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Original Paper

Loss of Physical Functioning Among Geriatric Cancer Patients: Relationships to Cancer Site, Treatment, Comorbidity and Age

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This study investigated differences in physical functioning and physical role limitations according to cancer site and treatment modality in a sample of 590 patients 65 years and older diagnosed with breast, colon, lung or prostate cancer. Analysis of covariance procedures were utilised to test for differences in levels of physical functioning and physical role limitations according to cancer site and treatment modality, adjusting for differences in age, comorbid conditions and retrospective physical functioning. Physical functioning and physical role limitations were measured using two subscales of the Medical Outcomes Studies MOS 36-item Short Form Health Survey (SF-36). Physical functioning prior to diagnosis, and to a lesser degree comorbidity, contributed significantly to current levels of physical functioning and physical role limitations. Patients with lung cancer reported lower physical functioning and physical role limitation scores than patients with prostate cancer, and patients treated with surgery only reported lower physical functioning and physical role limitation scores than patients treated with neither surgery nor radiation. No gender differences were observed among the reduced sample consisting of patients with colon or lung cancer. It is important not only that physicians and oncologists are cognizant of the fact that some cancers (particularly lung cancer) may be more physically debilitating than others, but that the patient's history of comorbid conditions and pre-existing physical limitations may be important factors in predicting current physical functioning.

Key words: physical functioning, geriatric, cancer, comorbidity, treatment
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INTRODUCTION

CANCER HAS shifted from an acute disease with prompt resolution, usually death, to a chronic disease with long-term treatment. It is estimated that nearly half of all newly diagnosed cancer patients will survive longer than 5 years. Among the elderly, a portion of that survival time may be spent with limitations in function, so long-term care and preservation of function become important care issues [1].

Cancer is predominantly a disease of the elderly, with risk increasing after the age of 50 years, and most cases occurring between the ages of 65 and 79 years [2]. In the United States, lung, colon, prostate and breast cancer account for 54% of all incident cases of cancer diagnosed annually among all age groups [1]. These four cancers constitute a very significant drain on health care resources.

As a chronic disease with a high prevalence among the elderly, cancer often co-exists with other chronic diseases [3]. This comorbidity among elderly patients may mask early symptoms of cancer, compromise treatment and compound losses in functioning once the diagnosis is made and treatment initiated. Greenfield and associates [4] found that, at early but not at later stages, comorbid conditions were related to less appropriate treatment. In contrast, Silliman and associates [5] could find no evidence of the effect of comorbidity on diagnosis or treatment. Kurtz and associates, in a two-wave longitudinal study of patients with a variety of cancers, found that at wave two, comorbidity was positively

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correlated with symptom reports, but the correlation with loss of physical functioning was not significant [6]. Satariano and associates in comparing breast cancer patients with their controls, found that cases with comorbid conditions were less likely to survive 3 months after diagnosis. They argued that comorbid conditions may influence treatment through the way they impact on renal, pulmonary, cardiac and hepatic systems that, possibly, were already compromised [7].

Some authors have observed treatment-related effects on cancer patients' symptomatology and loss of physical functioning. In particular, Mor and associates [8, 9] found that, compared with patients in the early stages of cancer, patients with advanced disease and those undergoing radiation therapy as opposed to other types of treatment reported more needs for assistance with personal care. Sarna [10] observed that in many clinical trials, patients exhibit a decline in physical functional status during the course of treatment for advanced lung cancer, especially those with concurrent illnesses. In one of our earlier studies, we [6] found a significant link between treatment-related symptomatology and loss of physical functioning among patients diagnosed with cancer. In this two-wave longitudinal study, most patients had completed their treatment by wave two, and reported fewer symptoms and improved physical functioning, suggesting a possible treatment effect. However, the model did not explicitly test for effects on loss of functioning attributable to treatment type or cancer site. Lindsey and associates [11] studied elderly patients receiving radiotherapy for breast or lung cancer and found no significant decline in their patients' functional status throughout the therapy process.

