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The impact of cancer and quality of life for post-treatment non-Hodgkin lymphoma survivors

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Abstract

Objective—Recent work suggests that perceptions of the impact of cancer on survivors' lives are associated with physical and mental health and quality of life (QOL) outcomes. This study examines the association between the Impact of Cancer version 2 scales (IOCv2) and these outcomes in a large sample of survivors of adult non-Hodgkin lymphoma (NHL).

Methods—Participants completed a mailed survey to assess physical and mental health (SF-36), cancer-specific quality of life (FACT-G) and perceived impact of cancer (IOCv2). Hierarchical multiple regression models, in which demographic, clinical, psychosocial and IOCv2 measures were added sequentially, were employed to evaluate their contribution to explaining variance in SF-36 and FACT-G scores.

Results—A total of 652 post-treatment NHL survivors participated. Survivors with comorbidities and negative appraisals of life threat and treatment intensity reported worse physical and mental health and QOL (all $P<.05$). After controlling for demographic and clinical characteristics, younger respondents reported better physical but worse mental health and QOL (all $P<.01$). Lower IOCv2 Negative Impact (all $P<.001$) and higher Positive Impact (all $P<.05$) scores were associated with better physical and mental health and QOL after controlling for demographic, clinical and psychosocial characteristics.

Conclusions—Findings suggest that perceptions of cancer's impact on survivors' lives may influence or be influenced by health status and functioning and QOL. Longitudinal research is needed to establish causality, which could lead to the development of interventions targeting survivors' impact of cancer concerns, and ultimately to the enhancement of overall health and QOL.

Keywords

Quality of life; health status; non-Hodgkin lymphoma; psychosocial oncology; cancer survivors

INTRODUCTION

The National Cancer Institute [1] estimates that there are 11.4 million cancer survivors in the US, representing about 3.8 percent of the population. Coinciding with this growing

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population is an increased interest in the quality of life (QOL) of individuals living long-term with a history of cancer. Studies have shown that younger age [2-4], lower income [5-7], and less education [3,8] and social support [3,6,8], for example, are associated with psychological distress and/or poorer QOL in adult cancer survivors. In addition, clinical characteristics such as time since diagnosis [3,9], comorbidity [3,7] and chemotherapy treatment [9,10] have been associated with QOL-related outcomes in cancer survivor samples.

Recent work suggests that positive and negative perceptions of the impact of cancer on health and well-being are also associated with physical and mental health functioning and QOL outcomes [11]. These associations have been observed in a mixed cancer survivor sample using an 81-item instrument, the Impact of Cancer (IOC), designed specifically to measure the unique issues (notably, both positive and negative impacts of cancer) associated with long-term survivorship [12]. Studies that employed the IOC stand in contrast to many other survivorship studies to date, which have largely focused on pathological or negative responses (e.g., depression and anxiety), identified through the use of general and cancer-related QOL instruments.

A refined and shortened version of the IOC instrument, the 47-item IOCv2, was recently validated in breast cancer survivors [13] and found to be robust in non-Hodgkin lymphoma (NHL) survivors [14]. With the availability of a large sample of off-treatment survivors of NHL, in this paper we assessed the contribution of survivors' perceptions of the positive and negative impacts of cancer as measured by the IOCv2 scales to explaining QOL-related outcomes.

MATERIALS AND METHODS

Participants and Procedures

Patients were eligible if they were diagnosed with adult NHL (≥19 years old), ≥2 years post-diagnosis, and currently off-treatment and in remission or cured. The Duke Cancer Center and University of North Carolina Lineberger Tumor Registries were used to identify potential participants following approval by their Institutional Review Boards. Prospective subjects were mailed a package which included a consent form, letter of introduction from their oncologist, and self-administered questionnaire; a $2 bill was provided as an incentive. Non-respondents were sent replacement mailings and later telephoned to confirm receipt of the mailed survey.

Measures

Demographic and Clinical Characteristics—Demographic and clinical characteristics were self-reported by participants. Histology was categorized as indolent or aggressive based on the REAL/WHO classification system [15]. A 12-item self-report version of the Charlson Index (Self-administered Co-morbidity Questionnaire) was used to assess other health-related problems [16].

Psychosocial Characteristics—The 20-item Medical Outcomes Study-Social Support Survey (MOS-SSS) measures perceived availability of social support [17] and has been used in various populations, including long-term breast cancer survivors [6,8]. The seven-item Appraisal of Life Threat and Treatment Intensity Questionnaire (ALTTIQ) assesses the extent to which cancer and its treatment are perceived to be life-threatening and intense in the past and currently [18]. A 24-item instrument developed by the CALGB clinical research group (TOTRELAT) [19] was used to assess cancer-related employment and insurance-related issues.

