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Research paper

Prevalence of current suicidal thoughts and lifetime suicide attempts in individuals with cancer and other chronic diseases in Germany: Evidence for differential associations from a representative community cohort

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ABSTRACT

Background: Research indicates an elevated risk for suicidal thoughts and behaviors (STBs) among individuals with cancer, but community-based studies on the prevalence of STBs in comparison to the general population and other chronic diseases are lacking.

Methods: Data was drawn from the representative population-based, prospective Gutenberg Health Study (GHS). Participants ($N = 12,382$; age: $M = 59.5$, $SD = 10.8$; 48.9 % women) completed highly standardized medical assessments and validated questionnaires such as the PHQ-9. In addition to prevalence estimates (stratified by STBs and gender), logistic regression models were calculated (controlling for confounders).

Results: The sample included 1910 individuals with cancer, 8.2 % of whom reported current suicidal thoughts and 2.0 % reported lifetime suicide attempts. There was neither a significant association between a cancer diagnosis and suicidal thoughts ($p = .077$) nor suicide attempts ($p = .17$) in models adjusting for age, gender, and income. Other chronic diseases were linked to suicidal thoughts and attempts only in men.

Limitations: Although the investigation of the two kinds of STB are a strength of the study, the items' different time frames complicate comparisons. In addition, the cross-sectional design limits the ability to understand observed relationships and to identify periods of risk.

Conclusion: This study expands the evidence base regarding the vulnerability to STBs in individuals with cancer, including long-term survivors. It highlights their heterogeneity, differential risk factors underlying suicidal thoughts and attempts, and the relevance of other (contextual) factors shaping an individual's susceptibility to suicidal crises.

1. Introduction

In recent decades, medical advances have greatly improved detection and treatment options for individuals with cancer such that it is often now conceived of as a chronic disease with or after which patients can live for years to decades. Nonetheless, in many Western countries such as Germany, cancer is among the three most common causes of death (Destatis, 2023). For survivors, the disease and its treatment can confer diminished quality of life as well as grave psychological distress (Ernst et al., 2023; Wu and Harden, 2015). There is evidence from numerous large original studies and research syntheses that cancer patients and survivors are at an increased risk for suicidal thoughts and behaviors (STBs) (Amiri and Behnezhad, 2019). These associations are now receiving increased policy attention, for example, with chronic disease being listed as a risk factor within the new English suicide prevention strategy (Department of Health and Social Care, 2023).

The most recent systematic review and meta-analysis showed a substantially elevated suicide mortality (standardized mortality ratio (SMR) = 1.85, 95 % confidence interval (CI) = 1.55–2.20) in cancer patients compared to the general population (Heinrich et al., 2022). The risk further depended on cancer prognosis, stage, time since diagnosis, and geographic region. This finding mirrored previous studies that had demonstrated increased risks of suicide death (Amiri and Behnezhad, 2019) with a high pooled incidence in cancer patients (39.72 per 100,000 person-years) (Du et al., 2020). By comparison, fewer large-scale studies investigated other STBs such as suicidal ideation and suicide attempts. From a prevention perspective, these are especially important as they can identify individuals at high risk of subsequent suicide. According to the most current reviews, the prevalence of suicidal ideation in cancer patients ranges greatly from 0.7 % to 71.4 % which is about up to 3.5 times higher compared to the general population (Kolva et al., 2020; Robson et al., 2010). The elevated risk transcends diagnostic groups and prognoses, as evidenced by the high rates of suicidal ideation in long-term childhood cancer survivors (compared to the general population) (Burghardt et al., 2019).

Only a small proportion of individuals who report STBs during their lifetime will die by suicide (Klonsky et al., 2016). However, suicidal ideation indicates a serious crisis in its own right (Jobes and Joiner, 2019): suicidal individuals engage in less self-care, including the sparse use of medical care services and poor treatment adherence (Gipson and King, 2012; Kissane, 2009). Related health risk behavior may imply unfavorable courses for the individual and increasing healthcare costs for the population (King et al., 2001; Poorolajal and Darvishi, 2016). Notably, nonfatal suicide attempts also pose massive psychological risks, such as interpersonal problems, injury, and persistent disability (Zalsman et al., 2017).

The available evidence base is limited by the fact that studies rarely investigated the prevalence or associated risk factors of several STBs within the same sample, limiting insights into their potentially differential development among people with cancer. Further, many studies only addressed one diagnosis (Carreira et al., 2018; Henry et al., 2018; Pranckeviciene et al., 2016) rather than comparing the risks for different diagnostic groups within the same settings. In addition, risk varies according to gender (Zaorsky et al., 2019) and time since diagnosis (Heinrich et al., 2022), making them important contextual variables to consider.

