Relationships between satisfaction with life, posttraumatic growth, coping strategies, and resilience in cancer survivors: A network analysis approach

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Please note that this version of the manuscript has not been peer reviewed.

Conflict of interests

None.

Data availability statement

Data and analytic code are freely available at <https://osf.io/9dsve/>.

Acknowledgements

This study is part of project “Integrative strategy in development of personalized medicine of selected malign oncological diseases and its effect on the quality of life” funded by Ministry of Transport and Construction of the Slovak Republic [contract no. 313011V446]. This work was also supported by Slovak Research and Development Agency [contract nos. APVV-17-0418 and APVV-20-0319] and by Research Grant Agency of Ministry of Education, Science, Research and Sport of the Slovak Republic and Slovak Academy of Science [contract no. VEGA 1/0305/18].

Abstract

Objective: Cancer survivors' satisfaction with life should be seen through the psychological factors related to a person's capabilities to face and handle the situation. This study aimed to (1) examine the relationships of satisfaction with life, posttraumatic growth, resilience and coping strategies in a global network model, (2) find the bridge indicators between satisfaction with life and the other constructs, and (3) test for the invariance of the network structures across several moderating variables.

Methods: In a heterogeneous sample of 696 cancer survivors (69% female; mean age = 53.1 ± 15.44 years; median time from being diagnosed = 4 years; breast cancer was the most frequent type of cancer) their satisfaction with life, resilience, coping strategies and posttraumatic growth was measured. In order to account for their complexity, the relationships between the constructs were explored using a network analysis approach.

Results: The network analysis shows that satisfaction with life is strongly connected to resilience, moderately connected to coping strategies, and has a weak connection with posttraumatic growth. In the separate networks, the relationships between the psychological constructs were examined in greater detail. Besides some exceptions observed in the invalidity percentage, the networks were invariant across gender, age, years since being diagnosed, cancer type and treatment type.

Conclusion: The findings suggest that interventions focused on survivors' coping strategies and resilience could help increase their satisfaction with life. However, further replication of the proposed network analysis is needed.

Keywords: bridge indicators, cancer, cancer survivors, coping strategies, network analysis, oncology, oncology survivors, posttraumatic growth, resilience, satisfaction with life

Background

Cancer causes significant changes in a patient's quality of life and subjectively experienced satisfaction with life (SWL). Cancer survivors experience a variety of physical and psychological effects as the result of cancer. These play an important role during treatment and should be considered in the process of health care provision.¹ With respect to health conditions and illness, subjectivity and individual satisfaction should not be neglected. In the case of cancer survivors, it is therefore important to study and describe the relationship between SWL and other psychological constructs in detail², as well as to explore their structure.

A cancer diagnosis is likely to increase psychological distress.³ For some people, the diagnosis is traumatic and could consequently trigger posttraumatic reactions. However, these are not necessarily negative reactions and can also result in positive changes in one's life.⁴ The presence of cancer can result in an improvement in some areas of a survivor's life referred to as posttraumatic growth (PTG). PTG means development in various areas of life such as relating to others, new possibilities, personal strength, spirituality, and appreciation of life and has been widely studied among cancer patients and cancer survivors.^{5,6}

An important role in the process of managing a cancer situation is the level of resilience of an individual. This can be defined as the ability to withstand difficult circumstances.⁷ A positive relationship has been documented between resilience and quality of life.⁸ The level of resilience is also related to the coping strategies that the person uses to deal with the difficult situation. For the process of resilience development, the use of active coping strategies is important. These are also known as solution-oriented strategies or cognitive coping strategies (e.g., acceptance, attempt to reformulate the situation or a humorous approach). This can also result in an increased SWL.⁹ Conversely, the use of avoidant coping strategies is not only associated with lower PTG, but also with a lower quality of life.¹⁰

It can be assumed that the constructs described above form an interconnected network of relationships. The constructs as well as the relationships between them could vary in cancer survivors due to several moderating factors. For example, a significant predictor of PTG is the time that it has been since the diagnosis. This might be because a certain level of distress is needed for PTG to develop. Such levels of distress are present during the diagnosis, particularly at the beginning of treatment as well as at the end.⁹ A longer time since diagnosis is associated with the well-being of survivors with higher PTG levels.¹¹ In addition to the level of distress,

age and gender also correlate with PTG in cancer patients.¹² Quality of life is influenced by the type of cancer (see supplementary material in¹³), the stage of cancer¹⁴ and the method of treatment.¹⁵

SWL, PTG, coping strategies and resilience are closely related and causally affect each other. However, the detailed mechanisms are not known and the findings can often be ambiguous or contradictory. Most research has either focused on the binary relationships between these variables or tests mediation models while there has been little attention paid to the interconnection structure of these variables. The aim of this study is to (1) explore and describe in detail the interconnection between these constructs (at the level of aspects of the individual constructs, not at the level of the constructs themselves), (2) identify which variables (bridge indicators) play the most important role in interconnecting these constructs, and (3) how the relationships between the constructs are moderated by variables such as gender, age, length since diagnosis of disease, percentage of disability, type of cancer and method of treatment.