Impact of Cancer—The IOCv2 was used to measure perceptions of positive and negative impacts of cancer on aspects of the survivors' lives. The IOCv2 uses 37 items to measure four positive (Altruism/Empathy, Health Awareness, Meaning of Cancer, and Positive Self-Evaluation) and four negative (Appearance Concerns, Body Change Concerns, Life Interferences, and Worry) subscales, which total to two summary scores (Positive and Negative Impact) [14]. Development of the IOC was spurred by the need to measure aspects of survivorship not addressed by existing QOL measures, such as health-related worries and post-traumatic growth [12]. In this study, internal consistency for the Positive and Negative Impact summary scores were α=0.90 and 0.91, respectively. Higher scores on the Positive Impact indicate greater positive impacts, while higher scores on the Negative Impact indicate greater negative impacts. Correlation coefficients for the IOCv2 subscales and the outcome measures used in this study are reported elsewhere [14].

Health Status and QOL Outcomes—A general health measure, the Medical Outcomes Study (MOS) SF-36, was used to assess physical and mental health status and functioning. The 36 items represent eight sub-scales (physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role-limitations due to emotional problems, and mental health) and two summary scores, the physical component (PCS) and the mental component (MCS) [20]. The 27-item Functional Assessment of Cancer Therapy (FACT-G) was used to assess cancer-specific QOL. The FACT-G contains four subscales (physical, social/family, emotional, and functional well-being) which may be summed to produce a total score [21].

Statistical methods

Bivariate analyses (t-tests, analysis of variance) compared mean values of the outcome measures (PCS, MCS, FACT-G) and IOCv2 Positive and Negative Impact Summary scores by demographic and clinical characteristics. Pearson correlations were calculated between the outcome measures and IOCv2 summary scores and all continuous covariates. Hierarchical multiple regression models in which sets of covariates were added sequentially were employed to evaluate their contribution to explaining variance in PCS, MCS and FACT-G scores, yielding a series of five regression models for each outcome variable. Model 1 included demographic characteristics, Model 2 added clinical variables, Model 3 added psychosocial variables (MOS-SSS, ALTTIQ and TOTRELAT), Model 4 added IOCv2 Negative Impact Summary score, and Model 5 added IOCv2 Positive Impact Summary score. Partial F-tests were conducted to compute the significance of each set of added variables in explaining the remaining variance in the outcomes after controlling for the other variables previously added to the model. All statistical analyses were conducted using SAS Version 9.1 (SAS Institute Inc., Cary, NC).

RESULTS

Sample characteristics. Of the 1312 eligible survivors who were mailed a survey, 117 (9%) packages were returned undelivered and untraceable. Of the remaining 1195 survivors, 886 (74%) completed and returned their surveys, 258 (22%) did not respond to the mailing, and 51 (4%) refused participation Those who reported being off-treatment and in remission or cured were included in the analyses (n=652). Sample bias analyses using demographic information from the registries indicated that participating survivors were less frequently African American (8% vs. 20%, P<.001), older at study enrollment (mean age 62.7 vs. 58.8 years, P<.001), and older at diagnosis (51.9 vs. 48.1 years, P<.001) than non-participants.

As indicated in Table 1, a similar number of females and males participated, 12% were non-Caucasian, 26% earned <$30,000 annually, 40% had a college degree, and 41% were

employed. Mean age at study enrollment was 62.7 and almost half (46%) were older adults (≥ 65 years of age). The mean time from diagnosis to study enrollment was 10.8 years (SD 7.5) while the mean age at lymphoma diagnosis was 51.9 (SD 14.2). Almost half of the participants (48%) had received radiation therapy and the majority (82%) had received chemotherapy. Most participants (55%) were diagnosed with an aggressive form of NHL. Participants cited an average of 2.9 (SD 2.1) co-morbid conditions. Scores for other scales were: ALTTIQ 23.8 (SD 6.4), PCS 46.1 (10.8), MCS 49.6 (11.1), FACT-G 87.8 (15.2), IOCv2 Positive 3.5 (0.8), and IOCv2 Negative 2.1 (0.7).

