Full Title

Cancer as a trauma? Risk factors of posttraumatic stress disorder (PTSD) in cancer survivors

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Abstract

Purpose

Living with cancer is associated with experiencing excessive stress which can consequently trigger posttraumatic stress disorder (PTSD). The present paper examines PTSD and its risk factors in cancer survivors.

Methods

In a sample of cancer survivors (N = 216), we tested 3 path models illustrating PTSD development in the context of psychological distress, occurrence of stressful events, personality traits, perceived cognitive impairment, social support, selected sociodemographic variables, and variables related to cancer treatment.

Results

Two proposed models explained 66% of the PTSD variance and one model explained 73% of the PTSD variance and about one third of the variance of perceived cognitive impairment. Both neuroticism and psychological distress significantly predicted PTSD. Neuroticism predicted PTSD both directly and indirectly via experiencing psychological distress. Particularly, the results suggested that this relationship depends on the time that passed since the person was diagnosed with cancer and also on the history of mental disorders. People lacking social support and those who had a history of mental disorders were significantly more vulnerable to PTSD development.

Conclusions

The findings depict a possible mechanism of PTSD development taking into account different possible combinations of potential risk factors.

Implications for Cancer Survivors

PTSD can be triggered by many distinct factors. Cancer survivors could benefit from having evidence-based information regarding which conditions can considerably contribute to PTSD development.

Keywords

Cancer, PTSD, Neuroticism, Distress, Social Support, Perceived Cognitive Deficits

Introduction

Being diagnosed with a life-threatening illness such as cancer is highly stressful and can be traumatic. Traumatic stress-like reactions (e.g. intrusive thoughts, reactivity to reminders, avoidance) are common for patients with cancer [1]. Research on trauma in cancer survivors has become systematic since medical illnesses (included cancer) were listed in the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), as a potential trigger of PTSD [2]. PTSD is a serious issue in patients with cancer [1, 3-4] with prevalence estimated to be up to 32% [5]. A higher level of psychological distress and the presence of PTSD can be an issue even a long time after the patient has survived cancer [6-7, 40, 44]. PTSD does not develop in every patient with cancer, it has been identified some risk factors of development of PTSD [8, 40, 44]. Surviving other trauma(s) or experiencing permanent stress are the 2 major risk factors for PTSD development [4].

From the perspective of personality traits, a higher level of neuroticism has been shown to be the strongest PTSD predictor [9]. It is also known that people expressing higher levels of neuroticism react on the demanding life events in a less appropriate manner [10] and are more prone to the development of higher levels of distress. Neuroticism also appears to be an important personality trait in managing one's cancer [11]. Patients with higher neuroticism are worse at coping with their situation and experience more psychological as well as somatic difficulties [12].

Cognitive impairment is another variable that is likely to play an important part in PTSD development. We can think of the relationship between cognitive impairment and PTSD from 3 different perspectives: a) cognitive impairment in patients with cancer could occur as a consequence of treatment (especially as a side effect of chemotherapy) when so-called “chemobrain” is present [13]. In this case, we could regard cognitive deficits as a risk factor of PTSD since the pre-existing cognitive impairment increases vulnerability for PTSD development [14]; b) cognitive deficits could mediate the relationship between sudden loss-incurring life events and PTSD, and also the relationship between neuroticism and PTSD. The accumulated stress could impair cognitive functions, for example, by long-term exposure to higher levels of glucocorticoids that are potentially leading to losses in neuronal connections in certain areas of the brain (e.g. hippocampus) [15]. Individuals with higher neuroticism are more prone to experiencing cognitive deficits [16]; c) cognitive deficits are a consequence of PTSD as there exists some evidence that PTSD is associated with a damage in certain parts of the brain (e.g. hippocampus, prefrontal cortex, locus coeruleus) that are known to be related to attention or memory [17].

Higher levels of PTSD were more frequent in women [18-19], individuals with lower social support [18], and individuals who reported the presence of another mental disorder in their personal anamnesis [20] as well as their family history. Lester et al. [26] point out the fact that psychological distress is higher in the early stage of cancer. Likewise, Kangas et al. [18] found that psychological distress in the initial stage of cancer (1 month after being diagnosed) was the best predictor of PTSD development compared to a 6-month interval.