Network analysis and bridge indicators

The network approach to psychological constructs has become widely popular in recent years, especially in the field of psychopathology.¹⁶ In this approach, a psychological construct is not conceptualized as a latent variable causing the observable behavior. Rather, the indicators of the construct are viewed as independent but mutually interacting entities and the construct emerges because of these indicators. The network approach thus allows one to study a selected construct in its complexity and reveal its structure and dynamics.¹⁷ As such, it shows what the relationships between the indicators are (conditional on all other indicators in the network), which indicators of the constructs are central/peripheral, as well as how well an indicator connects the other indicators in the network. In the network analysis, several constructs can be modelled within one network (of course, as in all other statistical models, the inference is only valid if the model involves all causally relevant variables). If a network involves several constructs, it might be of interest to study how these constructs are connected and see which indicators of the constructs are either (1) overlapping or (2) non-overlapping but still play an important part in connecting the constructs.¹⁸ In psychopathology, such indicators are called bridge symptoms.¹⁹ In this paper, the term “bridge indicators” will be used as the research focuses on constructs that do not represent psychopathology. In a similar way to the established centrality/connectivity measures,²⁰ the methods have been developed to examine how well an

indicator connects two constructs within a network.²¹ Given the aims of this study, (1) a global network comprising SWL, PTG, coping strategies, and resilience will be estimated, (2) the networks of SWL and one of the other constructs will be estimated and the bridge indicators between SWL and the other construct examined in detail, and (3) the invariance of the estimated networks will be tested across several moderators.

Methods

Participants and data collection procedure

Based on a recent systematic review,²² cancer survivorship is defined in this paper as a process that starts with a cancer diagnosis and continues throughout one's life. The following inclusion criteria were applied: being 18 or older, having been diagnosed with cancer, not having a severe mental health or physical condition and not being terminally ill. The participants were recruited in cooperation with the Slovak National Oncological Center (NOU), oncological clinics and from cancer support groups. The ethical permission was granted by the Ethical Committee at Trnava University, the National Cancer Institute and the hospital management. The research was carried out according to the Declaration of Helsinki. The present study is part of the project "Cognitive-existential profile and specifics of posttraumatic growth in cancer survivors" (<https://osf.io/gj3zc/>). The data was collected throughout 2019 and 2020.

After excluding participants with more than 80% missing data, the effective sample consisted of 696 cancer survivors. Sixty-seven percent of the participants were women. The mean age of the sample was 53.1 ± 15.44 , with participants ranging from 18 to 93 years old. Seventy percent of the participants were either married or in a relationship. About 52% of the participants had finished high school and about 32% had a university degree. Thirty percent of the participants had a job (at least a part-time job), 26% were on a disablement pension while 32% were retired. The remaining participants were either unemployed, students or on maternity leave.

The time since the diagnosis ranged from a few months to 58 years, with the median time being equal to 4 years. The most frequent diagnosis was breast cancer (30.3%). Five percent of the participants had had two or more types of cancer. The mean time since finishing treatment was 2.95 years (SD = 4.98). Almost 18% of the participants had experienced at least one relapse. About 65% of the participants had undergone a combination of three or more types of medical treatment. As much as 40% of the participants (N = 274) indicated that they had had experience

with cancer support groups. Out of those, 40% continued to visit cancer support groups even after they had finished treatment.

Measures

This section outlines the list of measures that were used in the current data collection. Each of the measures has been used in previous studies with cancer survivors.^{23–26} In order to make the study easier to read, abbreviations are used when referring to items (lower case) or factors (upper case) of the corresponding constructs.

Satisfaction with life (SWL) was measured using the Satisfaction with Life Scale (SWLS).²⁷ It is a 5-item scale (referred to here as swl1 - swl5), respectively: swl1 - life close to ideal, swl2 - conditions of life are excellent, swl3 - satisfied with life, swl4 - gotten the important things in life, swl5 - living life again, nothing would be changed. SWLS assesses an individual's global judgment regarding their life satisfaction. Participants were asked to indicate their level of agreement with the statements on a seven-point Likert-type scale ranging from 1 = "strongly disagree" to 7 = "strongly agree".