Relationship of Health Status and QOL to Other Variables

Bivariate associations between physical (PCS) and mental (MCS) health status and functioning and QOL (FACT-G) scores and the independent variables are shown in Table 1. Among categorical demographic and clinical variables, those who had an annual income under $30,000, did not obtain a college degree, were not married, were not employed or retired, or were older at study enrollment had lower PCS scores (all $P<.05$). Concerning mental health status, those who had an annual income under $30,000, were younger at study enrollment, or had received a bone marrow or stem cell transplant had lower MCS scores (all $P<.05$). Regarding QOL, those who were non-Caucasian, had an annual income under $30,000, did not obtain a college degree, were younger at study enrollment, or had received a bone marrow or stem cell transplant had lower FACT-G scores (all P<.05). Among the continuous variables, the strongest PCS relationships were for age at diagnosis ($r=-0.27$) and co-morbidity ($r=-0.57$) and the strongest MCS and FACT-G relationships were for co-morbidity ($r=-0.26$; -0.38) and social support ($r=0.37$; 0.51), respectively (all $P<.0001$).

Relationship of Impact of Cancer to Other Variables

Bivariate associations between IOCv2 Positive and Negative Impact scores and the independent variables are shown in Table 1. Among demographic and clinical variables, those who were male, were Caucasian, had an annual income ≥ $30,000, had a college degree, were not employed or retired, were older at study enrollment, did not receive chemotherapy, or did not receive a bone marrow or stem cell transplant had lower IOCv2 Positive Impact scores (all $P<.05$). In addition, those who were younger at study enrollment, were Stage IV at diagnosis, had received chemotherapy, had undergone a bone marrow or stem cell transplant, had received biologic therapy, or had one or more NHL recurrences had higher IOCv2 Negative Impact scores (all $P<.05$). Among the continuous variables, the strongest IOCv2 Positive Impact association was with appraisal of life threat and treatment intensity ($r=0.34$; $P<.001$). The strongest IOCv2 Negative Impact associations (all $P<.0001$) were with social support ($r=-0.29$), appraisal of life threat and treatment intensity ($r=0.44$), and employment and insurance issues related to having had cancer ($r=0.28$).

Hierarchical Multiple Regression Analyses

Tables 2-4 display the results of hierarchical regressions showing the contribution of demographic, clinical and psychosocial variables and IOCv2 Negative and Positive Impacts Summary scores to explaining variance in SF-36 PCS, MCS and FACT-G scores. The following demographic variables were independently associated (all $P<.05$) with at least one outcome: race, college and employment status, and age at enrollment. Only two clinical (received chemotherapy and comorbidity) and one psychosocial (social support) variables were significantly related to an outcome after all of the covariates were entered into the regression (Model 5). Both IOCv2 Negative and Positive Impact summary scores contributed significantly to the amount of variance explained (R^2) in all three models (all $P<.05$; Tables 2-4).

Physical health status and functioning (PCS)—As indicated in Table 2, education, employment status, age at study enrollment, chemotherapy receipt and comorbidity score remained significant predictors for PCS in all models after controlling for other variables. ALTTIQ was a significant predictor in Model 3 but became non-significant when IOCv2 Negative Impact Summary score was added to the model. IOCv2 Negative Impact Summary ($P<.0001$) and Positive Impact Summary ($P<.05$) scores explained a highly significant proportion of the variance in PCS after controlling for demographic, clinical and psychosocial variables. In total, 46% of the variance was accounted for by the covariates in Model 5.

Mental health status and functioning (MCS)—Per Table 3, survivors who were younger at study enrollment, had comorbid health conditions and less social support were more likely to report worse mental health status after controlling for other variables. Having received a bone marrow or stem cell transplant and negative appraisals of life threat and treatment intensity were associated with worse mental health status in Model 3 (all $P<.05$), but the associations became non-significant with the addition of the IOCv2 scores. Similar to the pattern seen with PCS, IOCv2 Negative ($P<.0001$) and Positive Impact ($P<.01$) Summary scores added a highly significant proportion of the variance in MCS after controlling for demographic, clinical and psychosocial variables (Model 5). The full model explained 36% of the variance in MCS scores.

Quality of life (FACT-G)—As displayed in Table 4, survivors who were non-Caucasian, did not receive a college degree, were not employed, were younger at study enrollment, had comorbid health conditions and less social support reported worse QOL when controlling for other variables (Model 5). Male gender, years since diagnosis, having received a bone marrow or stem cell transplant, and negative appraisals of life threat and treatment intensity were associated with worse QOL in some models (all $P<.05$), but these associations became statistically non-significant with the addition of the IOCv2 scores. The amount of variance explained by the full model (67%) was significantly increased with the addition of the IOCv2 summary scales (all $P<.0001$), with both the Negative and Positive Impact scales making a significant contribution while controlling for the other scale.