Further, comparisons of prevalence between people with cancer and other chronic diseases are scarce, although such knowledge is needed to inform prevention and intervention efforts, particularly among patients with comorbidities. For example, a small study by Taur et al. (2012) compared cancer patients to participants with chronic obstructive pulmonary disease (COPD) and found even higher proportions of at-risk individuals among the latter. In a large 14-country study, most physical conditions (e.g., high blood pressure, heart attack/stroke, arthritis, chronic headache, and respiratory conditions) were associated with suicide attempts; and as the number of physical conditions increased, so

did the risk of STBs. The study also included data from Germany, but it did not explicitly compare the risks associated with cancer to those associated with other chronic diseases (Scott et al., 2010). Even though international studies show the elevated risk of STBs for people with cancer, there has been no original research examining them in a comprehensive way in a community-based German sample. This is a research gap as findings from other countries with differently organized healthcare systems might not be generalizable. The available evidence indicates that STBs in the context of cancer are highly relevant in the German context. In a retrospective autopsy record study, 30.7 % of individuals with a chronic disease who died by suicide had cancer (Fegg et al., 2016). A recent cohort study of 4372 cancer patients reported a prevalence of suicidal ideation of 14.3 % (Sauer et al., 2022), but it did not investigate the relevance of disease-related information (i.e., time since diagnosis, stage) or include comparisons with the general population. A similar rate of suicidal ideation (15.0 %) was also reported in a study by Senf et al. (2022) based on a more modest patient sample from a general acute care hospital.

Against this background, this study aimed to examine the prevalence of suicidal thoughts and suicide attempts within a large, community-based cohort study that included cancer patients with different diagnoses as well as individuals with other chronic diseases and acknowledging relevant confounding factors (including disease-related factors such as time since diagnosis and other life domains). Specific goals were:

1) To determine the prevalence of current suicidal thoughts and lifetime suicide attempts in individuals with cancer
2) To investigate potential differences between diagnosis groups in individuals with cancer
3) To test whether the risk of current suicidal thoughts and lifetime suicide attempts differs between individuals with cancer and individuals not affected by cancer
4) To investigate differences in the risk of current suicidal thoughts and lifetime suicide attempts between those with cancer and those with other chronic diseases than cancer, including multimorbidity

2. Methods

2.1. Procedure and study sample

The Gutenberg Health Study (GHS) is a population-based, prospective, observational single-center cohort study in the Rhine-Main-Region in Western Mid-Germany. The primary aim of the GHS is to analyze cardiovascular (CV) risk factors and to foster health prevention in the community. The procedure (i.e., participant enrollment methods, laboratory analyses, etc.) has been described in more detail elsewhere (Hohn et al., 2015; Michal et al., 2013; Wild et al., 2012). Participants were randomly drawn from local registries of the city of Mainz and the adjacent district of Mainz-Bingen to be representative of the population. The response rate (defined as the recruitment efficacy proportion, i.e., the number of individuals participating in the baseline examination divided by the total number of persons participating in the baseline examination plus those refusing and those who were not contactable) amounted to 60.3 %. Recruitment was conducted in equal strata for gender and age decades. At baseline (assessments between 2007 and 2012), 15,010 participants (age range: 35–74 years) were examined. A total of 12,423 took part in the follow-up examination (82.8 %) five years later. The present work uses data from this second assessment only, as it was the first one that included the relevant assessment of suicide attempts.

The study protocol and documents were approved by the Medical Chamber of Rhineland-Palatinate ethics committee and the local data safety commissioner, and the study was conducted in line with the Declaration of Helsinki. Written informed consent was retrieved from all participants.

2.2. Measures and assessment

The baseline and the follow-up examinations were conducted at the study center (University Medical Center Mainz) and included the evaluation of CV risk factors and clinical variables assessed via a computer-assisted personal interview and laboratory examinations (e.g., blood samples and anthropometric measurements). Certified medical technical assistants performed all examinations according to standard operating procedures.

2.2.1. Sociodemographic information

Sociodemographic variables were assessed by self-report: gender, age in years, education level (adapted to information of baseline assessment), marital status, household size, equivalized household income (EHI, calculated as household income divided by square root of household size given in units of 1000 Euro).

2.2.2. Cancer diagnosis

Persons with a cancer diagnosis were categorized into groups based on cancer entity (skin; breast; prostate; colon, rectum, and small intestines; uterus, cervix, and female genitalia; other). This classification used all available data and prioritized information from highly reliable sources as cancer registry data (Schirrmacher et al., 2022) over less reliable sources as self-reported data. For self-reported data, non-malignant diseases were excluded ($N = 34$) based on the International Classification of Diseases (ICD) revision 10 system (World Health Organization, 1992) and expert review. Further, disease-related information comprised the time since diagnosis (coded in a binary fashion differentiating by less or more than five years a standard threshold of long-term survival (National Research Council, 2005)).