Posttraumatic growth (PTG) was measured by the Posttraumatic Growth Inventory (PTGI)²⁸ which includes 21 items. Each item is rated on a 6-point Likert scale, with values ranging from 0 = "I did not experience this change as a result of my crisis" to 5 = "I experienced this change to a very great degree as a result of my crisis". The PTGI consists of five subscales (referred to here as PTG1 - PTG5), respectively: PTG1 Relating to Others (7 items), PTG2 New Possibilities (5 items), PTG3 Personal Strength (4 items), PTG4 Spirituality (2 items), and PTG5 Appreciation of Life (3 items).

Coping strategies (COP) were measured by the Mini-Mental Adjustment to Cancer Scale (Mini-MAC).²⁹ This is a self-report 29-item instrument for evaluating five cancer-specific coping strategies (referred to here as COP1 - COP5), respectively: COP1 Helplessness-Hopelessness (8 items, reversed), COP2 Anxious preoccupation (8 items, reversed), COP3 Fighting spirit (4 items), COP4 Cognitive avoidance (4 items), and COP5 Fatalism (5 items). Each item is rated on a 4-point scale ranging from 1 = "Definitely does not apply to me" to 4 = "Definitely applies to me".

Resilience (RES) was measured using the Brief Resilience Scale (BRS).³⁰ The BRS consists of six items and measures resilience as the ability to recover from a stressful event (referred to here as res1-res6), respectively: res1 - bounce back after hard times, res2 - hard time making it through stressful events, res3 - recovery from a stressful event, res4 - hard to snap back when something bad happens, res5 - difficult times with little trouble, res6 - getting over setbacks in my life. Participants were asked to indicate their level of agreement with the statements on a five-point Likert-type scale ranging from 1 = strongly disagree to 5 = strongly agree.

Statistical analysis

First, the descriptive statistics and correlation matrix were examined. None of the analyzed observations were treated as outliers since all the observed data points could theoretically represent the distribution of the respective constructs in the population. The reverse-coded items were recoded as stated in the respective manuals. No further data transformation was applied. The missing data related to the scales (about 1%) were imputed using a regression-based imputation method and the reliabilities of the measured scales and subscales then calculated. As all the reliabilities were sufficiently high, a sum score was computed for each subscale. As part of the descriptive process, the observed scores were compared with the scores obtained from different studies in the general Slovak population that had used the same measures. In order to answer the research questions, the following network models were estimated: a) a global network combining the items of the SWLS, the five factors of the PTGI, the items of the BRS and the five factors of the Mini-MAC. It should be noted that the factors were used to make the structure of the network easier to interpret (reducing the number of nodes in the network substantially while capturing the relevant aspects of the constructs). To take a more detailed look at the networks involving satisfaction with life and one of the other constructs, the following were subsequently estimated; b) a network including the items of the SWLS and the items of PTGI; c) a network including the items of the SWLS and the items of BRS; and d) a network including the items of SWLS and the items of Mini-MAC. To examine exactly how the constructs are interconnected, the average weight of all the edges was calculated (in their absolute values) connecting the two constructs. Additionally, a latent network model and a structural model, in which the correlations between the latent factors were allowed, were computed. The networks were estimated using the EBICglasso estimator. In order to reduce the possibility of finding spurious correlations, the tuning parameters were set to produce sparse networks. Given the aims of the research, the focus was specifically on the

bridge variables and their centrality, following the method of Jones et al.²¹ To examine how the networks differ across the subgroups (based on gender, age, time since being diagnosed, type of cancer, type of treatment, invalidity), the networks for the subgroups were compared (a median split was used for the continual variables) using a Network comparison test.³¹ The networks were estimated in R, using the bootnet package.²⁰

Results

The descriptive characteristics of the scales including their reliability and comparison of the scores with the general Slovak population (the data were obtained from³²), is available in Table 1. A bivariate as well as a partial correlation matrix of the items/scales can be found in the supplementary materials at <https://osf.io/hfmaz/>.

Table 1. Descriptive statistics and reliabilities of the scales

	M	SD	Skewness	Kurtosis	ω_{total}	Comparison with general population (Hedges' g)
SWL	4.46	1.34	-0.44	-0.42	.90	0.22
RES	3.12	0.77	-0.10	-0.27	.85	0.01
COP1	3.01	0.82	-0.81	-0.18	.95	-
COP2	2.69	0.74	-0.18	-0.61	.90	-
COP3	2.95	0.72	-0.72	0.11	.80	-
COP4	2.91	0.72	-0.55	0.03	.81	-
COP5	2.93	0.66	-0.62	0.09	.78	-
PTG1	3.07	1.25	-0.61	-0.36	.92	0.70
PTG2	2.56	1.29	-0.09	0.83	.88	0.29
PTG3	2.97	1.29	-0.45	-0.52	.87	0.51
PTG4	2.53	1.71	-0.14	-1.26	.89	0.48
PTG5	3.56	1.28	-0.95	0.30	.86	0.81

Note: SWL = satisfaction with life; RES = resilience; COP1 – COP5 = factors of coping; PTG1 – PTG5 = factors of posttraumatic growth

Given the complexity of the network approach, it is only the main findings that will be highlighted. All the data, code and additional outputs are available in the supplementary materials at <https://osf.io/9dsve/>.