The aim of the study was to examine PTSD in the context of other risk factors. We hypothesize that: a) stressful events, neuroticism and psychological distress will be positive predictors of PTSD; b) the relationship between PTSD and stressful life events and also between PTSD and neuroticism will be mediated by psychological distress; c) the effect of psychological distress on PTSD will be stronger in patients in early stage after diagnosis; d) the effect of stressful life events on PTSD will be stronger in patients with lower social support; e) the effect of psychological distress on PTSD will be stronger in patients with a history of mental disorders. In this context, we hypothesize that perceived cognitive deficits could act as a predictor, mediator and also as an outcome of PTSD.

Methods

Sample and procedure

The questionnaires were administered during 2014-2015 to the cancer survivors in 3 hospitals and 1 cancer support group in Slovakia. Ethical approvals were granted by the ethical committee and management of the hospitals. The research was conducted following the Declaration of Helsinki. Patients confirmed their participation in the study by written informed consent. The questionnaires were administered individually or in groups. Before the administration, we explained the purpose of the research. After completing the questionnaires, we provided the participants with a short debriefing. Inclusion criteria were having 18 and more age, being diagnosed by cancer and being in undergoing cancer treatment or have finished cancer treatment, and being not terminally ill - data collection was not carried out in palliative care unit. There was no the strict selection of cancer survivors by specific type of diagnosis, because we are not aware of any evidence supporting that level of PTSD should be dependent on the specific types of cancer. It seems that for PTSD development in this context, the most important fact is that cancer can be highly stressful and being diagnosed by cancer can be seen as a traumatic event that can trigger PTSD [1].

Selection of cancer survivors

Definition of a cancer survivor is not a consistent. Widely used notion defines cancer survivorship as a process that begins at the moment of diagnosis and continues throughout life [45]. Some definitions see cancer survivors as a person with cancer after post-treatment until the end of life [46]. National Coalition for Cancer Survivorship [47] define cancer survivorship as cancer continuum – living with, through, and beyond a cancer diagnosis. On this continuum, three phases of survivorship can be identified: acute, which refers to the diagnosis and treatment of cancer; extended, related to the period following treatment; and permanent; survivorship as equivalent to complete recovery [48]. Due to our effort to reduce selection bias (range restriction), e.g., [49], we included patients into data collection regardless whether the treatment was finished or not. After excluding the incomplete questionnaires ($N = 22$, in which responses for an entire scale was missing), the sample consisted of 216 cancer survivors. In 3 participants were missing about 5% which was imputed by the expectation-maximization algorithm (EM) method.

Measures

PCL-5-SK (PCL-5 - PTSD Checklist for DSM-5) [21] was one of the main self-reported measures for PTSD screening. The questionnaire consists of 20 items representing 20 DSM-5 symptoms ($\alpha = .922$).

FACT-Cognitive Functions (3rd version) [22] is a self-reported questionnaire focused on subjective evaluation of cognitive functions, their impairments and the impact on quality life in patients with cancer. In this study, the Perceived cognitive deficits subscale (15 items; $\alpha = .958$), was used.

BSSS (The Berlin Scale of Social Support) [23] focuses on cognitive and behavioral aspects of social support, measuring its quantity, type, and function. In this study, the subscale Perceived social support (8 items; $\alpha = .972$), was used.

SCL-90 (Symptom Checklist – 90) [24] is a self-reported questionnaire of psychological and behavioral symptoms. Holi [25] points out that the SCL-90 does not measure persistent personality traits but detects the actual (point-in-time) mental state of the proband. SCL-90 consists of 90 items (symptoms) which measure Global Severity Index (GSI; $\alpha = .977$).

EPQ-R [26] measures 3 personality dimensions: Extraversion, Neuroticism and Psychoticism. In this study, the subscale Neuroticism (12 items; $\alpha = .812$), was used.

Screening for stressful life events consists of a list of 19 events that could trigger an intense stress reaction in a person (e.g. life partner death). The events were selected from a list of stressful and traumatic events [27-28]. For each event, the proband has to indicate whether had or had not experienced the event in the last year. Each marked event is scored by 1 point. Detailed information about measures can be found in supplementary materials.