2.2.3. Suicidal thoughts and suicide attempts

Suicidal thoughts were assessed using the respective item ("Thoughts that you would be better off dead or of hurting yourself in some way") of the Patient Health Questionnaire (PHQ-9). The PHQ-9 is a widely used, validated measure comprising nine items that assess the symptoms of major depressive disorder (Kocalevent et al., 2013; Lowe et al., 2004; Martin et al., 2006). The PHQ-9 is also valid for use in cancer patients (Hartung et al., 2017; Hinz et al., 2016). For each item, including the one focusing on suicidal thoughts, participants rate the occurrence of the respective symptom over the course of the last two weeks. Ratings were conducted on a Likert-type scale (0 = not at all, 1 = several days, 2 = more than half the days, 3 = nearly every day). In line with established procedures and previous work (e.g., Ernst et al., 2020b; Michal et al., 2010), suicidal thoughts were recoded into a binary variable distinguishing not present (response 0) and present (combining responses 1–3) suicidal thoughts.

A lifetime history of suicide attempts was assessed using a single self-report item: "Have you ever made an attempt to kill yourself?" (yes/no). The respective item has previously been used in prospective cohort studies, including long-term childhood cancer survivors (Ernst et al., 2020a). It is similar to established, validated questions that are included in the Self-Injurious Thoughts and Behavior Interview (SITBI) (Fischer et al., 2014; Nock et al., 2007).

2.2.4. Physical health and chronic diseases.

Chronic diseases were assessed via interview and self-report. We included hypertension, obesity (defined as a Body-Mass-Index (BMI) of $\geq$ 30), diabetes, dyslipidemia, COPD, asthma, chronic bronchitis, chronic liver disease, and chronic kidney disease as chronic diseases. Diagnoses of venous thromboembolism, myocardial infarction, stroke, deep vein thrombosis, heart failure, pulmonary embolism, and hypertension were summarized as CV comorbidities. If participants did or could not report about the presence or absence of CV comorbidities, this variable was coded as "unknown".

2.3. Statistical procedures

Analyses were performed using SAS 9.4 (SAS Institute, Cary NC). As the level of statistical significance, we defined $p < .05$ (conceiving of values below $p = .10$ as trends). Descriptive analyses were performed for each variable for the total sample and patients with cancer. This included numbers (means, standard deviation) and percentages for the presence of suicidal thoughts and suicide attempts. Logistic regression models were employed with suicidal thoughts or suicide attempts, respectively, as the dependent variable. To explore the relationship within the group of cancer patients, gender, cancer entity, survival time ($</>$ five years since diagnosis), and presence of CV comorbidities were included as covariates.

For the different research questions, we chose different operationalizations: for the comparison of people with cancer versus people without cancer, the model included a variable of cancer status (at least one past diagnosis versus no diagnosis). The coding of the cancer status variable (Cancer vs. No Cancer) was done irrespective of potentially present other chronic diseases. In consequence, the group of people with cancer included both individuals with and without comorbidities; and the group without cancer included both individuals with and without chronic diseases other than cancer.

In addition, for the more nuanced analyses modelling the effects of comorbidities/other chronic diseases, groups were distinguished differently: In these analyses, the group of cancer patients included only people who had no chronic diseases other than cancer. These models also included the number of present chronic diseases to account for multimorbid patients. Confounders controlled for were age, gender, EHI, and BMI. Skin cancer and the absence of chronic diseases were used as a reference category of the respective predictors.

3. Results

3.1. Sample characteristics

Participants' age ranged from 40 to 80 years and 15.4 % of participants ($N = 1910$) reported a cancer diagnosis. Descriptive characteristics are provided in Table 1, stratified for the presence of a cancer diagnosis (yes/no). The most common cancer types were skin ($N = 721$, 37.7 %), breast ($N = 267$, 14.0 %), and prostate ($N = 209$, 10.9 %). In total, 922 participants (51.3 % women) reported suicidal thoughts and 290 participants (63.8 % women) reported suicide attempts.

3.2. Participants with cancer

Combining all diagnoses, 151 participants with cancer (58.3 % women) reported current suicidal thoughts and 36 (75.0 % women) reported lifetime suicide attempts. By comparison, 771 of those without cancer (56.8 % women) reported suicidal thoughts and 254 (67.7 % women) reported suicide attempts. Univariate, unadjusted comparisons indicated neither an overall increased prevalence of suicidal thoughts ($p = .41$) nor of suicide attempts among those with cancer ($p = .15$).

3.3. Comparison of participants with different cancer diagnoses

Individuals with uterus, cervix, and female genitalia, breast, and skin cancer showed the highest prevalence of suicidal thoughts and suicide attempts (Fig. 1). We tested associations of different cancer entities with the risk of suicidal thoughts and suicide attempts in separate multivariate models (Table 2):

Table 1
Sample characteristics.