The first aim of the study was to explore and describe in detail the relationship between four psychological constructs. The network analyses revealed the following patterns: a global network comprising SWL, PTG, RES and COP has shown that the indicators of satisfaction with life are most strongly connected to the indicators of resilience, whereas there is virtually no connection between the indicators of PTG and satisfaction with life (see Figure 1). These results have been conceptually confirmed by the latent network model, in which the correlations between satisfaction with life, resilience, coping, and PTG were .42, .27, and .12, respectively. In this global network, satisfaction with life (swl3), quick recovery after a difficult situation (res1), difficulty to cope with stressful situations (res2) and anxious preoccupation (COP4) served as the bridge indicators. The second aim of the study was to identify which variables (bridge indicators) play the most important role in bridging the four psychological constructs. When a closer look was taken at how satisfaction with life was connected with each of the other three constructs (in separate networks; see Figures 1a, 1b, 1c), the following results were observed: satisfaction with life and PTG were linked through personal strength (PTG3) and life acceptance (swl5). Satisfaction with life and coping were mostly connected by life acceptance (swl5) and anxious preoccupation (COP4). Life satisfaction per se (swl3) and life acceptance (swl5) were found to be the strongest bridge indicators linking satisfaction with life and resilience. The third aim of the study was to identify how the relationships between the constructs are moderated by selected variables (e.g., gender, age, invalidity percentage, etc.). When the network invariance was tested across the moderating variables, it was found (with some exceptions in percentage of invalidity), that the networks were invariant across gender, age, years since being diagnosed with cancer, invalidity percentage, cancer type and treatment type number. The exact results can be seen in Table 2.

Figure 1. Visualization of the networks

A) A global network of satisfaction with life, posttraumatic growth, resilience, and coping strategies

B) A separate network of satisfaction with life and posttraumatic growth

C) A separate network of satisfaction with life and coping strategies

D. A separate network of satisfaction with life and resilience

Abbreviations: *swl* and *res* = the items of the SWLS and BRS scales. *PTG1* = Relating to others, *PTG2* = New possibilities, *PTG3* = personal strength, *PTG4* = Spirituality, *PTG5* = Appreciation of life, *COP1* = Helplessness, *COP2* = Anxious preoccupation, *COP3* = Fighting spirit, *COP4* = Cognitive avoidance, *COP5* = Fatalism; for more information see the measures section.

Table 2. Network invariance across the moderating variables

Moderating variable	Network	Network invariance test (p-value)	Global strength invariance test (p-value)
Gender (women; men)	SWL x RES	.623	.724
	SWL x COP	.168	.904
	SWL x PTG	.510	.600
Age (≤ 54 ; > 54)	SWL x RES	.553	.346
	SWL x COP	.294	.147
	SWL x PTG	.230	.700
Years from diagnosis (< 4 ; ≥ 4)	SWL x RES	.643	.438
	SWL x COP	.359	.135
	SWL x PTG	.570	.150
Invalidity percentage ($< 40\%$; $\geq 40\%$)	SWL x RES	.233	.016
	SWL x COP	.023	.923
	SWL x PTG	.220	.210
Cancer type (Breast and ovarian; other)	SWL x RES	.998	.169
	SWL x COP	.958	.824
	SWL x PTG	.980	.180
Treatment (< 3 types; ≥ 3 types)	SWL x RES	.999	.176
	SWL x COP	.949	.840
	SWL x PTG	.970	.230

Note: SWL = satisfaction with life; RES = resilience; COP = coping; PTG = posttraumatic growth