DISCUSSION

This study provides the first examination of the relationship between the recently validated IOCv2 and health status and functioning and QOL in a large sample of post-treatment NHL survivors. This analyses extends prior IOC research with mixed [11] and breast [13] cancer samples by using a robust set of covariates (demographic, clinical, psychosocial) and employing an NHL sample with good gender, race, and diagnosis (indolent and aggressive NHL) distributions, thereby enhancing generalizability.

Findings from the bivariate analyses indicate statistically significant relationships between QOL-related outcomes and select demographic (race, income, education, marital and employment status, age), clinical (treatment types, comorbidity), and psychosocial (social support, appraisals, and insurance and employment issues related to cancer) characteristics, which is consistent with previous studies of long-term cancer survivors [2-10]. However, many of these relationships became non-significant with the introduction of the IOCv2 scores in the multivariate models (Tables 2-4). For example, only age, comorbidity and social support remained independently associated with the mental health status and functioning component summary score (MCS) after the IOCv2 Positive and Negative Impact Summary scores were entered in the hierarchical regression. A possible explanation for older respondents reporting better QOL than the younger respondents is that they are

likely to have more experience coping with stressful events and fewer family-related and other demands than younger individuals.

In only one model (FACT-G) did a variable (race) gain significance after accounting for the IOCv2 scores (Positive Impact). It is possible that differences remained between the Caucasian and non-Caucasian cancer survivors that are not accounted for in the set of covariates used in this study and that were evident only after considering the IOCv2 in the hierarchical regression model. Further, it seems that the positive IOC that was statistically significantly related to race was largely operative for QOL among non-Caucasians.

Consistent with Zebrack et al. [11], our findings indicate that individuals' perceptions of the positive and negative IOC on various life domains are related to their health status and functioning and QOL. In addition, accounting for IOCv2 scores reduced or diminished associations between demographic, clinical and psychosocial variables and the outcome measures in most instances. Furthermore, our findings indicate that positive IOC was significantly associated with PCS ($P<.05$; Table 2) after controlling for all other variables, which was the only deviation from the previous study [11]. Finally, in only one instance did a demographic or clinical variable meet the criteria for minimally important difference [22] on the SF-36 scales after accounting for all variables; being presently employed added 3 points ($P<.001$) to the PCS score (Table 2).

Our findings suggest that how individuals perceive the cancer experience may influence or be influenced by their health status and functioning and QOL. As our colleagues [11] suggest, further research in the area of cognitive and behavioral interventions (e.g., cognitive re-framing) is needed to determine if positive reinterpretation of a negative traumatic event could subsequently lead to improved QOL and decreased distress. Based upon findings reported here and elsewhere [14], the IOCv2, with strong reliability and validity psychometrics, shows evidence of potential utility for monitoring intervention effects longitudinally.

As is typical for any cross-sectional study, we are unable to establish a cause-effect relationship between the IOCv2 and health status and functioning and QOL. For example, we cannot determine if perceptions of the cancer experience preceded the outcome variables of interest (health status and functioning, QOL), whether subjective QOL-related symptoms adjusted perceptions of how cancer impacted the survivors' lives, or if both are true. The ability to assess a cohort over time, as would be possible in a longitudinal design, would help determine the direction(s) of causality. As a second limitation, the inclusion of NHL survivors from only two NC cancer centers may limit the generalizability of our results to survivors living in other regions and treated at smaller hospitals. However, our demographic profile closely mirrors that of the national population of NHL survivors [23], thereby strengthening the generalizability of our analyses. Further, some of the findings may reflect the fact that the IOCv2 and outcome measures assess similar constructs, although psychometric evaluation indicates that while overlapping, the measures have distinct aspects [14]. Finally, study strengths include a high response rate (74%) and balanced gender ratio.

In closing, our findings suggest that positive and negative perceptions of cancer's impact on survivors' lives may influence or be influenced by self-reported physical and mental health and QOL. Longitudinal intervention research is needed to establish evidence of causality related to the IOCv2, which could lead to the development of treatments targeting perceptions of the cancer experience, ultimately to enhance health and QOL in survivors. In addition, results suggest that targeted screening, aimed at survivors who are younger, have comorbidities, and less social support would be beneficial to identify QOL-related issues that might be amenable to intervention.