Sparse and inconsistent information is available in the literature with respect to loss of physical functioning among cancer patients, particularly among the elderly. Furthermore, there is a need for a comprehensive picture of how loss of physical function among elderly patients relates to the type of cancer, treatment regimen and comorbidity. In the current study we applied a comprehensive approach and investigated, in a large sample of elderly patients diagnosed with cancer, the relationships of cancer site, age, comorbidity and treatment type to loss of physical functioning. Controlling for differences in age, comorbidity and loss of physical functioning prior to cancer diagnosis, we investigated whether loss of physical functioning among elderly patients with cancer varies according to cancer site and treatment regimen. In addition, in order to test for gender effects as well, we first removed from the sample the breast cancer patients (all women), and the prostate cancer patients (all men), and controlling as before for differences in age, comorbidity and loss of physical functioning prior to cancer diagnosis, examined whether loss of physical functioning among elderly patients with cancer varies according to gender, cancer site and treatment regimen.

PATIENTS AND METHODS

As part of an ongoing longitudinal study, 617 patients, aged 65 years and over, were recruited when visiting their physician for follow-up care after being discharged from cancer treatment centres located in the State of Michigan, U.S.A. The patients were recruited simultaneously from the six treatment centres over a period of 2–3 years. The study was restricted to patients with an incident diagnosis of breast, lung, colon or prostate cancer. Approximately 3–6 weeks after hospital discharge, the patients were interviewed by telephone and also asked to complete and return a self-administered questionnaire. Of the original sample, complete data on all study variables were available for 590 cases (96%).

Measures

Physical functioning was assessed using two subscales of the Medical Outcomes Study MOS 36-Item Short Form Health Survey (SF-36) which measure (1) limitations in physical activities because of health problems, and (2) limitations in usual role activities because of physical health problems. Validity studies have shown that these two subscales of the SF-36 best distinguish groups differing in severity of chronic medical condition, and have the purest physical health interpretation. The SF-36 was designed for use in clinical practice and research, health policy evaluations and general population surveys [12]. The physical functioning subscale (10 items, Cronbach's Alpha = 0.91) measures the degree of limitation in activities such as lifting or carrying groceries, bending, kneeling or stooping, walking one block (150 m), bathing and dressing, etc., while the subscale on physical role limitations (4 items, Cronbach's Alpha = 0.84) measures whether physical health has caused the patient to cut down on the amount of time spent on work or other activities, has limited the kind of work or other activities undertaken, etc. For those unfamiliar with the SF-36, the physical functioning and physical role limitations subscales are presented in their entirety in Appendix A. The scores for the two subscales were standardised in the usual way on a scale of 0–100, with higher scores indicating fewer limitations [13].

Comorbidity was computed as a count of the number of physical comorbid conditions reported by the patient and chosen from a list of 13 frequently occurring comorbid conditions (arthritis, hypertension, cardio-vascular, emphysema, diabetes, etc.). Although alternative methods have been examined by other authors, simple counts of other diagnoses/problems have been found to represent adequately the impact of comorbid conditions [14].

All of the above measures, as well as demographics and information on cancer site and treatment, were elicited 3–6 weeks after hospital discharge. In addition, the patients were asked to complete the physical functioning subscale based not only on their current status, but also to recall their functional status retrospectively relative to a period approximately 3 months earlier, prior to their initial diagnosis.

Analyses

As an initial step, basic descriptive statistics were computed (means, standard deviations and pairwise correlation coefficients) for all study variables. The overall strategy for addressing both research aims involved the use of a multiple analysis of covariance model. To examine the effect of cancer site and treatment regimen, the dependent variables were the two physical functioning measures (limitations in physical activities and physical limitations in usual role activities), while cancer site and treatment type were included as factors. In order to assess the effects of various treatment modalities, treatment type was included in the form of a polytomous factor (surgery, radiation, surgery and radiation, neither). A number of patients (16.7%) were also undergoing chemotherapy, mostly in conjunction with either surgery or radiation, but surgery (38.8%) and radiation (36.1%) were the predominant therapies. Initially an attempt was made to

Table 1. *Means and standard deviations for all study variables* (n = 590)

Variable	Mean	Standard deviation
Age	71.8	5.19
Comorbidity	2.7	1.71
Retrospective physical functioning	79.7	26.06
Current physical functioning	65.7	29.40
Physical role limitations	44.7	40.59

include chemotherapy as an additional factor, but this resulted in a number of empty cells, making the analysis unreliable. Thus, the decision was made to concentrate on just the dominant therapies involved. To help justify this decision, we computed separate *t*-tests for each of the four treatment groups as well as the entire sample, and found no significant differences in either physical functioning or physical role limitations for any of the groups, according to whether the patient was undergoing chemotherapy or not. Finally, in order to distinguish the effects due to cancer site and treatment type, age, comorbidity and the retrospective physical functioning measure were entered into the model as covariates.