Statistical analysis

We have tested 3 hypothesized models, all of which consisted of the same variables, but perceived cognitive deficits have had a slightly different role in each model. In all 3 models, PTSD was an outcome and psychological distress was a mediator. Sudden life events and neuroticism were considered as predictors. The time since being diagnosed by cancer, the history of mental disorders, and perceived social support were used as moderating variables, while gender, the stage of the treatment, chemotherapy, and the family history of mental disorders were included as controlled variables. To test which role of perceived cognitive deficits fits the data better, the perceived cognitive deficits were modelled as an independent variable (Model A); as a mediating variable (Model B), and as a dependent variable (Model C). The models were estimated using the WLSMV method. Due to our effort to mitigate range restriction, all participants were included in the analysis. Before testing, the proposed path models were inspected (by Welch t-test or Chi-square test, depending of the type of dependent variable; due to multiple comparisons, p-values were adjusted by Bonferroni correction): a) whether there were any crucial differences between the group recruited from a support group ($N = 27$) compared to others ($N = 189$), in every measured variable included in the path models and also in moderation analyses. No differences between groups in all measured variables (see Table 22 in supplementary materials) were found. Due to the small size of one compared group, the absence of differences in these variables between compared groups was also confirmed by equivalence testing [52] (for results of equivalence testing see The results of TOST in supplementary materials) ; b) whether there were any crucial differences between the group of patients who were less than 6 months after being diagnosed with cancer ($N = 54$; 95% patients were undergoing primary treatment - this group could represent cancer survivors in acute phase of survivorship) and patients who were more than 6 months after being diagnosed with cancer ($N = 162$; 68% patients were after primary treatment; this group could represent cancer survivors in extended phase of survivorship). We found that patients less than 6 months after being diagnosed had lower level of psychological distress ($t = -3.44$, $df = 116.53$, adjusted p-value = 0.004; $d = 0.48$), and slightly higher level of perceived cognitive deficits ($t = 2.77$, $df = 163.7$, adjusted p-value = 0.03, $d = 0.33$). In other compared variables, no differences were found (see Table 24 and the results of TOST in

supplementary materials). Considering these findings, we decided to include in path analysis cancer survivors recruited from a supportive group, and also patients less than 6 months after being diagnosed by cancer. Importance of the findings of differences (between a group of patients less than 6 months after being diagnosed by cancer and group of patients more than 6 months after being diagnosed by cancer) in psychological distress and perceived cognitive deficits and its possible different effect on PTSD will be separately tested on the whole path models by multigroup moderation. The effect of ongoing treatment on PTSD will be also tested in path models. Inclusion of all cancer survivors (thereby increasing N) increases statistical power and also reduces potential selection bias (range restriction). This does not induce bias in estimates and leads to higher generalizability of findings.

When inspecting the mediation effect, we followed the procedure recommended by Baron and Kenny [29]. We used the multi-group moderation method to analyze the effects of the moderators. To define groups for multi-group moderation, we created a dummy variable as we aimed to compare 2 groups of patients – those who had been diagnosed in a period of fewer than 6 months and those who had known their diagnosis for more than 6 months at the time of data collection. The period of 6 months was selected because the period about 6 months seems to be important from point of view of time since trauma for development of PTSD [18], and after 6 months, the patients with cancer are usually after primary treatment and then can be seen as cancer survivors in an extended phase of survivorship. By creating these two groups, we were able to compare our proposed path models in cancer survivors in acute phase survivorship with cancer survivors in an extended phase of survivorship. When we inspected group differences (less than 6 months; from 6 months to 1 year; from 1 year to 2 years; from 2 years to 5 years; more than 5 years) we did not find any differences in PTSD ($F = 3.62$; $p = 0.058$, $df = 214$). On the other hand, if we compared suggested grouping by 6 months periods (less than 6 months; more than 6 months), we found differences in PTSD ($t = 2.29$, $d = 0.37$, $df = 214$). From this point of view, it seems to be important to look at the possible different mechanisms of development of PTSD in the acute phase of survivorship and extended phase of survivorship. The perceived social support was, too, divided into 2 groups according to the median. In the moderation analysis, the differences between the individual non-standardized regression coefficients were analyzed and evaluated by the critical ratio for differences values. The differences were expressed as t-scores [30]. The analytical code and data [39] are available in supplementary materials.