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Table 1

Sample Characteristics of 652 Non-Hodgkin Lymphoma Survivors and Associations with SF-36, FACT-G and IOCv2 Scores

	N	% [a]	SF-36 PCS [b]	SF-36 MCS [b]	FACT-G Overall [b]	IOCv2 Positive Impact [b]	IOCv2 Negative Impact [b]
DEMOGRAPHIC CHARACTERISTICS							
Gender							
Male	329	50	46.5 (10.9)	50.1 (11.1)	87.4 (15.4)	3.4 (0.8)	2.1 (0.7)
Female	323	50	45.6 (10.5)	49.0 (11.1)	88.3 (15.0)	3.6 (0.7)	2.1 (0.7)
(p-value)			(.33)	(.25)	(.45)	(.0003)	(.93)
Race							
Caucasian	571	88	46.4 (10.7)	49.9 (10.8)	88.5 (14.6)	3.5 (0.8)	2.1 (0.7)
Non-Caucasian	81	12	43.9 (11.2)	47.1 (12.7)	83.4 (18.0)	4.0 (0.6)	2.3 (0.8)
(p-value)			(.06)	(.07)	(.02)	(<.0001)	(.12)
Income							
<$30,000 per year	155	26	40.8 (11.2)	47.1 (11.4)	82.3 (16.8)	3.7 (0.7)	2.2 (0.8)
$30,000 - $99,999 per year	281	48	46.8 (10.2)	49.9 (10.9)	88.4 (14.4)	3.5 (0.8)	2.1 (0.6)
≥$100,000 per year	150	26	50.1 (9.3)	50.4 (10.4)	91.1 (13.6)	3.4 (0.7)	2.1 (0.6)
(p-value)			(<.0001)	(.02)	(<.0001)	(.01)	(.40)
Education							
Less than college	384	60	44.1 (11.0)	49.0 (11.3)	86.8 (15.5)	3.6 (0.7)	2.2 (0.7)
College graduate or higher	259	40	49.2 (9.5)	50.5 (10.3)	89.6 (14.2)	3.4 (0.8)	2.1 (0.7)
(p-value)			(<.0001)	(.09)	(.02)	(.0005)	(.13)
Marital/Partner Status							
Married/committed	518	80	46.6 (10.6)	49.9 (10.8)	88.4 (15.0)	3.5 (0.7)	2.2 (0.7)
Not married/committed	133	20	44.0 (11.0)	48.0 (11.8)	85.6 (15.7)	3.6 (0.8)	2.1 (0.8)
(p-value)			(.02)	(.09)	(.06)	(.67)	(.31)
Employment Status							
Currently employed	263	41	50.8 (8.5)	49.8 (9.8)	89.2 (14.4)	3.6 (0.7)	2.2 (0.7)

	N	% [a]	SF-36 PCS [b]	SF-36 MCS [b]	FACT-G Overall [b]	IOCv2 Positive Impact [b]	IOCv2 Negative Impact [b]
Not employed or retired	381	59	42.6 (10.9)	49.4 (12.0)	86.9 (15.7)	3.5 (0.8)	2.1 (0.7)
(p-value)			(<.0001)	(.61)	(.07)	(.04)	(.24)
Age at Enrollment							
Mean (SD): 62.7 (13.5)							
25-49	115	18	51.3 (9.3)	47.6 (10.8)	86.0 (17.0)	3.7 (0.7)	2.2 (0.8)
50-64	235	36	47.2 (10.3)	48.6 (11.2)	85.9 (15.3)	3.5 (0.7)	2.3 (0.7)
≥65	302	46	43.1 (10.7)	51.1 (10.9)	90.0 (14.0)	3.4 (0.8)	2.0 (0.6)
(p-value)			(<.0001)	(.004)	(.003)	(.003)	(<.0001)
CLINICAL CHARACTERISTICS							
Age at Diagnosis	652	100	−.27	.08	.06	−.15	−.10
Mean (SD): 51.9 (14.2)			(<.0001)	(.04)	(.14)	(.0002)	(.01)
Years Since Diagnosis							
Mean (SD): 10.8 (7.5)							
2-4 years	151	23	47.3 (10.4)	50.3 (9.9)	88.6 (13.5)	3.6 (0.7)	2.2 (0.6)
≥5 years	501	77	45.7 (10.9)	49.3 (11.4)	87.6 (15.6)	3.5 (0.8)	2.1 (0.7)
(p-value)			(.10)	(.32)	(.50)	(.22)	(.44)
NHL Histology							
Indolent	276	45	45.9 (11.0)	49.7 (10.8)	88.1 (15.9)	3.5 (0.8)	2.1 (0.7)
Aggressive	338	55	46.4 (10.4)	50.0 (11.2)	88.4 (14.3)	3.6 (0.7)	2.1 (0.7)
(p-value)			(.58)	(.71)	(.78)	(.06)	(.85)
NHL Stage at Diagnosis							
Stage I-III	420	72	46.6 (10.9)	50.0 (11.0)	88.9 (14.8)	3.5 (0.8)	2.1 (0.7)
Stage IV	166	28	46.0 (9.7)	49.0 (11.7)	86.9 (15.2)	3.6 (0.7)	2.3 (0.8)
(p-value)			(.53)	(.36)	(.17)	(.84)	(.02)
Had Surgery							
No	434	68	46.4 (10.7)	49.9 (10.6)	88.2 (14.8)	3.5 (0.7)	2.1 (0.7)

