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How much do cancer-related symptoms contribute to health-related quality of life in lung and colorectal cancer patients? A report from the Cancer Care Outcomes Research and Surveillance (CanCORS) Consortium

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Abstract

Objective—To examine associations of symptoms with physical and mental health-related quality of life (HRQOL) in colorectal cancer (CRC) and lung cancer patients

Methods—Newly diagnosed CRC (n=3,040) and lung cancer (n=2,297) participants of the Cancer Care Outcomes Research and Surveillance Consortium completing surveys on general HRQOL and symptoms. HRQOL was measured by the SF-12 physical and mental component summary scores (PCS and MCS, respectively). Non-specific cancer symptoms were measured using EORTC-QLQ-C30 items. Cancer type-specific modules developed by the EORTC were used to assess CRC and lung cancer-specific symptoms. For each cancer, linear regression models examined the relationship of non-specific and cancer-specific symptoms with PCS and MCS, controlling for demographic and clinical information.

Results—CRC and lung cancer patients' PCS scores were below the general population norm of 50 (43 and 37, respectively) and MCS scores were at population norm. For CRC, in the model with both symptom indices, an increase in non-specific symptoms was more strongly associated with lower PCS and MCS scores than an increase in CRC-specific symptoms (standardized coefficients; β=−0.41 vs. −0.09 for PCS and β=−0.38 vs. −0.08 for MCS). In the similar model for lung cancer, increases in lung cancer-specific symptoms were more strongly associated with lower PCS scores (β=−0.34 vs. −0.20) while non-specific symptoms were more strongly associated with lower MCS (β=−0.34 vs. −0.14).

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Conclusion—Symptoms were associated with HRQOL impairments in recently diagnosed patients. Additional supportive care implemented early in cancer care, regardless of cancer stage, may provide symptom relief and improve HRQOL.

Keywords

cancer; colorectal; lung; health-related quality of life; symptoms

Introduction

Lung and colorectal cancer (CRC) are the leading non-gender related cancers among men and women and are estimated to account for over 360,000 incident cases in 2014.[1] Health-related quality of life (HRQOL) serves as an important outcome in cancer clinical trials, and is increasingly an important outcome for evaluation of quality of care. For lung cancer and CRC patients, especially those diagnosed with advanced disease, information about HRQOL can contribute to better palliative and supportive care interventions from the time of diagnosis.[2,3] Given that lung cancer is often diagnosed at advanced stages, assessment of HRQOL can facilitate evaluation of treatment practices and the effect of symptoms on patient comfort.[4]

Introducing palliative care management for symptoms early in the cancer process is an emphasis of the recently released Institute of Medicine (IOM) report on delivering high-quality cancer care, as well as a goal of organizations such as the American Society of Clinical Oncology (ASCO) and the National Comprehensive Cancer Network (NCCN).[5–7] To support the implementation of these recommendations, more information is needed on the specific symptoms associated with HRQOL, especially close to the time of diagnosis. Walling and colleagues[8] reported symptom prevalence using data from the Cancer Care Outcomes Research and Surveillance (CanCORS) Consortium study of newly-diagnosed lung cancer and CRC patients.[9] Almost all patients (93%) reported at least some symptoms and over half of patients reported moderate to severe symptoms.[8] CRC patients are burdened by disease-specific symptoms, such as stoma-related or defecation problems.[10] Lung cancer patients also have disease-specific symptoms, such as cough and dyspnea.[11] Both CRC and lung cancer patients also may experience non-specific cancer-related symptoms, such as nausea, vomiting, or trouble sleeping. The extent to which cancer symptoms are associated with general HRQOL has had more limited evaluation.[12] Additionally, much of the information on the relationship of symptoms with HRQOL in *newly* diagnosed patients comes from clinical trials or small samples derived from single institutions, limiting generalizability.[13,14]

Thus, we chose to address these gaps using the population-based patient sample from CanCORS hypothesizing that mitigation of symptom burden early in the disease and treatment trajectory could potentially affect long-term HRQOL. Knowing which symptoms contribute to poorer HRQOL can help prioritize planning of palliative interventions that have been called for across the cancer care continuum.[5,6] We aimed to provide information regarding HRQOL in newly diagnosed lung and CRC patients and assess the extent to which

cancer type-specific symptoms and non-specific cancer symptoms contribute to poorer HRQOL.