	Cancer (N = 1910)	No Cancer (N = 10,472)
Sociodemographic characteristics		
Women (N, %)	939 (49.2)	5113 (48.8)
Age at study assessment (M, SD)	66.0 (9.6)	58.3 (10.6)
High school education (N, %)	608 (31.9)	4285 (41.1)
Marital status (N, %)		
- Married	1426 (75.0)	7701 (73.7)
Household size (M, SD)	2.1 (0.8)	2.4 (1.1)
Equivalized household income [Euro] (M, SD)	2314.9 (1317.0)	2543.9 (1813.4)
Disease-related information		
Diagnosis group (N, %)		
- Skin	721 (37.7)	
- Breast	267 (14.0)	
- Prostate	209 (10.9)	
- Colon, rectum, and small intestines	117 (6.2)	
- Uterus, cervix, and female genitalia	110 (5.8)	
- Other	334 (17.7)	
Time since first cancer diagnosis (N, %)		
- ≥ 5 years	1115 (58.4)	
- < 5 years	795 (41.6)	
Suicidal thoughts and attempts (N, %)		
- Current suicidal thoughts (PHQ-9 item)	151 (8.2)	771 (7.6)
- Lifetime suicide attempts	36 (2.0)	254 (2.5)
Physical health risk factors (N, %)		
- BMI (M, SD)	27.60 (5.05)	27.50 (5.01)
- Obesity (N, %)	488 (25.5)	2734 (26.1)
Chronic diseases (N, %)		
- Hypertension	1252 (65.6)	5410 (51.7)
- Dyslipidemia	770 (40.5)	3503 (33.5)
- Diabetes	271 (14.2)	1035 (9.9)

Note. Missing values on the suicidal thoughts item pertained to $N = 77$ among those with and $N = 293$ among those without cancer; missing values on the suicide attempts item pertained to $N = 91$ among those with and $N = 425$ among those without cancer. The three most common chronic diseases in the cohorts are listed.

- *Suicidal thoughts.* No diagnosis group was associated with suicidal thoughts in a statistically significant way. Neither time since diagnosis nor CV comorbidities were associated with suicidal thoughts.

- *Suicide attempts.* The logistic regression model of suicide attempts indicated no associations with diagnosis groups, time since diagnosis, and CV comorbidities.
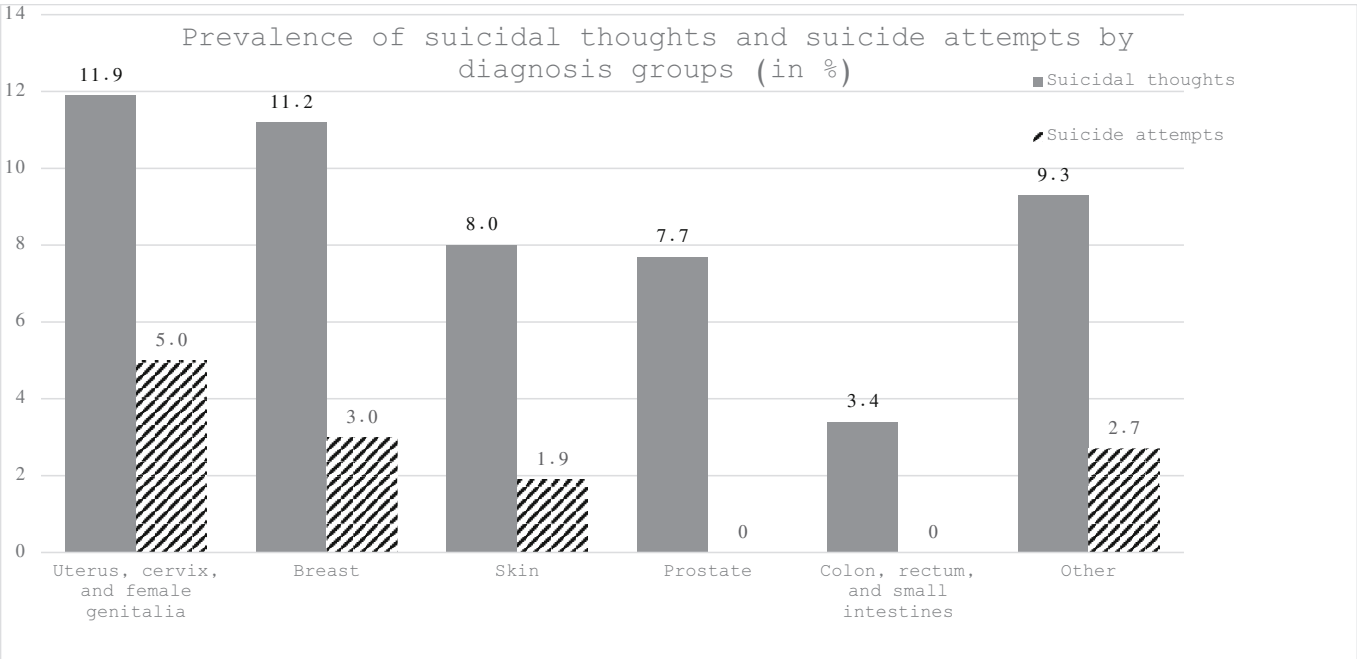