	N	% [a]	SF-36 PCS [b]	SF-36 MCS [b]	FACT-G Overall [b]	IOCv2 Positive Impact [b]	IOCv2 Negative Impact [b]
Yes	201	32	45.5 (10.8)	48.6 (12.1)	86.7 (16.1)	3.6 (0.8)	2.1 (0.7)
(p-value)			(.35)	(.22)	(.24)	(.17)	(.95)
Had Radiation							
No	336	52	45.9 (10.9)	49.9 (10.8)	88.4 (14.5)	3.5 (0.8)	2.1 (0.7)
Yes	316	48	46.3 (10.6)	49.3 (11.3)	87.3 (15.8)	3.5 (0.8)	2.2 (0.7)
(p-value)			(.62)	(.51)	(.38)	(.68)	(.22)
Had Chemotherapy							
No	118	18	47.5 (10.3)	51.1 (10.3)	90.3 (15.0)	3.3 (0.9)	1.9 (0.7)
Yes	534	82	45.7 (10.8)	49.2 (11.2)	87.3 (15.2)	3.6 (0.7)	2.2 (0.7)
(p-value)			(.12)	(.11)	(.06)	(<.0001)	(.0002)
Had a BMT							
No	549	84	46.0 (11.0)	50.2 (10.7)	88.8 (14.6)	3.5 (0.8)	2.1 (0.7)
Yes	103	16	46.4 (9.3)	46.5 (12.5)	82.8 (17.0)	3.7 (0.6)	2.5 (0.8)
(p-value)			(.73)	(.007)	(.001)	(.02)	(<.0001)
Had Biologic Therapy							
No	497	76	45.9 (11.1)	49.7 (11.0)	88.5 (14.8)	3.5 (0.8)	2.1 (0.7)
Yes	155	24	46.5 (9.6)	49.1 (11.3)	85.8 (16.1)	3.5 (0.7)	2.3 (0.7)
(p-value)			(.51)	(.56)	(.06)	(.74)	(.002)
Number of NHL Recurrences							
None	466	72	45.9 (11.1)	49.8 (11.0)	88.2 (15.0)	3.5 (0.8)	2.1 (0.7)
One or more	181	28	46.4 (9.8)	48.9 (11.1)	86.7 (15.6)	3.6 (0.7)	2.2 (0.7)
(p-value)			(.65)	(.34)	(.28)	(.12)	(.03)
Co-morbidity Index	652	100	−.57	−.26	−.38	−.02	.18
Mean (SD): 2.9 (2.1)			(<.0001)	(<.0001)	(<.0001)	(.68)	(<.0001)
PSYCHOSOCIAL SCALES	Mean	SD					

	N	% [a]	SF-36 PCS [b]	SF-36 MCS [b]	FACT-G Overall [b]	IOCv2 Positive Impact [b]	IOCv2 Negative Impact [b]
Social Support (MOS-SSS)	83.9	15.9	.10 (.02)	.37 (<.0001)	.51 (<.0001)	.10 (.01)	−.29 (<.0001)
Appraisal of Life Threat and Treatment Intensity (ALTTIQ)	23.8	6.4	−.12 (.002)	−.18 (<.0001)	−.24 (<.0001)	.34 (<.0001)	.44 (<.0001)
Total Employment & Insurance Issues Related To Cancer (TOTRELAT)	1.0	2.0	−.05 (.26)	−.16 (.0001)	−.24 (<.0001)	.15 (.0002)	.28 (<.0001)