METHODS

Data

Data were obtained from CanCORS, a cohort study of lung cancer and CRC patients established by the National Cancer Institute in 2001.[9] CanCORS recruited patients from five geographically defined regions, five integrated health-care delivery systems in the Cancer Research Network, and 15 Veterans hospitals. Recruitment is described in detail in Ayanian et al 2004.[9] Between 2003 and 2005, patients were surveyed at an average of 4 months from diagnosis. Participants were surveyed about their cancer, treatment, symptoms, HRQOL, and health care quality.[15] Clinical information was abstracted from medical records. Abbreviated and surrogate versions of the surveys were available for those unable to complete the full version or who were deceased at survey time.

Study sample

The CanCORS cohort included 4,723 CRC patients and 5,013 lung cancer patients. For this study, we included the 3,040 CRC participants and 2,297 lung cancer participants who completed the full survey at baseline because the questions of interest were only asked in the full survey (CanCORS data version 12). The study protocol was approved by institutional review boards of all participating research groups.

Measures

Patient-reported measures—The primary dependent variable was the Medical Outcomes Study SF-12 physical component summary (PCS) and mental component summary (MCS) scores.[16] The PCS and MCS are weighted combinations of items measuring physical functioning, role limitations due to physical health problems, bodily pain, general health, mental health, role limitations due to emotional problems, social functioning and vitality. Higher scores indicate better health. The U.S. general population mean score for the PCS and MCS is 50 (SD=10).

CRC and lung specific symptom items were selected subscales from CRC specific EORTC QLQ-CR-38[17] and the lung specific EORTC QLQ-LC13[18] questionnaires. For CRC, symptom items included: problems caring for stoma, skin irritation around the stoma, and feeling embarrassed by the stoma (for stoma patients only) and frequency of bowel movements, unintentional release of stools, or blood in stools (defecation symptoms for non-stoma patients). Lung cancer specific symptoms included: coughing, coughing blood, shortness of breath at rest, shortness of breath, shortness of breath while walking, shortness of breath when climbing stairs, sore mouth or tongue, trouble swallowing, and pain or tingling in hands or feet. Because of conceptual overlap with SF-12 items, we excluded “shortness of breath when climbing stairs” and “pain or tingling in hands or feet” from the lung cancer-specific symptom index score.

Non-specific cancer symptoms were measured by items from the EORTC QLQ-C30[19] symptom scale that were asked of both lung and CRC patients. Items included trouble sleeping, lack of appetite, nausea, vomiting, constipation, diarrhea, and shortness of breath. The shortness of breath item was included only for CRC patients since the specific shortness of breath items were included in the cancer-specific index for lung cancer.

Participants responded with how much they had experienced each symptom in the past four weeks using a categorical rating scale ranging from “not at all” to “quite a bit.” The summed scores for all symptom scales were transformed linearly to a 0 to 100 possible range.[20] Higher scores indicated more symptoms.

Demographic and clinical—Data on age, race/ethnicity, gender, marital status, education, and family income were collected from patients at baseline. Information on disease stage, time since diagnosis, and treatment was obtained from medical records or cancer registry if medical records were unavailable.

Data Analysis

Descriptive statistics, including frequency, means, and standard deviations were calculated for all variables. The estimated correlation between the PCS and MCS were 0.09 and 0.01, respectively, in the CRC and lung cancer samples. Separate linear regression models were run for PCS and MCS scores, and also separately for CRC and lung cancer patients. For each dependent variable (PCS and MCS) three, pre-specified, models were run. Model 1 included the cancer type-specific symptom index (stoma/defecation items for CRC subjects and cough/dyspnea items for lung subjects), demographic and clinical characteristics. Model 2 included the non-specific symptom index, demographic and clinical characteristics, but not the cancer type-specific symptom index. Model 3 included cancer type-specific and non-specific symptom indices, demographics and clinical characteristics. The amount of variance in HRQOL explained by each model was indexed by adjusted R-squared. Standardized coefficients (β) are reported. Effect sizes (ES) were used to compare differences in the standardized coefficients for the symptom indices.[21] Statistical analyses were conducted using SAS Version 9.3.[22]

Results

Characteristics of Survey Respondents

Table 1 shows that a majority of both CRC and lung cancer patients were older than 55 (74% and 85%, respectively), White (66% and 68%, respectively), and male (55% and 51%, respectively). Almost all CRC patients received surgery (93%) and half of lung cancer patients received surgery (50%). Approximately 15% and 27% of CRC and lung cancer patients had Stage IV disease.