Fig. 1. Prevalence of current suicidal thoughts and lifetime suicide attempts, stratified by cancer diagnosis.
The figure shows the prevalence of current suicidal thoughts and lifetime suicide attempts varied across cancer diagnoses. They were highest among those with cancers of the uterus, cervix, and female genitalia ($N = 12$, 11.9 % of the diagnosis group in the case of suicidal thoughts and $N = 5$, 5,0 % of the diagnosis group in the case of suicide attempts) and lowest among those with cancer of the colon, rectum and small intestines ($N = 4$, 3.4 % of the diagnosis group in the case of suicidal thoughts and $N = 0$ in the case of suicide attempts).

Table 2

Logistic regression analyses of current suicidal thoughts and lifetime suicide attempts.

	Model of suicidal thoughts ($N = 1833$)			Model of suicide attempts ($N = 1819$)		
	p-value	OR	95 %-CI (OR)	*p*-value	OR	95 %-CI (OR)
Intercept	< .001			< .001		
Gender (male vs. female)	.157	0.74	0.48–1.12	.091	0.48	0.21–1.12
Cancer type						
- Skin (reference)						
- Breast	.356	1.28	0.76–2.14	.797	1.13	0.44–2.95
- Prostate	.733	1.11	0.60–2.06	.097*		n.d.
- Uterus, cervix, and female genitalia	.590	1.21	0.60–2.44	.323	1.76	0.57–5.40
- Colon, rectum, and small intestines	.107	0.43	0.15–1.20	.733*		n.d.
- Other	.297	0.79	0.50–1.24	.958	1.02	0.44–2.39
Time since diagnosis	.310	0.84	0.59–1.18	.337	0.72	0.36–1.42
($\geq$ 5 years vs. < 5 years)						
CV comorbidities						
- No (reference)						
- Unknown/uncertain	.340	1.70	0.57–5.02	.149	3.06	0.67–13.97
- Yes	.144	1.45	0.88–2.40	.415	0.55	0.13–2.32

Note. CV = Cardiovascular; CV comorbidities including diagnoses of venous thromboembolism, myocardial infarction, stroke, deep vein thrombosis, heart failure, pulmonary embolism, hypertension; p-value based on Wald-test, *-marked *p*-values based on score test; n.d. = not defined; OR = Odds ratio; 95 %-CI = 95 %-confidence interval. Incomplete cases pertained to $N = 77$ in the model of suicidal thoughts and to $N = 91$ in the model of suicide attempts. Participants with cancer diagnoses of the colon, rectum, and small intestines and prostate did not report any suicide attempts, which is why these categories were not entered as predictors in the latter model and their CI is not defined.

3.4. Persons with cancer versus without cancer

- *Suicidal thoughts.* There was a trend for the associations of a cancer diagnosis with suicidal thoughts (Odds Ratio (OR) = 1.19, p = .077) (Table 3). Male gender (OR = 0.73, p < .001), higher age (OR = 0.99, p = .002), and higher EHI (OR = 0.79, p < .001) were negatively associated with suicidal thoughts. In gender-stratified analyses, cancer diagnoses showed no significant relation to suicidal thoughts in men (p = .24) or women (p = .26) (Suppl. Table 1).
- *Suicide attempts.* There was no statistically significant association between cancer diagnoses and suicide attempts regarding the whole sample (p = .17) (Table 3) and in the stratified analyses (Suppl. Table 2) (p = .37 in men and p = .30 in women).

3.5. Persons with cancer versus with other chronic diseases

The prevalence of suicidal thoughts and attempts also varied between participants with different numbers of chronic diseases. In the case of suicidal thoughts, prevalence ranged from 11.9 % (N = 16) among those with five or more chronic diseases to 7.2 % (N = 221) among those without any chronic disease and in the case of suicide attempts from 8.7 % (N = 12) among those with five chronic diseases or more to 2.3 % (N = 70) among those with no chronic diseases.

- *Suicidal thoughts.* The presence of a multimorbidity of up to four chronic diseases other than cancer was not associated with suicidal thoughts (p = .56), but for five or more (OR = 1.96, p = .02) or a cancer diagnosis (OR = 1.38, p = .013) there was a significant association (Table 4). Other relevant predictors were male gender (OR = 0.71, p < .001), age (OR = 0.99, p < .001), and EHI (OR = 0.80, p < .001). In stratified analyses (Suppl. Table 3), associations with suicidal thoughts

were only observed in the male subsample, with OR increasing with more diseases (from OR = 1.14, p = .43 in the case of one disease to OR = 3.56, p = .001 in the case of five or more diseases). There was a trend for the association of a cancer diagnosis with suicidal thoughts in men (OR = 1.50, p = .051) but not in women (p = .10). EHI was relevant in both genders (OR = 0.80, p < .001 in men, OR = 0.81, p < .001 in women) as was age (OR = 0.98, p < .001 in men, OR = 0.99, p = .067 in women).