To examine the influence of gender, the sample was reduced to only those patients diagnosed with colon or lung cancer. The model used was essentially the same as before, with the only changes being the introduction of gender as an additional factor and reducing the cancer site factor to two categories.

RESULTS

Of the 590 patients, 51.7% were male and 48.3% were female. The breakdown according to cancer type was 30.7% breast cancer, 15.4% colon cancer, 22.0% lung cancer and 31.9% prostate cancer. The average age of the patients was 71.8 years. Means and standard deviations for all study variables are presented in Table 1.

As the correlations in Table 2 show, current physical functioning was strongly related to both past physical functioning and current physical role limitations. The comorbidity index also showed the expected relationships: moderate correlations indicating that patients with more comorbid conditions exhibited lower physical functioning and more physical role limitations. However, unexpectedly, age was not related to physical functioning or physical role limitations, and showed only a small positive correlation with the comorbidity count.

The multiple analysis of covariance for the whole sample population revealed that the covariates comorbidity and retrospective physical functioning had significant impact on current physical functioning (beta = −0.09, $t = -3.03$, $P = 0.003$ and beta = 0.55, $t = 17.54$, $P < 0.001$, respectively) and on physical role limitations (beta = −0.12, $t = -3.15$, $P = 0.002$ and beta = 0.18, $t = 4.38$, $P < 0.001$, respectively). Thus, patients with more comorbid conditions tended to report worse current physical functioning and more physical role limitations. Similarly, patients who retrospectively reported more limitations in physical activities tended to report more current limitations in physical functioning and more physical role limitations.

After adjusting for the values of the covariates (age, comorbidity and retrospective physical functioning), both cancer site and treatment type proved to be significant factors. It should be noted here that simple contrasts were used for both the treatment factor (reference category is neither surgery nor radiation) and the cancer site factor (reference category is prostate cancer). This means that the hypothesis being tested for each factor was that for the dependent variables, physical functioning and physical role limitations, the mean for each category did not differ from the mean for the appropriate reference category. Tables 3 and 4 show observed and adjusted mean scores for physical functioning and physical role limitations according to cancer site and treatment type, as well as the relevant contrast parameter estimates and corresponding confidence intervals.

Table 2. *Pairwise correlation coefficients for all variables* (n = 590)

	Age	Comorbidity	Retrospective physical functioning	Current physical functioning
Comorbidity	0.087*			
Retrospective physical functioning	−0.087*	−0.353†		
Current physical functioning	−0.040	−0.324†	0.618†	
Physical role limitations	0.017	−0.211†	0.257†	0.594†

*$P < 0.05$; †$P < 0.001$.

Table 3. *Observed and adjusted means for physical functioning and physical role limitations by cancer site; parameter estimates and* 95% *confidence intervals* (95% *CI*)* *for simple contrasts*† (n = 590)

Cancer site	Number of patients	Physical functioning			Physical role limitations		
		Observed	Adjusted‡	Coefficient (95% CI)	Observed	Adjusted‡	Coefficient (95% CI)
Breast	181	68.8	69.9	−1.37 (−8.00, 5.27)	45.0	46.3	−5.59 (−17.56, 6.38)
Colon	91	63.4	68.3	−2.97 (−13.95, 8.01)	39.4	44.6	−7.20 (−27.00, 12.60)
Lung	130	43.1	52.6	−18.63 (−26.14, −11.11)	26.7	34.3	−17.56 (−13.11, −4.01)
Prostate	188	75.4	71.3	Ref Ref	58.1	51.8	Ref Ref

*Confidence intervals of Bonferroni type. †Reference (Ref) category prostate cancer. ‡Adjusted for differences in age, comorbidity and retrospective physical functioning.