HRQOL and Symptoms

The PCS mean score was 43 for CRC respondents and 37 for lung cancer respondents (Table 2). The MCS mean scores were 51 for CRC and 50 for lung cancer participants.

Internal consistency reliability (Cronbach's alpha) of the stoma and defecation scales in our sample were 0.60 and 0.71, respectively. Internal consistency reliability of the lung cancer-specific scale in our sample was 0.60. Internal consistency reliability of the non-specific symptom scale was 0.66 and 0.65 for the CRC and lung cancer samples, respectively.

The product-moment correlation between the non-specific and cancer type-specific scales was 0.51 for the CRC sample and 0.43 for the lung cancer sample. Among both CRC and lung cancer patients, trouble sleeping was the most frequently reported non-specific cancer symptom (Supplementary Table 1). The prevalence of symptoms ranged from 11% (blood in stool) to 64% (frequent bowel movements) among CRC patients and 7% (coughing blood) to 82% (cough) for lung cancer patients.

Multivariable models examining associations with HRQOL

Colorectal cancer—Table 3 shows that Model 2 (non-specific symptoms only; Adj. R^2=0.29) explained more variance of the PCS than Model 1 (cancer type-specific symptoms only; Adj. R^2=0.19) in CRC patients. Demographic and clinical variables accounted for 12% of the total variance in each model. Additionally, the non-specific symptoms had a significantly greater association with an overall decrease in PCS compared to cancer type-specific symptoms in Model 3 (β=−0.41 vs. −0.09, ES=0.32). Older age (Model 1 and 3), female gender, lower education, receiving chemotherapy (Model 1) surgery or radiation, higher stage at diagnosis, and having more comorbidities were associated with lower PCS. Unstandardized coefficients are provided in Supplementary Tables 2 and 3.

For the MCS, Model 1 (cancer type-specific symptoms only Adj. R^2=0.11) explained more variance than Model 2 (non-specific symptoms only; Adj. R^2=0.07). Demographic and clinical variables accounted for 6% of the total variance in each model. Non-specific symptoms had significantly greater associations with MCS in Model 3 (β=−0.38 vs. −0.08, ES=0.30). Older age and higher education was associated with significantly higher MCS. In Model 1, being female was negatively associated with MCS and being married was positively associated with MCS. Chemotherapy was significantly associated with poorer MCS scores in Model 1 and radiation was significant in Model 2.

Lung cancer—Table 4 shows that Model 1 (Adj. R^2=0.24) accounted for more variance in PCS than Model 2 (Adj. R^2=0.18). Demographic and clinical variables accounted for 8% of the total variance in each model. In Model 3, the association of the negative relationship of the cancer type-specific symptoms was marginally higher than the non-specific cancer symptoms, (β=−0.34 vs. −0.20, ES=0.14). African Americans had significantly higher PCS scores than white patients. Lower education (Model 1 and 3), receiving surgery (Model 1 only) and radiation, higher stage at diagnosis, and comorbidities were associated with lower PCS.

In contrast to PCS, the association between the non-specific symptom index and MCS was significantly higher than the cancer-type specific symptom index, particularly in Model 3 (β=−0.34 vs. −0.14, ES=0.20). Model 2 (Adj. R^2=0.18) accounted for more variance in PCS than Model 1 (Adj. R^2=0.10). Demographic and clinical variables accounted for 4% of the total variance in each model. Older age and higher education (Model 2) was associated with

significantly higher MCS. In Model 1, female gender, more comorbidities, higher stage at diagnosis and surgery were significantly associated with lower MCS.

Discussion

CRC and lung cancer CanCORS participants surveyed near diagnosis reported substantially worse physical HRQOL than the U.S. general population. Although CRC and lung cancer patients reported similarly high levels of their respective cancer type-specific symptoms, lung cancer symptoms had a stronger association with physical HRQOL among lung cancer patients than the stoma/defecation symptoms had for CRC patients. While both groups of CanCORS participants had mental HRQOL scores comparable to the general population, symptoms also contributed to mental HRQOL: non-specific symptoms were more strongly associated with the mental HRQOL than cancer-specific symptoms in CRC and lung cancer patients.