Results

Sample

Out of the whole sample ($N = 216$), 166 cancer survivors were females. Most of the cancer survivors were married (67%) and had a high school education (46.3%). The mean age of the cancer survivors was 56 years (range = 23-81). Approximately 60% of the cancer survivors have had cancer in their family history. About 16% of the cancer survivors have history of mental disorder and 22.2% of the cancer survivors have had a mental disorder in their family history. The sample was heterogeneous from the perspective of type of cancer (22 different types of cancer). The most prevalent diagnosis was breast cancer (89 cases). The exact composition of sample by cancer types can be found in supplementary materials in tables sample characteristics. Most cancer survivors were more than 5 years after being diagnosed by cancer (35%) without cancer relapse (75%). Most of the patients received chemotherapy during cancer treatment (78%) and being hospitalized (86%). For more details see the sample characteristics tables in the supplementary materials.

Descriptive analysis

According to the cut-off score (33 points) [21], the prevalence of PTSD in our study was 14.8% with 50.9% of those patients reported intrusive symptoms, 41.7% avoidance symptoms, 31.5% negative alterations in cognitions and mood changes, and 26.4% reported alterations in arousal and reactivity. Was found that level of PTSD was higher in cancer survivors with history of mental disorder ($n = 34$, $df = 214$, $t = 4.93$, $d = 0.9$) and in cancer survivors who were more than 6 months since being diagnosed by cancer ($n = 162$, $df = 214$, $t = 2.29$, $d = 0.37$). In other sociodemographic, anamnestic and variables related to cancer (e.g. type of treatment, relapse), there were found no significant differences. More detailed descriptive statistics (means, SD, correlation) are presented in the tables in supplementary materials.

Path analysis

The results of path analysis for all the analyzed models are presented in Table 1. Based on chi-square statistics and approximate fit indices, Model C has shown the best fit to the data out of all 3 competing models.

Table 1

Indices of model fit for tested path models of PTSD in cancer survivors (N = 216)

	χ^2	p	df	CFI	TLI	RMSEA [90% CI]	SRMR	AIC	BIC
Model A	27.08	.057	17	.954	.902	.053 [.000 - .088]	.053	7320.6	7415.1
Model B	30.39	.034	18	.943	.886	.057 [.016 - .090]	.060	7358.9	7450.0
Model C	22.54	.258	19	.984	.969	.029 [.000 - .069]	.047	7336.2	7423.9

Note. CFI = comparative fit index; TLI = Tucker Lewis for non-normed fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; AIC = Akaike information criteria; BIC = Bayesian information criteria; method of estimation – WLSMV (Weighted Least Square Mean and Variance); fit indexes – scaled; AIC and BIC were estimated by ML (maximum likelihood) method

Note. Perceived cognitive deficits are scored in reverse order, a higher level means less amount of perceived cognitive deficits (and vice versa); * $p < .05$; ** $p < .01$; *** $p < .001$

Figure 1 Path models of PTSD in cancer survivors (N = 216)

Mediation analysis

The results of the mediation analysis of all analyzed path models are in Table 2. It was found that stressful life events have an indirect effect on PTSD through psychological distress. The effect of neuroticism on PTSD is partially mediated by an increase in the level of psychological distress. These results were stable across all three path models. In Model B, we also tested the mediation effect of perceived cognitive deficits and this effect was not found.

Table 2

Mediation analysis in tested path models of PTSD in cancer survivors (N = 216)

Path	Direct effect without mediator	Direct effect with mediator	Indirect effect	Result
Model A				
SLE→GSI→PTSD	.08(ns)	.03(ns)	.06*	indirect effect
PCD→GSI→PTSD	-.25***	-.07(ns)	-.18***	full mediation
NEURO→GSI→PTSD	.54***	.18*	.37***	partially mediated
Model B				
SLE→GSI→PTSD	.10(ns)	.03(ns)	.07*	indirect effect
NEURO→GSI→PTSD	.63***	.17**	.46***	partially mediated
SLE→PCD→PTSD	.10(ns)	.08(ns)	.01(ns)	no effect
NEURO→PCD→PTSD	.63***	.53***	.10**	partially mediated
Model C				
SLE→GSI→PTSD	.09(ns)	.03(ns)	.07*	indirect effect
NEURO→GSI→PTSD	.71***	.18**	.50***	partially mediated

Note. *p<.05; **p<.01; ***p<.001; ns = non-significant; SLE = stressful life events; GSI = psychological distress; NEURO = neuroticism; PCD = perceived cognitive deficits.