- *Suicide attempts.* Suicide attempts were only related to high numbers of comorbidities (in the case of five or more: OR = 3.17, p = .003). In this model, cancer diagnoses showed no independent association (p = .64) (Table 4). Other negatively related factors were male gender (OR = 0.42, p < .001), higher age (OR = 0.98, p < .001), and higher EHI (OR = 0.69, p < .001). In stratified analyses (Suppl. Table 4), chronic diseases were significantly related to suicide attempts in the male subsample in the case of five or more (OR = 6.74, p = .001). In women, neither other chronic diseases nor cancer diagnoses were related to suicide attempts. Suicide attempts were related to younger age in women (OR = 0.98, p = .005). Women also had a weak association with BMI (OR = 1.03, p = .048). EHI was relevant in both men (OR = 0.62, p < .001) and women (OR = 0.73, p < .001).

4. Discussion

4.1. Main aims and the findings of this study

The present work explored the association of cancer with suicidal thoughts and suicide attempts in a large, representative German community sample including 1910 persons with a cancer diagnosis and 10,472 persons without a cancer diagnosis. We investigated particularly

Table 3

Logistic regression analyses of current suicidal thoughts and lifetime suicide attempts in those with cancer vs. those without.

	Model of suicidal thoughts ($N = 10,953$)			Model of suicide attempts ($N = 10,819$)		
	p-value	OR	95 %-CI (OR)	*p*-value	OR	95 %-CI (OR)
Intercept	< .001			< .001		
Cancer vs. No Cancer	.077	1.19	0.98–1.46	.172	0.76	0.51–1.13
Gender (male vs. female)	< .001	0.73	0.64–0.85	< .001	0.43	0.33–0.56
Age [years]	.002	0.99	0.98–1.00	.003	0.98	0.98–1.00
EHI [1000 Euro]	< .001	0.79	0.74–0.84	< .001	0.68	0.59–0.77

Note. EHI = Equivalized Household income; *p*-value based on Wald-test; OR = Odds ratio; 95 %-CI = 95 %-confidence interval. Incomplete cases pertained to $N = 1429$ in the model of suicidal thoughts and to $N = 1563$ in the model of suicide attempts.

Table 4

Logistic regression analyses of current suicidal thoughts and lifetime suicide attempts of participants with cancer vs. those with other chronic diseases.

	Model of suicidal thoughts (N = 10,952)			Model of suicide attempts (N = 10,818)		
	p-value	OR	95 %-CI (OR)	*p*-value	OR	95 %-CI (OR)
Intercept	< .001			< .001		
Chronic diseases						
No chronic disease (reference)						
1 chronic disease	.291	1.12	0.91–1.39	.344	1.19	0.83–1.70
2 chronic diseases	.180	1.18	0.93–1.51	.989	1.00	0.64–1.54
3 chronic diseases	.090	1.30	0.96–1.77	.533	1.19	0.69–2.02
4 chronic diseases	.559	1.14	0.73–1.78	.150	1.63	0.84–3.18
≥ 5 chronic diseases	.023	1.96	1.10–3.49	.003	3.17	1.47–6.87
Cancer vs. No Cancer	.013	1.38	1.07–1.78	.637	0.89	0.55–1.44
Gender (male vs female)	< .001	0.71	0.62–0.82	< .001	0.42	0.32–0.54
Age [years]	< .001	0.99	0.98–0.99	< .001	0.98	0.97–0.99
BMI [kg/m^2]	.133	1.01	1.00–1.03	.079	1.02	1.00–1.05
EHI [1000 Euro]	< .001	0.80	0.75–0.85	< .001	0.69	0.61–0.79

Note. BMI = Body-Mass-Index; EHI = Equivalized Household income; chronic diseases include hypertension, obesity (resulted from Body-Mass-Index), diabetes, dyslipidemia, chronic obstructive pulmonary disease, asthma, chronic bronchitis, chronic liver disease, and chronic kidney disease, but no cancer diagnosis; *p*-value = based on Wald-test; OR = Odds ratio; 95 %-CI = 95 %-confidence interval. For the model of suicidal thoughts, incomplete cases pertained to N = 1430 and for the model of suicide attempts N = 1564.

vulnerable subgroups within the cancer sample. Furthermore, this population-based approach yields a complementary perspective to previous work as it allowed us to perform comparisons of individuals with cancer and those without cancer while taking important confounding variables into account. Further, we clarified questions around comorbidities as we also compared individuals with cancer with those affected by other chronic diseases than cancer; also modelling multimorbidity.