The physical and mental HRQOL scores for both CRC and lung cancer patients were similar to findings from previous studies.[23,24] The prevalence of some symptoms, however, was higher in our study. For example, our CRC patients were more likely to report constipation (33% vs. 22%) and diarrhea (43% vs. 32%) than the sample studied by Wilson et al.[23] This comparison may seem to contradict the findings on the association between increasing symptoms and worse HRQOL. However, even in Wilson et al, SF-12 PCS and MCS scores were only significantly worse for patients with severe symptoms compared to those with mild or moderate symptoms.[23] For lung cancer, Fleming and colleagues reported similar HRQOL in lung cancer patients as we report.[24] We found 92% of lung cancer patients experienced at least one cough or dyspnea symptom, slightly higher than what was reported in a systematic review of lung cancer patients (50% to 87%).[11] Collectively, these results suggest that, while there is a strong association between symptoms and HRQOL, the assessment of HRQOL alone using generic summary scores may miss bothersome symptoms that warrant clinical attention.

Both the cancer-type specific and non-specific cancer symptoms were associated with worse self-reported physical and mental health. Non-specific symptoms were more strongly associated with CRC patients' HRQOL than cancer-specific. While cancer-type specific symptoms were significantly associated with lower physical and mental HRQOL after controlling for non-specific symptoms, the lower strength of association may be due to the few stoma patients in our sample (12%). Previous studies suggest that stoma patients have worse symptoms and poorer HRQOL than non-stoma patients.[23] For example, stoma-related problems may negatively affect normal activities, such as work duties, likely impacting emotional and social functioning.[25]

In contrast to CRC patients, lung cancer patients reported cancer-type specific symptoms more frequently than non-specific cancer symptoms. The later stage at diagnosis may partially explain this finding. Cough/dyspnea symptoms were more strongly associated with physical HRQOL than the non-specific symptoms, supporting cancer-type specific symptom measures to identify and treat problem areas to improve physical HRQOL.[26] The stronger association between non-specific symptoms and mental HRQOL may be related to the high

frequency of reporting trouble sleeping, which has been associated with increased mental distress.[27]

Overall, other potential risk factors for worse physical and mental HRQOL were female gender, low education, higher stage at diagnosis, and chemotherapy and radiation. Older age was associated with lower physical HRQOL, but higher mental HRQOL. Additionally, we found negative associations between comorbidities and physical HRQOL. Comorbidities are also an indicator for introducing palliative care in NCCN guidelines.[7] Even after accounting for demographic, clinical, and symptom factors, in both CRC and lung cancer, the total variance explained was relatively low (7–30%). HRQOL is multidimensional construct that can be affected by other psychosocial or psychological factors not included in our model. For example, coping strategies, stress levels, and social support and family life. Second, our measure of comorbidity was only a count of comorbidity, not a measure of severity. Finally, we did not include measures of quality of care received.

Our study provides population-based estimates of symptom and HRQOL in cancer patients near diagnosis, and enriches the findings of previous studies that were based on small, non-representative samples[28] or on collapsed multiple cancer types.[29] Our findings describe symptoms experienced across all stages of disease early in cancer care: palliative care strategies traditionally reserved for end-stage disease may alleviate these same symptoms in earlier stage patients.[30] In a post-hoc analyses, we compared the regression results stratified by localized and metastatic disease. The association of non-specific and cancer-type specific symptoms with PCS and MCS remained the same across localized and metastatic sub-groups for both CRC and lung cancer patients. The symptom associations with HRQOL were also similar compared to the findings from the non-stratified sample. This further demonstrates that that symptoms are a burden on HRQOL even in those with localized disease: patients are in need of supportive care strategies to address symptoms with the intentions of improved HRQOL

The study has several limitations. The majority of patients (>97%) have health insurance, limiting generalizability. However, CanCORS incorporates several health-care delivery systems and geographically distinct sites.[32] Second, patients who were unable to complete the full version of the survey were not included in our analysis, therefore our sample is healthier than the full cohort. Third, data were obtained between 2003 and 2005. However, treatments for these cancers have not changed substantially. Information from this representative cohort is important for addressing the issues in the recent IOM report on high-quality cancer care.[5] Additionally, we cannot discern whether symptoms are treatment side-effects, from the disease itself, or from other comorbidities. Finally, we do not present longitudinal changes in HRQOL.