Discussion

The presented results corroborate the previous literature,⁷ which has suggested a significant relationship between quality of life and resilience in cancer survivors. In other words, a person's resilience promotes positive attitudes towards their own life in the long run. In line with Polański et al.,²³ the current results also indicate that to a considerable extent, life satisfaction is decreased by negative coping strategies. As such, either decreasing destructive or increasing constructive coping strategies could be expected to have a positive effect on one's life satisfaction. From the constructive coping strategies, cancer survivors tend to have high levels of fighting spirit and positive redefinition.^{33,34} This could partially explain the higher observed levels of life satisfaction compared to the general population. However, neither the global network nor the dyadic networks in the presented results have fully supported this argument. Constructive coping strategies were not linked with life satisfaction the most. Rather, anxious preoccupation was found to be the strongest bridge indicator. While it would be assumed that PTG should be strongly associated with life satisfaction, the findings in samples of cancer patients have been ambiguous with a heterogeneity usually caused by the stage of cancer.^{12,35} Shand et al.¹⁰ found that a deteriorated QoL was correlated with lower Personal Strength (a factor of PTG) as well as with the usage of avoidant coping strategies. QoL increased in survivors when they accepted their life circumstances and used cognitive coping strategies.⁹ In this case, resilience could serve as a protective factor that mediates the effect of active coping on QoL.¹⁴ However, further research is needed to understand the relationship (and causality) between coping strategies and resilience better.

The observed relationships between the constructs were invariant across the whole spectrum of potentially moderating variables except for the percentage of invalidity. Joshy et al.³⁶ has provided evidence that QoL decreases with an increase in limitations to physical functioning. The authors further demonstrated that physical disability is a key determinant of psychological distress and deteriorated quality of life. The current findings support this claim as the percentage of invalidity was found to be a significant moderator of the relationship between satisfaction with life and coping strategies in cancer survivors. The potential differences in the observed relationships could stem from the stage of cancer. However, such data was not at our disposal in the present study.

Study limitations

The study has several caveats. (1) The present network analysis is of an exploratory nature and thus the results are needed to be replicated on other samples of cancer survivors. (2) The study has a cross-sectional design and, as such, does not capture the intrapersonal dynamic of the relationships in time. (3) Given the heterogeneity of the sample, it is likely that the findings could be further shaped by some factors which were not able to be controlled or were not focused on in the survey (e.g., the stage of cancer). However, the invariance testing indicates that the observed relationships were invariant across different moderating variables. (4) The SWLS assesses the most general level of life satisfaction. For more precise inferences, it would be helpful to focus on the specific domains of quality of life. (5) The retrospective evaluation of PTG could be biased by social desirability or participants' motivation to perceive growth. The participants could thus report a growth but this might not necessarily reflect the truth.³⁷

Clinical implications

Based on the observed relationships, there are several clinical implications for psycho-oncological practice:

1. Both satisfaction with life and PTG could be fostered by interventions that focus on coping strategies adopted by cancer survivors. In particular, the interventions should aim to develop more constructive coping strategies, support a positive adjustment to the situation and reinforce the internal sources of coping.
2. Since resilience serves as a protective factor for mental health (especially in stressful circumstances and at times of personal crisis), a systematic training of resilience could also help to increase life satisfaction and PTG.
3. A closer look at the specific domains of a survivor's quality of life could reveal where they experience the most severe imbalances between personal expectations and current life conditions and where they might need particular psychological or social support.

The quality of life of cancer survivors could greatly benefit from having sufficient psychological therapy from psycho-oncologists and also from supportive survivor groups. For higher efficiency, psycho-oncological support should ideally also include the survivor's closest family and friends. Furthermore, psycho-social support should continue even after the medical treatment is finished, although this is often absent in practice.

Conclusion

The present study offers a unique view of the structure and relationships between four psychological constructs - satisfaction with life, posttraumatic growth, coping, and resilience - that are highly relevant for understanding how cancer survivors fare in their situation. The results of the network analyses (both the global network as well as the separate networks) suggest that psychological interventions aimed at increasing the satisfaction with life of cancer survivors could benefit from focusing on the development of constructive coping strategies and reinforcement of resilience. Given the exploratory nature of this study, both further replications and studies with repeated-measures designs are needed. Moreover, it would be beneficial to add other psychological constructs into the network analysis to deepen the understanding of the relationship complexity between them.

Author contributions (CRediT taxonomy)

MA: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing; DF: Conceptualization, Funding acquisition, Investigation, Project administration, Writing – original draft, Writing – review & editing; MK: Conceptualization, Funding acquisition, Investigation, Writing – original draft, Writing – review & editing; MB: Conceptualization, Funding acquisition, Investigation, Writing – original draft, Writing – review & editing; DH: Conceptualization, Investigation, Writing – original draft, Writing – review & editing; GB: Conceptualization, Data curation, Funding acquisition, Investigation, Resources, Writing – review & editing, MD: Funding acquisition, Resources, Writing – review & editing; IP: Conceptualization, Funding acquisition, Investigation, Project administration, Writing – original draft, Writing – review & editing.

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