Abbreviations: : PCS, Physical Component Summary; MCS, Mental Component Summary, FACT-G, Functional Assessment of Cancer Therapy – General; IOC, Impact of Cancer; NHL, non-Hodgkin's lymphoma; BMT, bone marrow or stem cell transplantation; SD, standard deviation

[a] Percentages based on valid responses

[b] For categorical variables, the numbers represent means (standard deviations), and p-values reflect results of t-tests or ANOVA; for continuous variables, the numbers represent correlation coefficients, and p-values reflect results of Pearson correlation tests

Table 2

Hierarchical Regressions for Outcome **SF-36 Physical Component Summary Score (PCS)**

	Model 1 Demographics Only	Model 2 Add Clinical Variables	Model 3 Add MOS-SSS, ALTTIQ and TOTRELAT to Model 2	Model 4 Add IOCv2 Negative Impact to Model 3	Model 5 Add IOCv2 Positive Impact to Model 4
Model Statistics					
Model F statistic	20.1	39.7	32.1	34.3	32.7
Model P-value	<.0001	<.0001	<.0001	<.0001	<.0001
Adjusted R-square	.18	.41	.43	.46	.46
Model coefficients (p-values)					
Female, compared to male	−0.1 (.92)	0.2 (.80)	0.1 (.90)	0.0 (.98)	−0.2 (.76)
Race non-Caucasian, compared to Caucasian	−1.7 (.17)	−1.5 (.17)	−1.7 (.13)	−1.6 (.15)	−2.0 (.07)
College graduate [a]	3.1 (.0002)	2.9 (<.0001)	2.8 (.0001)	2.5 (.0004)	2.7 (.0001)
Married/partnered [a]	1.7 (.09)	0.7 (.44)	0.6 (.54)	1.0 (.27)	1.1 (.23)
Employed [a]	5.4 (<.0001)	3.1 (.0002)	3.2 (.0002)	3.1 (.0002)	3.0 (.0002)
Years since diagnosis	−0.0 (.49)	−0.0 (1.0)	0.0 (.71)	−0.0 (.30)	−0.1 (.28)
Age at study enrollment	−0.1 (.0005)	−0.1 (.01)	−0.1 (.003)	−0.1 (.0001)	−0.1 (.0002)
Received chemotherapy [a]		−2.6 (.004)	−2.0 (.04)	−1.9 (.04)	−2.0 (.03)
Received a transplant [a]		−1.6 (.11)	−0.9 (.37)	−0.3 (.79)	−0.2 (.86)
Received biologic therapy [a]		−0.1 (.95)	0.3 (.74)	0.3 (.73)	0.3 (.73)
Comorbidity total score		−1.1 (<.0001)	−1.1 (<.0001)	−1.1 (<.0001)	−1.0 (<.0001)
Social support (MOS-SSS)			0.0 (.35)	−0.0 (.54)	−0.0 (.33)
Appraisal of Life Threat (ALTTIQ)			−0.1 (.02)	−0.0 (.80)	−0.1 (.40)
Insurance & Employment Issues (TOTRELAT)			−0.2 (.42)	−0.0 (.83)	−0.1 (.68)
IOCv2 Negative Impact Scale				−3.6 (<.0001)	−3.7 (<.0001)
IOCv2 Positive Impact Scale					1.0 (.04)

Abbreviations: IOC, Impact of Cancer

[a] Compared to not

Table 3

Hierarchical Regressions for Outcome **SF-36 Mental Component Summary Score (MCS)**