Our study found that both CRC and lung cancer patients experience symptoms that are negatively associated with quality of life, especially physical HRQOL. Symptom and HRQOL assessment is important to obtain a comprehensive understanding of patient needs at diagnosis, regardless of disease stage. Our findings support the positions of the IOM and ASCO to implement symptom relief and supportive care strategies early in the cancer care

process and across all stages by generating evidence on the relationship of symptom burden and HRQOL in a population-based cancer sample.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Demographic and clinical characteristics

	Colorectal cancern n=3040	Lung cancer n=2297
Demographic Variables	**N(%)**	**N(%)**
Age		
<55	800 (26%)	350 (15%)
55–59	383 (13%)	300 (13%)
60–64	386 (13%)	351 (15%)
65–69	423 (14%)	391 (17%)
70–74	372 (12%)	380 (17%)
75–79	343 (11%)	299 (13%)
80+	334 (11%)	226 (10%)
Race		
White	1999 (66%)	1661 (68%)
African American	443(15%)	270 (11%)
Hispanic	206 (7%)	45 (2%)
Asian/Hawaiian/Other	392 (13%)	103 (4%)
Gender		
Male	1657 (55%)	1181 (51%)
Female	1383 (45%)	1116 (43%)
Marital Status		
Married	1920 (63%)	1380 (60%)
Widowed	449 (15%)	404 (18%)
Divorced/Separated	468 (15%)	412 (18%)
Never Married	185 (6%)	100 (4%)
Education		
<High School	471 (15%)	404 (18%)
High School Graduate	850 (28%)	753 (33%)
Some College	815 (27%)	670 (29%)
College Graduate	457 (15%)	263 (11%)
>College	413 (14%)	198 (59%)
Clinical Variables		
Surgery for Cancer		
Yes	2815 (93%)	1142 (50%)
No	203 (7%)	1155 (50%)
Radiation		
Yes	440 (14%)	829 (36%)
No	2576 (85%)	1466 (64%)
Chemotherapy		
Yes	1622 (54%)	1375 (60%)
No	1392 (46%)	921 (40%)
Disease Stage		

Demographic Variables	Colorectal cancern n=3040 N(%)	Lung cancer n=2297 N(%)
Stage 0–1	722 (24%)	709 (31%)
Stage 2–3	1726 (57%)	864 (38%)
Stage 4	446 (15%)	610 (27%)
Unknown	146 (5%)	114 (5%)
Number of Comorbidities		
0	1706 (56%)	985 (43%)
1	887 (29%)	804 (33%)
2+	414 (14%)	503 (22%)
Years Since Diagnosis Mean (STD)	0.41 (0.19)	0.40 (0.17)
CRC Site		
Colon	2080 (68%)	
Rectum	664 (22%)	
Both	128 (4%)	
Unknown	168 (6%)	
Lung Histology		
Not small cell		1935 (84%)
Small cell		243 (11%)
Unknown		119 (5%)

Table 2

SF-12 Scores[†] and symptom scores[‡]

	CRC patients n=3040	Lung cancer patients N=2297
	Mean(SD)	**Mean(SD)**
SF-12 PCS	42.8 (11.0)	37.2 (11.1)
SF-12 MCS	51.3 (10.7)	50.1 (11.5)
Cancer-specific symptom index		
CRC:stoma/defecation	18.4 (18.1)	
Lung:cough/dyspnea		22.4 (16.7)
Non-specific symptom index	20.6 (17.9)	22.7 (19.5)

[†]Higher scores=better HRQOL;