From Table 3 it is apparent that patients with lung cancer were worse off for both physical functioning and physical role limitations than patients with prostate cancer. Similarly, Table 4 reveals that those patients who had undergone surgery only were clearly worse off for physical functioning and physical role limitations than patients who had undergone neither surgery nor radiation. However, the interpretation of Tables 3 and 4 is clouded somewhat by the fact that the interaction effect between cancer site and treatment type also proved to be significant. From Table 5, which presents mean scores for physical functioning and physical role limitations according to cancer site and treatment type, we see that the relative rankings of the physical functioning and physical role limitations mean scores differ from one cancer site to the next, which is indicative of the interaction effect.

To investigate the interaction of cancer site and treatment type further, graphs were constructed separately for physical functioning and physical role limitations in terms of treatment type. As Figure 1(a) illustrates, physical functioning scores of prostate cancer patients were much lower for the surgery-only treatment option than for the other options, while colon cancer patients were better off under the no-treatment option. Otherwise, the four graphs are more or less parallel, as would be the case when no interaction is present. With respect to physical role limitations, Figure 1(b) reveals that surgery only was clearly much more limiting than the other treatment options for prostate cancer patients, while colon cancer patients experienced the most limitations under the surgery plus radiation treatment option, and the least limitations under the no-treatment option. In summary, the interaction effect seems to be related primarily to the prostate and colon sites, with little interaction effect evident among the breast and lung cancer patients.

To investigate the effect of gender the sample was reduced to just those patients suffering from colon or lung cancer, and the additional factor patient gender was introduced. The cancer site reference category for this analysis was taken as lung cancer. The situation in this case was more clear-cut, as none of the interaction terms showed significance. Of the covariates, only retrospective physical functioning showed significance, and this was only evident with relation to current physical functioning (beta = 0.47, $t = 7.52$, $P < 0.001$). There were no significant differences in physical functioning or physical role limitations according to patient gender. However, as before, there were differences according to cancer site and treatment type. More specifically, with respect to treatment type, differences were present for both physical functioning and physical role limitations, with patients who

Table 4. *Observed and adjusted means for physical functioning and physical role limitations by treatment type; parameter estimates and* 95% *confidence intervals* for simple contrasts*† (n = 590)

Treatment type	Number of patients	Physical functioning			Physical role limitations		
		Observed	Adjusted‡	Coefficient (95% CI)	Observed	Adjusted‡	Coefficient (95% CI)
Surgery only	229	57.9	53.1	−16.53 (−23.42, −9.62)	30.9	28.1	−23.28 (−35.73, −10.84)
Radiation only	213	67.5	68.2	−1.39 (−8.78, 6.01)	54.1	50.8	−0.58 (−13.92, 12.76)
Surgery and radiation	81	73.8	71.2	1.61 (−10.18, 13.41)	54.3	46.6	−4.80 (−26.07, 16.46)
Neither	67	65.4	69.6	Ref Ref	47.0	51.4	Ref Ref

*Confidence intervals of Bonferroni type. †Reference (Ref) category prostate cancer. ‡Adjusted for differences in age, comorbidity and retrospective physical functioning.

Table 5. *Observed and adjusted means for physical functioning and physical role limitations, by cancer site and by treatment type* (n = 590)

	n	Physical functioning		Physical role limitations	
		Observed	Adjusted	Observed	Adjusted
Breast					
Surgery only	79	66.0	65.3	37.1	36.5
Radiation only	25	67.7	76.0	42.7	46.2
Surgery and radiation	60	74.6	73.6	55.8	54.7
Neither	17	62.9	64.6	47.1	47.6
Colon					
Surgery only	63	60.0	57.8	31.3	30.0
Radiation only	16	62.5	62.5	50.0	50.3
Surgery and radiation	2	87.5	73.1	37.5	28.2
Neither	10	84.4	79.8	73.3	70.1
Lung					
Surgery only	32	39.1	41.2	20.3	23.7
Radiation only	69	42.4	53.7	27.9	34.3
Surgery and radiation	9	46.3	58.4	41.7	49.1
Neither	20	50.9	57.3	27.1	31.0
Prostate					
Surgery only	55	55.4	48.0	27.4	23.3
Radiation only	103	85.1	80.6	75.2	72.6
Surgery and radiation	10	91.5	79.8	60.0	54.4
Neither	20	72.6	76.7	53.8	57.0

received surgery only clearly worse off for both measures than patients who received neither surgery nor radiation. Finally, patients with colon cancer had better physical functioning and physical role limitation scores than those with lung cancer (see Table 6).