Our first research question concerned the prevalence of suicidal thoughts and suicide attempts in German cancer patients and survivors compared to a community sample without cancer. A special feature of the present work was that participants with cancer were also assessed as part of a representative population cohort, guarding against an oversampling of distressed individuals as is likely to happen in clinical or care settings (Hartung et al., 2017). We found no elevated prevalence rates of current suicidal thoughts and lifetime suicide attempts compared to other members of the community, however, our findings highlight the great heterogeneity among those with cancer, as well as the relevance of contextual factors (such as demographic characteristics) in shaping mental health. The comparatively higher rates of current suicidal thoughts than lifetime suicide attempts - both in the general population as well as in individuals with cancer - are in line with previous epidemiological studies (Cao et al., 2015; Kye and Park, 2017; Turecki et al., 2019). The prevalence of suicidal thoughts among those with cancer (8.2 %) is within the overall range reported in current reviews, although they included studies that found both markedly higher and lower rates (Kolva et al., 2020; Robson et al., 2010). The present rates are most similar to previous studies examining outpatients (Nanni et al., 2018; Walker et al., 2008). The prevalence of STBs in people with cancer was slightly higher than among people without cancer. Compared to other cohorts studied, we drew on a representative population sample. In contrast, other samples were recruited in contexts where higher distress can be expected (e.g., cancer patients referred to a psychiatry division (Akechi et al., 1999)), which is one explanation for the diverging prevalence between studies.

The second research question focused on differences between diagnosis groups within persons with cancer. The highest prevalence of STBs was found in uterus, cervix, and female genitalia, skin, breast, and prostate cancer. Sauer et al. (2022) also reported high rates of suicidal ideation among patients with cancer of the breast (prevalence of 15.5 %), skin (7.3 %), female genitalia (14.9 %), and male genitalia (14.0 %). Another study also found high rates of suicidal ideation among those with breast cancer (34.1 %), prostate cancer (5.8 %), and gynecologic cancer (14.5 %) (Vehling et al., 2021). In the present cohort, no specific cancer entities showed strong associations with suicidal thoughts.

However, the present type of analysis does not allow for in-depth interpretations as the burden of diagnoses implicated for the individual also varies with prognosis, treatment status, treatment side, and late effects profiles; all of which are potential sources of variation that were not captured and modelled in the present work.

Time since diagnosis was not related to the risk of suicidal thoughts and suicide attempts, potentially owing to the relatively unspecific operationalization in the present study differentiating just more or less than five years and including no data on treatment courses (which can differ greatly). Others, however, have also found no effect of survival time on cancer survivors' depression or anxiety comparing large intervals of five and ten years (Gotze et al., 2019). Investigations reporting time-dependent effects used shorter periods and found the largest increase in risk shortly after diagnosis (Lu et al., 2013), which declined again afterwards (Hem et al., 2004).

Our third question focused on the comparison between individuals with cancer and individuals without regarding the risk of suicidal thoughts and suicide attempts. A cancer diagnosis showed a trend to be associated with a risk of suicidal thoughts, but much less so with suicide attempts. These differential associations may be understood against the background of previous research and also theoretical conceptualizations in the sense of the ideation-to-action-framework positing fundamentally different risk factors underlying the emergence of suicidal ideation and the transition to behavior (e.g., Klonsky et al., 2016; Klonsky et al., 2018; O'Connor and Kirtley, 2018).

Women were overrepresented among those reporting suicidal thoughts and suicide attempts, both in the general population and among those with cancer. This is a common observation in suicide research (e.g., Turecki et al., 2019). At the same time, gender-stratified analyses showed that a cancer diagnosis conferred different elevations in risk of STBs in men and women: The association of cancer with suicidal thoughts was stronger in men. Previous research has already attested to men's increased vulnerability in the context of cancer (Ernst et al., 2019). It has been suggested that men and women cope differently with chronic diseases, including the use of informal social support as well as professional services (Baider and Bengel, 2001; Wenger and Oliffe, 2014). In previous studies, female cancer patients voiced more need for psychosocial support than men, irrespective of their level of distress (Faller et al., 2016). Other important contextual factors comprised age and income. Age could influence the extent to which a cancer diagnosis comes as a shock or is a life event that has already been witnessed in friends and relatives; furthermore, with age and life experience, affected individuals may also have more appropriate coping strategies at their disposal and might be able to look back on other difficult situations in

life they could master successfully (Blank and Bellizzi, 2008; Martins-Klein et al., 2021; Yancura and Aldwin, 2008).

In addition, consistent with research in other populations (Turecki et al., 2019), higher income was a relevant protective factor for STB in the regression models. Within the framework of financial toxicity, cancer and its treatment can be associated with material and financial losses, in addition to psychological consequences and maladaptive coping strategies (Abrams et al., 2021; Lentz et al., 2019). Regarding financial hardship, three domains (material, psychological, and coping/behavioral) were previously associated with suicidal ideation in adult childhood cancer survivors ($p < .05$) (Huang et al., 2019). EHI and employment status may also provide indications of available resources prior to the disease so that those who are better off are, for instance, able to afford household help, may have to rely less on informal caregivers, and have access to better treatment options.