[‡]Higher scores=increasing symptoms

Table 3

Multivariable Regressions on **SF-12** for **CRC subjects**

	PCS			MCS		
	Model 1 CRC symptom index	**Model 2 Non-specific symptom index**	**Model 3 Non-specific & CRC symptom index**	**Model 1 CRC symptom index**	**Model 2 Non-specific symptom index**	**Model 3 Non-specific & CRC symptom index**
Model Statistics						
Whole Model F-statistic (degrees of freedom)	29.7 (21, 2495)	52.1 (21, 2495)	50.1 (21,2493)	17.1 (21,2495)	33.5 (21, 2495)	32.3 (21,2493)
P-value for Whole Model F-statistic	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Full model Adjusted R^2	0.19	0.29	0.29	0.11	0.07	0.21
N	2516	2516	2515	2516	2516	2515
Model coefficients(p-values)	β	β	β	β	β	β
Age: ref=<65						
65–74	0.05(0.01)	0.03(0.12)	0.02(0.19)	0.01(<0.001)	0.09(<0.001)	0.09(<0.001)
75+	−0.03(0.12)	−0.05(0.01)	−0.06(0.003)	0.05(0.02)	0.03(0.10)	0.03(0.18)
Race: ref=White						
African American	−0.01(0.69)	−0.01(0.64)	−0.01(0.58)	−0.01(0.63)	−0.01(0.58)	−0.01(0.53)
Unknown/Other	0.05(0.01)	0.03(0.10)	0.03(0.09)	0.01(0.59)	−0.01(0.67)	−0.01(0.69)
Gender: ref=Male						
Female	−0.09(<0.001)	−0.05(0.002)	−0.06(0.001)	−0.05(0.01)	−0.01(0.43)	−0.02(0.34)
Marital Status: ref=Not Married						
Married	−0.01(0.71)	−0.02(0.37)	−0.02(0.36)	0.04(0.04)	0.03(0.08)	0.03(0.08)
Education: ref=<High School						
High School Graduate	0.04(0.12)	0.03(0.18)	0.03(0.22)	0.02(0.41)	0.01(0.58)	0.01(0.65)
Some College	0.07(0.01)	0.05(0.06)	0.05(0.05)	0.06(0.02)	0.05(0.09)	0.04(0.10)
College Graduate	0.07(0.01)	0.05(0.04)	0.05(0.05)	0.06(0.02)	0.04(0.11)	0.04(0.12)
>College	0.08(<0.001)	0.08(<0.001)	0.07(0.002)	0.06(0.02)	0.05(0.03)	0.05(0.04)
Treatment: ref=Not receiving						
Surgery	−0.05(0.01)	−0.04(0.02)	−0.05(0.01)	0.02(0.34)	0.02(0.18)	0.02(0.79)
Radiation	−0.07(<0.001)	−0.12(<0.001)	−0.10(<0.001)	0.001(0.95)	−0.05(0.02)	−0.03(0.18)
Chemotherapy	−0.11(<0.001)	0.01(0.80)	0.002(0.94)	−0.08(<0.001)	0.02(0.33)	0.02(0.42)

	PCS			MCS		
	Model 1 CRC symptom index	**Model 2 Non-specific symptom index**	**Model 3 Non-specific & CRC symptom index**	**Model 1 CRC symptom index**	**Model 2 Non-specific symptom index**	**Model 3 Non-specific & CRC symptom index**
Stage at diagnosis: ref=Stage:0–1						
Stage:2–3	−0.02(0.38)	−0.01(0.65)	−0.01(0.60)	−0.02(0.48)	−0.01(0.75)	−0.01(0.71)
Stage:4	−0.06(0.01)	−0.05(0.03)	−0.05(0.03)	−0.02(0.40)	−0.01(0.64)	−0.01(0.66)
Stage:unknown	0.01(0.79)	0.01(.53)	0.01(0.58)	−0.01(0.74)	−0.00(0.96)	−0.002(0.91)
Comorbidity: ref=None						
One	−0.12(<0.001)	−0.10(<0.001)	−0.10(<0.001)	−0.03(0.14)	−0.02(0.44)	−0.01(0.52)
Two+	−0.13(<0.001)	−0.09(<0.001)	−0.09(<0.001)	−0.02(0.29)	0.02(0.34)	0.02(0.41)
Years since diagnosis	0.03(0.09)	0.02(0.17)	0.02(0.22)	−0.001(0.95)	−0.01(0.66)	−0.01(0.56)
Cancer-type specific symptom index (CRC)†‡	−0.27(<0.001)		−0.09(<0.001)	−0.26(<0.001)		−0.08(<0.001)
Non-specific cancer symptom index†		−0.45(<0.001)	−0.41(<0.001)		−0.42(<0.001)	−0.38(<0.001)

β=standardized coefficients; Ref=reference;

†Higher scores=increasing symptoms;

‡Subjects with stoma responded to stoma items and non-stoma subjects responded to defecation items.