Moderation analysis

In model C, it was found that psychological distress had a stronger effect on PTSD in patients who were less than 6 months since being diagnosed with cancer, compared to patients who were more than 6 months after being diagnosed with cancer. In all models, a significantly weaker effect of stressful life events on PTSD was found in patients with a higher level of perceived social support compared to patients with lower level of

perceived social support. Moderation effect of history of mental disorder was not found. However, in model A and C, a stronger significant effect of neuroticism on PTSD was found in the group of patients with a history of mental disorder, compared to patients without a history of mental disorder. In the same models, we also found weaker effect of psychological distress on PTSD in patients with a history of mental disorder, compared to patients without a history of mental disorder. In the model B, this pattern was not so apparent. These results are in Table 3, detailed results of moderation analyses are in the supplementary materials.

Table 3

Moderation analysis in tested path models of PTSD in cancer survivors (N = 216)

		Compared groups		t-score
		less than 6 months (n = 54)	more than 6 months (n = 162)	
	path	β	β	
Model C	distress → PTSD	.88	.65	-2.32*

		Compared groups		t-score
		lower perceived social support (n = 120)	higher perceived social support (n = 96)	
	path	β	β	
Model A	stressful life events → PTSD	.14	-.16	-3.15**
Model B	stressful life events → PTSD	.13	-.05	-2.86**
Model C	stressful life events → PTSD	.12	-.13	-2.97**

		Compared groups		t-score
		has history of mental disorder (n = 35)	no history of mental disorder (n = 181)	
	path	β	β	
Model A	neuroticism → PTSD	.33	.12	1.23
Model C	neuroticism → PTSD	.35	.09	1.83
Model A	distress → PTSD	.41	.66	-1.88
Model C	distress → PTSD	.60	.75	-1.88

Note. *p<.05; **p<.01; β = standardized regression coefficient

Sensitivity analysis

Due to an absence of consensus in the definition of cancer survivors, we also carried out path analysis in a sample with excluded cancer survivors who did not finished primary treatment (N = 115). These patients were selected according to the current state of treatment – 135 patients were in treatment and 81 patients were after treatment. Among the patients who were in treatment, we selected patients who were in relapses and finally we subset restricted sample of cancer survivors who were

after primary treatment (N = 135). The result of sensitivity analyses can be found in supplementary materials. By sensitivity analysis, we found results similar to the results in the whole sample (e.g., Model C had the best model fit; psychological distress and neuroticism were strong predictors of PTSD, etc.; for more details, look at the results of sensitivity analysis in supplementary materials). Minor differences in regression weights in the models can be due to sampling variation (smaller sample size) and also the results of the sensitivity analysis can be biased because of range restriction. Other downside of this sample selection is that multigroup moderation cannot be carried out because of small sample size in subgroups.

Discussion

In all three models, neuroticism and psychological distress were found to be strong predictors of PTSD. Neuroticism did not affect PTSD only directly but also partially through the increase in the level of psychological distress. In a group of cancer survivors with a lower level of perceived social support, we found a stronger effect of stressful life events on PTSD, compared to patients with a higher level of social support. An indirect effect of a stressful life event mediated by psychological distress was found as well. In the context of perceived cognitive deficits, it was found that PTSD had a significant effect on the perceived cognitive deficits.

We found that cancer survivors with higher neuroticism showed a higher level of symptoms of PTSD. Similar findings were also reported in, e.g. Matsuoka et al. [9]. Individuals with a higher level of neuroticism are more anxious, moody, more prone to depression, are strongly emotional, inadequately respond to all kinds of stimuli, and after an intense emotional experience, they hardly calm down, they also have a more labile autonomic nervous system [26]. This makes them more susceptible to worse stress management [31], and also for having a more intense physiological response to stress [32]. Individuals like these are less able to cope with stressful life situations [10] and therefore, cancer survivors with higher neuroticism show higher levels of psychological distress [13].