	Model 1 Demographics Only	Model 2 Add Clinical Variables	Model 3 Add MOS-SSS, ALTTIQ and TOTRELAT to Model 2	Model 4 Add IOCv2 Negative Impact to Model 3	Model 5 Add IOCv2 Positive Impact to Model 4
Model Statistics					
Model F statistic	4.1	9.8	14.7	22.9	22.0
Model P-value	.0002	<.0001	<.0001	<.0001	<.0001
Adjusted R-square	.03	.14	.25	.36	.36
Model coefficients (p-values)					
Female, compared to male	−0.6 (.50)	−0.4 (.67)	−0.2 (.79)	−0.4 (.63)	−0.6 (.42)
Race non-Caucasian, compared to Caucasian	−1.0 (.49)	−0.9 (.51)	−0.8 (.53)	−0.6 (.62)	−1.2 (.32)
College graduate [a]	1.6 (.07)	1.5 (.09)	1.3 (.12)	0.7 (.34)	1.0 (.22)
Married/partnered [a]	1.8 (.11)	1.3 (.23)	−0.5 (.63)	0.2 (.80)	0.4 (.72)
Employed [a]	2.1 (.06)	0.4 (.73)	1.2 (.23)	1.1 (.22)	1.0 (.30)
Years since diagnosis	0.1 (.20)	0.1 (.09)	0.1 (.07)	−0.0 (.68)	−0.0 (.71)
Age at study enrollment	0.2 (.0001)	0.2 (<.0001)	0.2 (.0001)	0.1 (.004)	0.1 (.003)
Received chemotherapy [a]		−1.0 (.36)	−0.3 (.75)	−0.3 (.81)	−0.4 (.66)
Received a transplant [a]		−3.4 (.006)	−2.5 (.04)	−1.3 (.24)	−1.1 (.30)
Received biologic therapy [a]		0.1 (.89)	0.6 (.56)	0.6 (.53)	0.6 (.49)
Comorbidity total score		−0.8 (<.0001)	−0.6 (<.0001)	−0.4 (<.0001)	−0.4 (<.0001)
Social support (MOS-SSS)			0.2 (<.0001)	0.2 (<.0001)	0.2 (<.0001)
Appraisal of Life Threat (ALTTIQ)			−0.2 (.03)	0.1 (.25)	0.0 (.64)
Insurance & Employment Issues (TOTRELAT)			−0.1 (.74)	0.1 (.50)	0.1 (.65)
IOCv2 Negative Impact Scale				−6.6 (<.0001)	−6.7 (<.0001)
IOCv2 Positive Impact Scale					1.4 (.01)

Abbreviations: IOC, Impact of Cancer

[a] Compared to not

Table 4

Hierarchical Regressions for Quality of Life Outcome **Functional Assessment of Cancer Therapy (FACT-G)**

	Model 1 Demographics Only	Model 2 Add Clinical Variables	Model 3 Add MOS-SSS, ALTTIQ and TOTRELAT to Model 2	Model 4 Add IOCv2 Negative Impact to Model 3	Model 5 Add IOCv2 Positive Impact to Model 4
Model Statistics					
Model F statistic	4.9	17.2	33.1	67.8	74.3
Model P-value	<.0001	<.0001	<.0001	<.0001	<.0001
Adjusted R-square	.04	.23	.43	.63	.67
Model coefficients (p-values)					
Female, compared to male	1.7 (.17)	2.0 (.06)	2.0 (.03)	2.1 (.008)	1.3 (.09)
Race non-Caucasian, compared to Caucasian	−3.1 (.11)	−2.3 (.18)	−2.1 (.18)	−1.9 (.14)	−3.6 (.003)
College graduate [a]	2.6 (.04)	2.2 (.05)	2.0 (.04)	1.0 (.21)	1.8 (.02)
Married/partnered [a]	2.8 (.07)	2.1 (.12)	−1.3 (.28)	0.3 (.77)	0.5 (.57)
Employed [a]	4.6 (.002)	1.9 (.16)	2.9 (.01)	3.0 (.002)	2.6 (.005)
Years since diagnosis	0.1 (.30)	0.1 (.21)	0.2 (.01)	−0.1 (.23)	−0.1 (.22)
Age at study enrollment	0.2 (.0001)	0.2 (<.0001)	0.2 (.0004)	0.1 (.02)	0.1 (.003)
Received chemotherapy [a]		−1.4 (.31)	−1.0 (.46)	−0.8 (.46)	−1.4 (.15)
Received a transplant [a]		−5.3 (.0009)	−3.3 (.02)	−1.5 (.18)	−1.1 (.30)
Received biologic therapy [a]		−2.0 (.13)	−0.6 (.63)	−0.5 (.58)	−0.2 (.81)
Comorbidity total score		−1.4 (<.0001)	−1.1 (<.0001)	−0.8 (<.0001)	−0.7 (<.0001)
Social support (MOS-SSS)			0.4 (<.0001)	0.3 (<.0001)	0.3 (<.0001)
Appraisal of Life Threat (ALTTIQ)			−0.3 (.0001)	0.1 (.13)	−0.0 (.55)
Insurance & Employment Issues (TOTRELAT)			−0.3 (.23)	0.2 (.42)	0.0 (.84)
IOCv2 Negative Impact Scale				−12.0 (<.0001)	−12.5 (<.0001)
IOCv2 Positive Impact Scale					4.3 (<.0001)

Abbreviations: IOC, Impact of Cancer

[a] Compared to not