=All years</i>	Edit	<input type="checkbox"/>	<input type="checkbox"/>
# 4	7,405	#2 AND #1 <i>Indexes=SCI-EXPANDED, SSCI Timespan=All years</i>	Edit	<input type="checkbox"/>	<input type="checkbox"/>
# 3	5,093,657	TS=(prevalence or incidence or epidemiol* or survey or cohort or surveillance or "long-term" or longterm or "follow-up" or followup or "case-control" or cross-sectional or crosssectional) <i>Indexes=SCI-EXPANDED, SSCI Timespan=All years</i>	Edit	<input type="checkbox"/>	<input type="checkbox"/>
# 2	4,319,340	(TS=(cancer* or tumor* or tumour* or neoplas* or malignan* or carcinoma* or adenocarcinoma* or choriocarcinoma* or leukemia* or leukaemia* or metastas* or sarcoma* or teratoma* or oncolog* ) <i>Indexes=SCI-EXPANDED, SSCI Timespan=All years</i>	Edit	<input type="checkbox"/>	<input type="checkbox"/>
# 1	102,917	(TS=(suicid*)) OR (TS=(parasuicid* or "para suicid**")) OR (TS=(deliberat* or self*) NEAR/0 (destruct* or harm* or injur* or mutilat* or poison* or killing) )) <i>Indexes=SCI-EXPANDED, SSCI Timespan=All years</i>	Edit	<input type="checkbox"/>	<input type="checkbox"/>

AND  OR

## PsycInfo (EBSCOhost)

Database: APA PsycInfo (psyh)

Date of last search: 2021-02-19

Records: 1,143

#	Query	Limiters/Expanders	Last Run Via	Records
S4	S3 AND (LA english)	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - APA PsycInfo	1,143
S3	S1 AND S2	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - APA PsycInfo	1,223

S2	(DE "Neoplasms" OR DE "Benign Neoplasms" OR DE "Breast Neoplasms" OR DE "Endocrine Neoplasms" OR DE "Leukemias" OR DE "Melanoma" OR DE "Metastasis" OR DE "Nervous System Neoplasms" OR DE "Terminal Cancer" OR DE "Brain Neoplasms" OR DE "Glioma") OR (TI (cancer* OR tumor* OR tumour* OR neoplas* OR malignan* OR carcinoma* OR adenocarcinoma* OR choriocarcinoma* OR leukemia* OR leukaemia* OR metasta* OR sarcoma* OR teratoma* OR oncolog*)) OR (AB (cancer* OR tumor* OR tumour* OR neoplas* OR malignan* OR carcinoma* OR adenocarcinoma* OR choriocarcinoma* OR leukemia* OR leukaemia* OR metasta* OR sarcoma* OR teratoma* OR oncolog*))	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - APA PsycInfo	89,702
S1	(DE "Suicidal Ideation" OR DE "Suicidality" OR DE "Suicide" OR DE "Attempted Suicide" OR DE "Suicidality" OR DE "Suicide Prevention") OR (TI (suicid* OR parasuicid* or "para suicid*")) OR (AB (suicid* OR parasuicid* or "para suicid*")) OR (TI ((deliberat* or self*) W0 (destruct* or harm* or injur* or mutilat* or poison* or killing))) OR (AB ((deliberat* or self*) W0 (destruct* or harm* or injur* or mutilat* or poison* or killing)))	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - APA PsycInfo	77,202

**CINAHL (EBSCOhost)**

Database: CINAHL (cin20)

Date of last search: 2021-02-22

Records: 1,503

#	Query	Limiters/Expanders	Last Run Via	Records
S4	S3 AND (LA english)	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	1,503
S3	S1 AND S2	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	1,521
S2	(MH "Neoplasms+") OR (TI (cancer* OR tumor* OR tumour* OR neoplas* OR malignan* OR carcinoma* OR adenocarcinoma* OR choriocarcinoma* OR leukemia* OR leukaemia* OR metasta* OR sarcoma* OR teratoma* OR oncolog*)) OR (AB (cancer* OR tumor* OR tumour* OR neoplas* OR malignan* OR carcinoma* OR adenocarcinoma* OR choriocarcinoma* OR leukemia* OR leukaemia* OR metasta* OR sarcoma* OR teratoma* OR oncolog*))	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	776,019