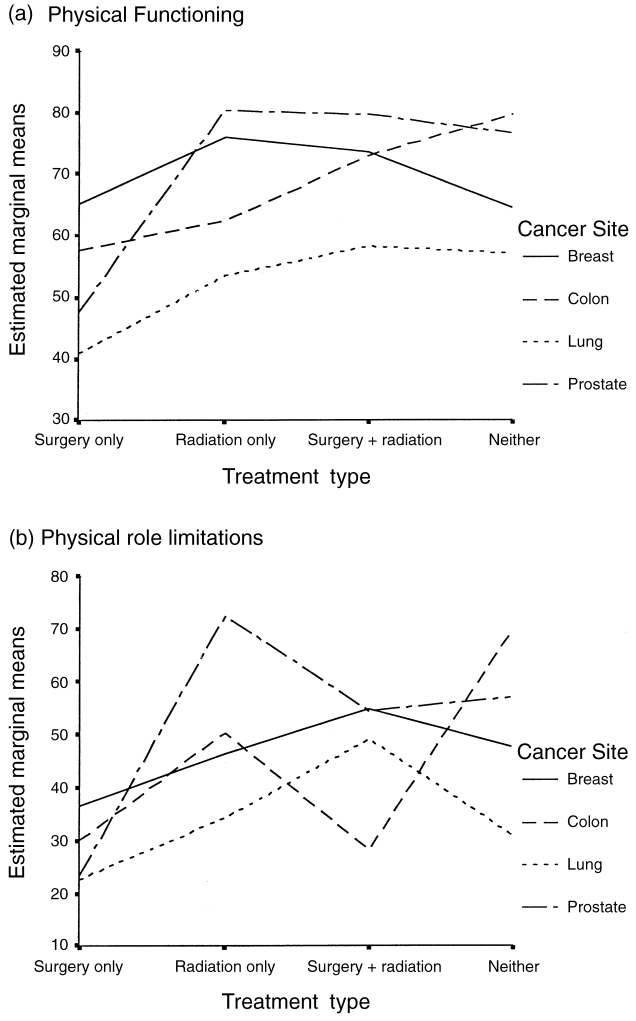

Figure 1. Estimated marginal means for (a) physical functioning and (b) physical role limitations according to treatment type ($n = 590$).

DISCUSSION

The patients in our sample were evenly divided in terms of gender. As our sample was drawn from an elderly population (minimum age 65 years, average age 71.8), there was no wide variation in age, and it is not surprising that age did not play a significant role in any of the analyses. Age was significantly correlated with comorbidity ($r = 0.087$), but a correlation this small has little practical significance. As expected, older patients tended to report more comorbid conditions, which is consistent with our previous results [6], in adult patients with cancer over the age of 20 years, where age and comorbidity were positively correlated.

Correlations among the other study variables were as anticipated, with more comorbid conditions corresponding to more limitations in physical functioning (both retrospective and current), and more physical role limitations. Also noteworthy (and expected) was the high correlation between the patients' retrospective and current physical functioning scores. Further evidence of this high correlation was revealed in the analysis of covariance which showed retrospective physical functioning, and to a lesser degree comorbidity, to be significant predictors of current physical functioning.

After adjusting for the covariates, significant differences were still observed for physical functioning and physical role limitations, with lung cancer patients being clearly more compromised with respect to both of these measures than patients with prostate cancer. These differences could be in part explained by the fact that lung cancer surgery (pneumonectomy or thoracotomy) is often quite debilitating and may require a longer recovery period. Ganz [15] has observed that because of a higher rate of comorbid cardiac and pulmonary disease, older lung cancer patients are at higher risk of complications stemming from surgical intervention. Furthermore, lung cancer is recognised as having one of the highest mortality rates, usually with a rapid rate of progression, and is the most frequent cause of cancer death for women [10]. The patients in our sample were surveyed approximately 3–6 weeks after discharge from the hospital, so it is also possible that those with lung cancer had deteriorated more rapidly than the other patients, making their lower physical functioning and physical role limitation scores understandable. In contrast, prostate cancer is often more in the nature of a chronic disease among the elderly, which may explain why our patients with prostate cancer seemed to be doing somewhat better.