Neuroticism, therefore, does not have to affect PTSD only directly but may do so also through its effect on the level of psychological distress, with psychological distress being a strong predictor of PTSD itself [33]. In model C (note: model showing the best fit and the greatest proportion of explained variance of PTSD), we found that psychological distress had a stronger effect on PTSD, in cancer survivors less than 6 months after being diagnosed with cancer. Some authors [18] report that patients experience increased psychological distress,

particularly in the early stages of illness and treatment. Therefore, we could assume that in the early stages after diagnosis, the level of psychological distress could have a greater effect on PTSD. In the same model, a non-significant effect of neuroticism on PTSD was found in the same group of cancer survivors, whereas in a group of cancer survivors more than 6 months after being diagnosed with cancer (extended phase of survivorship), the effect of neuroticism on PTSD was significant. Cancer survivors who are in extended phase of survivorship, PTSD appears to be increasingly affected by largely stable personality characteristics such as neuroticism. However, the moderating effect of time from being diagnosed on the effect of neuroticism on PTSD was not significant and therefore, this interpretation should be taken with a grain of salt.

We have hypothesized that a similar trend (stronger effect of psychological distress on PTSD, rather than the effect of neuroticism on PTSD) will also be present in cancer survivors who have experienced psychological problems in the past [34]. We found that cancer survivors with a history of psychiatric disorders reported significantly higher level of PTSD and significantly higher level of overall psychological distress (see Table 21 in supplementary materials). A stronger effect of psychological distress on PTSD was, however, not found. On the other hand, we found a stronger effect of neuroticism on PTSD in these cancer survivors. It is possibly points to some predispositions for the development of PTSD. Our findings suggest that in cancer survivors with a history of psychiatric disorders, personality traits (such as more persistent characteristics compared to e.g. psychological distress) are more important in the development of PTSD. This finding suggests that in cancer survivors having a history of mental disorder, screening for PTSD should be a routine, as these cancer survivors seem to be more prone to the development of PTSD. Similar to the temporal aspect of the time since the diagnosis of the disease, the moderating effect of the presence of mental illness in the medical history was not significant and therefore no strong conclusions are warranted.

In the context of social support, several authors [18] have found that low level of social support is associated with the development of PTSD. In our research, we found that lower social support makes the effect of stressful life events on PTSD stronger. The direct effect of stressful life events on PTSD has been hypothesized based on several findings [18]. But this effect was detected only if the subjects were low in social support. If cancer survivors do not perceive the sufficient availability of social support, then stressful life events may be more prone to trigger the development of PTSD.

Several authors point out that cognitive deficits occur in cancer survivors as a result of treatment [13]. In this case, cognitive deficits may pose a risk factor for the development of PTSD [14]. We did not find a direct

effect of perceived cognitive deficits on PTSD. The effect of perceived cognitive deficits on PTSD was fully mediated through psychological distress. Moreover, perceived cognitive deficits have not been found to act as a significant mediator of the impact of sudden life events and neuroticism on PTSD. Perceived cognitive deficits could more likely be present as a result of PTSD, as we found that the level of PTSD affected the level of perceived cognitive deficits. One has to be careful with the interpretation of the effect of cancer treatment on cognitive deficits because we did not examine a particular type of treatment and we assumed that different types of cancer treatment may have a different effect on structural changes in specific parts of the brain. On the contrary, in case of PTSD, we can say that the structural changes and disturbances of the hippocampus, OFC (orbitofrontal cortex), and locus coeruleus have been relatively stable so far. The disruption of these structures is directly reflected in the deficient functioning of selected cognitive functions (especially memory and attention). The incidence of cognitive deficits in cancer survivors due to PTSD is also indicated [35].

Limitations and Implication for practice

Our study also has some limitations, mainly concerning the testing procedure. Conditions for the collection of research data was not entirely uniform for all cancer survivors. For example, in a few patients, data was collected during outpatient chemotherapy. These patients were selected by physicians or nurses, and they were patients who did not take aggressive chemotherapy and who did not take benzodiazepines to ensure that patients will be able to pay attention during data collection but regardless to this, in this condition, patients may have had an increased level of distress, which could affect some responses to some items. The length of the questionnaire battery in our research can be seen as an additional limitation, since the length of testing combined with not ideal testing conditions may have caused fatigue and some loss of attention in some cancer survivors. The heterogeneity of cancer survivors in terms of different types of cancer and in terms of different phases of survivorship has reduced the internal validity of the research, but on the other hand, it has increased the ecological validity of the research, as the results obtained from different types of cancer allow a greater generalization of the results. In this context, there is no evidence that the level of PTSD in cancer survivors should depend on the type of cancer. It seems that in the meaning of psychotraumatology, the important thing in itself is that cancer is a severe illness in which the cancer survivors have an intense experiencing that their life is threatened. However, this would need to be verified in further research. According to our findings, it seems that these variables do not have such a major impact on the level of PTSD symptoms. Additionally, with no strict selection by specific type of cancer and also by a specific phase of cancer survivorship, the range restriction issue (selection bias) can be mitigated. Range restriction can be often present in a more homogeneous sample. A