S1	(MH "Suicide+") OR (MH "Suicide Prevention (Iowa NIC)") OR (MH "Suicide Risk (Saba CCC)") OR (MH "Suicide Self-Restraint (Iowa NOC)") OR (MH "Suicide, Assisted") OR (TI (suicid* OR parasuicid* OR "para suicid*")) OR (AB (suicid* OR parasuicid* OR "para suicid*")) OR (TI ((deliberat* OR self*) W0 (destruct* OR harm* OR injur* OR mutilat* OR poison* OR killing))) OR (AB ((deliberat* OR self*) W0 (destruct* OR harm* OR injur* OR mutilat* OR poison* OR killing)))	Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	47,004
----	---	-------------------------------	--	--------

## Google Scholar

Database: Google Scholar

Date of last search: 2021-02-19

Records: 400 (only the first 200 records (ranked by relevance) were exported during searches in 2019 and 2021)

The search was conducted using the program "Harzing's Publish or Perish", Version 7.29.3156 while having a German IP address. The search string was entered in the program's field "Keywords". This yielded the same ranking of records as when entering the search string in the simple search field in the web browser.

Search string:

(suicide|parasuicide|"self OR deliberate killing OR harm OR destruction OR poisoning")(cancer|carcinoma|adenocarcinoma|tumor|malignant|metastasis|leukemia)(prevalence|incidence|cohort|epidemiology|case-control|cross-sectional)

**Supplementary Table 6: PRISMA-S Checklist** <sup>16</sup>

Section/to pic	#	Checklist item	Location(s) Reported
<b>INFORMATION SOURCES AND METHODS</b>			
Database name	1	Name each individual database searched, stating the platform for each.	Subjects and Methods - Literature search and data sources
Multi-database searching	2	If databases were searched simultaneously on a single platform, state the name of the platform, listing all of the databases searched.	Subjects and Methods - Literature search and data sources
Study registries	3	List any study registries searched.	Supplement: Materials and Methods Literature search and data source
Online resources and browsing	4	Describe any online or print source purposefully searched or browsed (e.g., tables of contents, print conference proceedings, web sites), and how this was done.	Supplement: Materials and Methods Literature search and data source
Citation searching	5	Indicate whether cited references or citing references were examined, and describe any methods used for locating cited/citing references (e.g., browsing reference lists, using a citation index, setting up email alerts for references citing included studies).	Supplement: Materials and Methods Literature search and data source
Contacts	6	Indicate whether additional studies or data were sought by contacting authors, experts, manufacturers, or others.	Supplement: Materials and Methods Literature search and data sources.
Other methods	7	Describe any additional information sources or search methods used.	Supplement: Materials and Methods Literature search and data sources
<b>SEARCH STRATEGIES</b>			
Full search strategies	8	Include the search strategies for each database and information source, copied and pasted exactly as run.	Supplement: Supplementary Table 5
Limits and restrictions	9	Specify that no limits were used, or describe any limits or restrictions applied to a search (e.g., date or time period, language, study design) and provide justification for their use.	Supplement: Materials and Methods Literature search and data sources
Search filters	10	Indicate whether published search filters were used (as originally designed or modified), and if so, cite the filter(s) used.	Supplement: Materials and Methods Literature search and data sources
Prior work	11	Indicate when search strategies from other literature reviews were adapted or reused for a substantive part or all of the search, citing the previous review(s).	Supplement: Materials and Methods Literature search and data sources
Updates	12	Report the methods used to update the search(es) (e.g., rerunning searches, email alerts).	Supplement: Materials and Methods Literature search and data sources
Dates of searches	13	For each search strategy, provide the date when the last search occurred.	Supplement: Supplementary Table 5