Table 4

Multivariable Regressions on **SF-12** for **Lung subjects**

	PCS			MCS		
	Model 1 Lung cancer symptom index	**Model 2 Non-specific cancer symptom index**	**Model 3 Non-specific & lung cancer symptom index**	**Model 1 Lung cancer symptom index**	**Model 2 Non-specific cancer symptom index**	**Model 3 Non-specific & lung cancer symptom index**
Model Statistics						
Model F-statistic (degrees of freedom)	33.7 (20,2058)	24.0 (20,2058)	37.20 (21,2057)	13.0 (20,2058)	23.4 (20,2058)	24.4 (21,2057)
P-value for Whole Model F-statistic	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.001
Full model Adjusted R^2	0.24	0.18	0.27	0.10	0.18	0.19
N	2079	2079	2079	2079	2079	2079
Model coefficients(p-values)	β	β	β	β	β	B
Age: ref=<65						
65–74	0.06(0.01)	0.05(0.03)	0.04(0.08)	0.07(0.004)	0.03(0.09)	0.03(0.13)
75+	0.02(0.43)	0.02(0.34)	0.003(0.88)	0.08(0.002)	0.06(0.01)	0.05(0.02)
Race: ref=White						
African American	0.07(<0.001)	0.06(0.01)	0.07(<0.001)	−0.02(0.35)	−0.03(0.14)	−0.03(0.20)
Unknown or Other	0.01(0.54)	0.004(0.82)	0.01(0.52)	−0.02(0.37)	−0.02(0.30)	−0.02(0.37)
Gender: ref=Male						
Female	0.0003(0.99)	0.04(0.04)	0.02(0.36)	−0.06(0.003)	−0.02(0.25)	−0.03(0.11)
Marital Status ref=Not Married						
Married	0.04(0.08)	0.05(0.03)	0.03(0.19)	0.03(0.14)	0.02(0.25)	0.02(0.44)
Education: ref=<High School						
High School Graduate	−0.08(0.004)	−0.04(0.22)	−0.08(0.002)	0.05(0.12)	0.06(0.03)	0.04(0.13)
Some College	−0.03(0.21)	0.02(0.48)	−0.04(0.17)	0.04(0.14)	0.06(0.03)	0.04(0.16)
College Graduate	−0.04(0.15)	0.01(0.78)	−0.03(0.14)	0.01(0.59)	0.03(0.21)	0.01(0.55)
>College	0.01(0.69)	0.05(0.05)	0.004(0.85)	0.05(0.05)	0.06(0.02)	0.04(0.09)
Treatment: ref=Not receiving						
Surgery	−0.05(0.03)	0.01(0.50)	−0.04(0.13)	−0.06(0.03)	−0.02(0.39)	−0.03(0.24)
Radiation	−0.05(0.02)	−0.003(<0.001)	−0.05(0.02)	−0.03(0.15)	−0.04(0.06)	−0.03(0.18)
Chemotherapy	−0.05(0.02)	0.04(0.51)	−0.02(0.34)	−0.03(0.32)	0.03(0.21)	0.03(0.26)

	PCS			MCS		
	Model 1 Lung cancer symptom index	**Model 2 Non-specific cancer symptom index**	**Model 3 Non-specific & lung cancer symptom index**	**Model 1 Lung cancer symptom index**	**Model 2 Non-specific cancer symptom index**	**Model 3 Non-specific & lung cancer symptom index**
Stage at diagnosis: ref=Stage:0–1						
Stage:2–3	−0.03(0.34)	−0.02(0.49)	−0.01(0.57)	−0.02(0.54)	−0.002(0.95)	−0.0002(0.99)
Stage:4	−0.09(0.002)	−0.06(0.03)	−0.07(0.01)	−0.08(0.01)	−0.02(0.34)	−0.06(0.04)
Stage:unknown	−0.01(0.63)	−0.002(0.90)	−0.01(0.77)	−0.03(0.20)	−0.02(0.95)	−0.02(0.31)
Comorbidity: ref=None						
One	−0.08(<0.001)	−0.11(<0.001)	−0.07(<0.001)	0.01(0.55)	0.001(0.95)	0.02(0.48)
Two+	−0.07(<0.001)	−0.08(<0.001)	−0.06(0.004)	−0.03(0.26)	−0.02(0.47)	−0.01(0.75)
Years since diagnosis	0.05(0.02)	0.02(0.30)	0.03(0.12)	0.03(0.13)	0.001(0.97)	0.004(0.84)
Cancer-type specific symptom index (lung cancer)†	−0.42(<0.001)		−0.34(<0.001)	−0.27(<0.001)		−0.14(0.001)
Non-specific cancer symptom index†		−0.33(<0.001)	−0.20(<0.001)		−0.39(<0.001)	−0.34(<0.001)

β=standardized coefficients; Ref=reference;

†Higher scores=increasing symptoms.

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