Table 6. Combined observed and adjusted means for physical functioning and physical role limitations by gender, treatment type and cancer site for colon and lung cancer patients only (n = 221)

		Physical functioning		Physical role limitations	
	n	Observed	Adjusted*	Observed	Adjusted*
Gender					
Male	117	54.6	57.5	34.6	40.7
Female	104	48.0	56.9	29.1	36.7
Treatment type					
Surgery	95	52.6	46.7	27.6	23.6
Radiation	85	46.2	56.3	32.1	39.2
Surgery and radiation	11	53.8	62.6	40.9	47.6
Neither	30	62.1	63.1	42.5	44.5
Cancer site					
Colon	91	63.4	65.6	39.4	46.5
Lung	130	43.1	48.7	26.9	30.9

*Adjusted for differences in age, comorbidity and retrospective physical functioning.

Surgery alone was identified as the most debilitating treatment modality for the patients in our sample, in the sense that it was the only treatment option which showed statistically significant differences for physical functioning and physical role limitations when compared to the no-treatment option. This finding appears anomalous, since no such differences were found for the surgery plus radiation treatment option. This does not appear to be related to any interaction effect, as both physical functioning and physical role limitation scores were almost uniformly lower for surgery only as compared to surgery and radiation. One possible explanation for this phenomenon lies in the fact that there was some variation in the time between hospital discharge and the collection of data. A *t*-test revealed that the average time interval from surgery to interview was significantly longer for the surgery plus radiation group than for the surgery-only group ($t = 3.63$, $P < 0.001$). Thus, the patients reporting surgery only had less time to recover from their surgery (mean = 41 days), while those patients who reported surgery and radiation had more time to convalesce (mean = 83 days), and were most likely in the early stages of their radiation therapy. We also investigated the possibility that the differences in physical functioning and physical role limitations between the surgery-only and the surgery plus radiation groups could be related to the fact that some patients (16.7%) were also undergoing chemotherapy. Separate *t*-tests for each treatment group revealed no significant differences in either physical functioning or physical role limitations according to whether the patient was under chemotherapy or not under chemotherapy. Thus, concurrent chemotherapy does not appear to provide an explanation for the differences in physical functioning and physical role limitations observed between the surgery-only and surgery plus radiation groups.

The gender of the patient turned out to be irrelevant with regard to our measures of physical functioning and physical role limitations. The important additional information from this analysis was that, for the subset of patients with lung or colon cancer, lung cancer patients also had significantly lower physical functioning and physical role limitation scores than patients with colon cancer.

In summary, for this sample of geriatric cancer patients, retrospective physical functioning and to a lesser degree comorbidity were important predictors of current physical functioning and physical role limitations. Over and above these effects, both cancer site and treatment modality were found to play a significant role. These findings have implications for oncologists, primary care physicians and other health care personnel providing care for these patients, as they must make available appropriate supportive services to assist with the physical limitations of their patients, and thus maximise quality of life. It is important not only that they are cognizant of the fact that some cancers (particularly lung cancer) may be more physically debilitating than others, but that the patient's history of comorbid conditions and pre-existing physical limitations may be important factors in predicting current physical functioning.

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APPENDIX A

SF-36 Physical functioning subscale

The following items are activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

Activities		Yes, limited a lot	Yes, limited a little	No, not limited at all
a.	Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	1	2	3
b.	Moderate activities, such as moving a table, pushing a vacuum, bowling or playing golf	1	2	3
c.	Lifting or carrying groceries	1	2	3
d.	Climbing several flights of stairs	1	2	3
e.	Climbing one flight of stairs	1	2	3
f.	Bending, kneeling, or stooping	1	2	3
g.	Walking more than a mile	1	2	3
h.	Walking several blocks	1	2	3
i.	Walking one block	1	2	3
j.	Bathing or dressing yourself	1	2	3

SF-36 Physical role limitations subscale

During the past week, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

		Yes	No
a.	Cut down on the amount of time you spent on work or other activities	1	2
b.	Accomplished less than you would like	1	2
c.	Were limited in the kind of work or other activities	1	2
d.	Had difficulty performing the work or other activities (for example, it took extra effort)	1	2