Regarding our fourth question, we investigated whether the risk of STBs was higher in persons with cancer or with other chronic diseases. In women, we found no relevant associations between cancer or chronic diseases and STBs, while in men we had an incidental, yet important finding that there are divergent patterns depending on the number of diseases. Kye and Park (2017) investigated whether STBs were related to different chronic diseases and found that certain chronic diseases (e.g., stroke, osteoarthritis, angina pectoris, pulmonary tuberculosis, renal failure) and cancer entities (e. g., lung cancer, cervical cancer) increased the risk of STBs.

In conclusion, the present results show that cancer patients are indeed a potentially vulnerable group, even as long-term survivors, but not all to the same extent. Differences between those with cancer relate, on the one hand, to disease-relevant variables such as the diagnosis, but on the other hand also to factors such as gender, age, and income that shape risk profiles in the population.

4.2. Limitations and strengths

This is the first German study with a large community sample including cancer patients and survivors investigating the prevalence of different STBs. The comparison to the general population and people with other chronic somatic diseases also contributes to closing an important research gap regarding the German context and beyond. However, the results must be interpreted considering the study's limitations. One limitation of this study is its cross-sectional design. To inform prevention and intervention efforts, it is important to also draw on longitudinal data to better understand the (causal) nature of the observed relationships and to model the dynamics of suicidal thoughts as well as identify particular risk periods.

Furthermore, our data contained information about two kinds of STBs within the same sample, which is a great strength. However, there are limitations to their comparison because of the items' different timeframe dimensions. Along these lines, it is a limitation that we do not additionally know about lifetime suicidal ideation. This could have yielded valuable information about particularly vulnerable phases in the process of diagnosis, treatment, and recovery. A major limitation regarding the assessment of suicide attempts, on the other hand, is the missing information about the exact point in time (including whether it was before or after the cancer diagnosis), and more information about the attempt(s) or their frequency would have been informative as well. As part of this, we do not know whether participants' attempts took past before or after a potential cancer diagnosis, precluding us from drawing inferences in the sense of a causal effect of the diagnosis on the development of a suicidal crisis. Although the sample size was large, given the prevalence of suicide attempts, the study was likely not sufficiently powered to detect differences in suicide attempt rates in different subgroups. Even though the PHQ-9 item is a validated and well-established measure of suicidal ideation, it is important to bear in mind that its wording refers to passive death wishes and thoughts of harming oneself, two things with potentially different clinical implications, and assesses

them as part of one question. Further, it does not yield information about other facets of suicidal ideation, including intent and plans. This limits its interpretation and future studies are needed investigating the same associations as the present study, but with more nuanced approaches to the full range of STBs.

Moreover, the data included many persons with skin cancer; a broader distribution across more cancer entities would have been informative. Although the available data included time since diagnosis, the data lack information about e.g., cancer stage and cancer prognosis that were associated with STBs in previous studies (Heinrich et al., 2022; Kim et al., 2013). An important limitation that arises from this is that some entities are generally difficult to detect because they have an extremely poor prognosis (pancreas or lung cancer, for example). They often cannot be detected in time or followed up quickly enough. This needs to be taken into consideration, especially against the background that the present analyses use the 5-year follow-up (after the GHS' initial enrolment) as a cross-section. This means that we may have missed cases of individuals with cancer between these measurement point. As a result, the findings might be most applicable to the mental health ramifications of cancer entities that are likely to have a better prognosis. Moreover, cancer treatment or treatment-related characteristics were shown to be relevant (Kolva et al., 2020). More research is needed regarding longitudinal studies investigating trajectories of STBs over time in cohorts with different cancer entities, with both smaller intervals of data collection and more specific information on the individual disease or treatment progression. In addition, a more nuanced assessment of suicidal ideation and attempts would yield more valuable information regarding individual differences as well. Lastly, although the present sample was representative of a large age range (from 40 to 80 years), which overlaps with the occurrence of most cases of cancer (and comorbidities) in the population, it did not include adolescents or young adults, although of course cancer can occur at any point throughout the lifespan and a person's age is highly relevant to the experience of the disease and its treatment. Given the peak of suicide attempts in young adulthood (Turecki et al., 2019) and the grave burden associated with cancer in young people (Lang et al., 2015), future studies should aim to include (and compare) the whole lifespan.

4.3. Conclusion

This study adds to the knowledge of the prevalence of STBs in individuals with cancer in the German context and sheds light on further influencing risk and protective factors.

It also underscores the role of contextual factors relating to social inequalities such as financial issues, age, and gender differences. This information is of high practical relevance and could inform both, screening efforts and targeted intervention.

CRediT authorship contribution statement

acquisition. **Manfred E. Beutel:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization. **Mareike Ernst:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Project administration, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. This work is part of the dissertation of the first author.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2024.08.093.

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