homogeneous sample represents a sample taken from the population. For such a sample the standard deviation tends to be smaller than in for the entire population [49-50]. Range restriction can also be a problem in correlation research because correlation coefficients in the restricted sample are usually (significantly) lower than they would have been, when sampling from the entire population [51]. In the context of our study, range restriction could be caused if we sampled or analyzed a subset of the entire population based on specific type of cancer diagnosis or specific phase of cancer survivorship. Despite stated limitations, our research findings could inform both the research and the practice.

In the context of prevention of PTSD development, our findings may suggest that cancer survivors who are a less than 6 months after being diagnosed by cancer (acute phase of survivorship), should be encouraged to include more interventions that are more focused on reducing current psychological distress, as prevention of PTSD development. In cancer survivors who are more than 6 months after being diagnosed by cancer (extended phase of survivorship), it could be appropriate to include intervention strategies that focus on the patient's personality (e.g. to reduce negative effect of neuroticism). In cancer survivors, the intervention could be designed to provide social support (e.g. through support groups) but also improve coping strategies, to teach them to effectively seek social support. This could be a protective factor of PTSD development and also reduce the effect of other stressful events on PTSD in these cancer survivors. Regarding the issue of cognitive deficits in PTSD, there is a space for the implementation of various cognitive programs focused on, e.g. memory or attention training. Cognitive functions could also be improved through various CBT procedures, cognitive training, or neurofeedback therapy. Improving individual cognitive functions could prove helpful in the process of consolidating traumatic experiences and memories.

Despite its prevalence, post-traumatic stress disorder is a scarcely discussed issue which cancer survivors have to face. Since cancer-related PTSD can have various predictors, cancer survivors would greatly benefit from an evidence-based knowledge about the specific set of cancer-related conditions that can be related to PTSD, e.g., for the purpose of which form of intervention could be more suitable to choose given the specific set of conditions. For patients who are shortly after being diagnosed by cancer, the interventions focused on reducing currently experienced psychological distress can be more suitable. On the other hand, for patients who are aware of their cancer for a longer time, individual psychotherapy focused on the regulation of selected personality traits can be more effective. The fact that higher social support is usually a protective factor for the impact of other stressful events on cancer-related PTSD, can encourage cancer survivors to seek social support in, for instance, relatives, friends, caregivers, or cancer support groups. Last but not least, being informed that

perceived cognitive impairment can be caused by PTSD could reduce the related anxiety of cancer survivors. Nonetheless, this assumption needs to be further supported by additional research on this topic. In summary, we recommend cancer survivors who perceive cognitive decline to seek interventions focused on stress reduction. Relieving cancer-related stress can improve the perceived cognitive impairment. Having cognitive abilities back to normal could be helpful not only for better handling of daily activities but also for improved coping with cancer as a traumatic experience – for example, by reconsolidating traumatic memories related to cancer.

Conclusions

Cancer survivors can suffer from several psychosocial symptoms [41] a long time after being diagnosed by cancer, and PTSD can be one of these issues [6-7, 40, 44]. Our findings may elucidate possible different mechanisms of PTSD development given different combinations of individual risk factors, offering not only new possibilities to explore in future research but also leading to practical knowledge. The reduction of cancer survivor's stress can improve emotional well-being and quality of life [42-44]. Findings about the PTSD development in cancer survivors depending on various factors is important not only because the presence of PTSD decrease the quality of life of these patients [3]. It is also important because of the high comorbidity with other disorders, especially depression [36]. Last but not least, cancer survivors with PTSD may exhibit dysregulated stress response, which could have an adverse effect on the immune system [37-38]. The presence of PTSD in cancer survivors in ongoing treatment could thus have a direct negative impact on cancer treatment.

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Conflict of interest

Authors declare no conflict of interest.

Compliance with ethical standards

Ethical approvals were granted by the ethical committee and management of the hospitals (Ethical approval number: 56/EK/2014)

Supplementary materials

Data, analytical script, additional tables and descriptions can be found at:

https://osf.io/n6vg8/?view_only=746a169833fc461fb47d6d9fcd63b2aa

Note

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