<b>PEER REVIEW</b>			
Peer review	14	Describe any search peer review process.	Supplement: Materials and Methods Literature search and data sources
<b>MANAGING RECORDS</b>			
Total Records	15	Document the total number of records identified from each database and other information sources.	12,193
Deduplication	16	Describe the processes and any software used to deduplicate records from multiple database searches and other information sources.	Supplement: Materials and Methods - Data extraction and assessment of study quality

## References

1. Harrod CS, Goss CW, Stallones L, DiGuseppi C. Interventions for primary prevention of suicide in university and other post-secondary educational settings. *Cochrane Database Syst Rev* 2014; 29(10):CD009439. doi: 10.1002/14651858.CD009439.pub2
2. Hawton K, Witt KG, Taylor Salisbury TL, et al. Psychosocial interventions for self-harm in adults. *Cochrane Database Syst Rev* 2016; 2016(5):CD012189. doi: 10.1002/14651858.CD012189
3. John A, Hawton K, Okolie C, Dennis M, Price SF, Lloyd K. Means restriction for the prevention of suicide: generic protocol. *Cochrane Database of Systematic Reviews* 2018; 8(10):e022762. doi: 10.1136/bmjopen-2018-022762
4. Ostuzzi G, Matcham F, Dauchy S, Barbui C, Hotopf M. Antidepressants for the treatment of depression in people with cancer. *Cochrane Database of Systematic Reviews* 2018; 4:CD011006. doi: 10.1002/14651858.CD011006.pub3
5. Larney S, Kopinski H, Beckwith CG, et al. Incidence and prevalence of hepatitis C in prisons and other closed settings: results of a systematic review and meta-analysis. *Hepatology* 2013; 58(4): 1215-24. doi: 10.1002/hep.26387
6. McGowan J, Sampson M, Salzwedel DM, Cogo E, Foerster V, Lefebvre C. PRESS Peer Review of Electronic Search Strategies: 2015 Guideline Statement. *J Clin Epidemiol* 2016; 75: 40-6. doi: 10.1016/j.jclinepi.2016.01.021
7. Bramer WM, Giustini D, de Jonge GB, Holland L, Bekhuis T. De-duplication of database search results for systematic reviews in EndNote. *J Med Libr Assoc* 2016; 104(3): 240-3. doi: 10.3163/1536-5050.104.3.014
8. Falzone L, Salomone S, Libra M. Evolution of Cancer Pharmacological Treatments at the Turn of the Third Millennium. *Front Pharmacol* 2018; 9: 1300. doi: 10.3389/fphar.2018.01300
9. Benjamini Y, Hochberg Y. Controlling the False Discovery Rate: A Practical and Powerful Approach to Multiple Testing. *Journal of the Royal Statistical Society Series B (Methodological)* 1995; 57(1): 289-300.
10. Cohen GR, Yang SY. Mid-P confidence intervals for the Poisson expectation. *Stat Med* 1994; 13(21): 2189-203. doi: 10.1002/sim.4780132102
11. R Core Team (2020). R: A language and environment for statistical computing. . Vienna, Austria: Foundation for Statistical Computing; 2020.
12. Viechtbauer W. Conducting Meta-Analyses in R with the metafor Package. 2010 2010; 36(3): 48. doi: 10.18637/jss.v036.i03
13. Begg CB, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. *Biometrics* 1994; 50(4): 1088-101.
14. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. *BMJ* 1997; 315(7109): 629-34. doi: 10.1136/bmj.315.7109.629
15. VanderWeele TJ, Ding P. Sensitivity Analysis in Observational Research: Introducing the E-Value. *Ann Intern Med* 2017; 167(4): 268-74. doi: 10.7326/M16-2607
16. Rethlefsen ML, Kirtley S, Waffenschmidt S, et al. PRISMA-S: an extension to the PRISMA Statement for Reporting Literature Searches in Systematic Reviews. *Syst Rev* 2021; 10(1): 39. doi: 10.1186/s13643-020-01542-z