



Original Article

Factors affecting the performance of activities of daily living in patients with advanced cancer undergoing inpatient rehabilitation: results from a retrospective observational study

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Abstract. [Purpose] Many clinicians believe that rehabilitation for patients with advanced cancer is futile. We determined factors affecting the performance of activities of daily living in patients with advanced cancer based on age, gender, marital status, living arrangement, rehabilitation intensity, type of cancer, impairment, metastasis, and active cancer treatment. [Participants and Methods] We assessed the Barthel Index to evaluate the performance of activities of daily living. Of the 120 adult patients with cancer who underwent inpatient rehabilitation, we analyzed the Barthel Index scores, consisting of 10 items, and reviewed the clinical characteristics from the medical records of 48 patients who completed supportive or palliative rehabilitation according to Dietz and showed an increased or maintained total Barthel Index score at final evaluation. [Results] The median total Barthel Index score increased from 45 (5–95) to 72.5 (5–100); the rehabilitation intensity was 320 (40–1,240) minutes. The analytical results showed that the increase of total Barthel Index score was positively associated with rehabilitation intensity ($\beta=0.350$) and negatively associated with the initial grooming score ($\beta=-0.277$). [Conclusion] Adequate rehabilitation positively affects performance of activities of daily living, especially in patients with advanced cancer who lost their grooming ability at the onset of rehabilitation. Importantly, rehabilitation may be beneficial for patients with advanced cancer.

Key words: Activities of daily living, Cancer inpatients, Palliative care

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INTRODUCTION

Cancer is one of the most prevalent, disabling, and costly medical conditions¹⁾. The number of people living with cancer has been increasing because of advances in the early detection and treatment of cancer, as well as aging and growth of the population²⁾. For most patients with advanced cancer, both the physiological effects of the cancer itself and cancer treatment can result in physical impairment³⁾. Such impairment, including dysfunction of the nervous, muscular, skeletal, and internal organ systems, is a factor that contributes to disabilities⁴⁾.

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Occupational and physical therapists work with critically ill patients to create realistic and meaningful goals for improving comfort, mobility, socialization, and performance of activities of daily living (ADL), regardless of disease state and medical status⁵). Dietz⁶) has classified cancer rehabilitation into four categories according to cancer patients' physical and demonstrated needs: preventive, restorative, supportive, and palliative. The Dietz classification, as summarized by Silver et al.⁷), is as follows: 1) Preventive includes interventions that will lessen the effect of expected disabilities; 2) Restorative includes interventions that attempt to return patients to previous levels of physical, psychological, social, and vocational functioning; 3) Supportive includes interventions designed to teach patients to adapt to their disabilities and minimize debilitating changes from ongoing disease; and 4) Palliative includes interventions focused on minimizing or eliminating complications and providing comfort and support. Dietz insisted that the treatment goal of rehabilitation should be selected for each patient after initial evaluation at the onset of care⁶).

Rehabilitation, even in the advanced phases of illness, can help to restore or maintain function or ameliorate the functional decline through exercises for range of motion, pain relief, and improving performance of ADL⁸). It is reasonable to assume that patients with advanced cancer may recover autonomy for performance of ADL, as do patients with other advanced and end-stage diseases⁹). However, many clinicians and researchers have held the view that for patients with advanced cancer, rehabilitation is futile, trivial, or even inappropriate¹⁰). By undergoing adequate rehabilitation, cancer patients in the restorative phase can increase the performance of ADL compared to patients in the supportive or palliative phase⁴). However, 73% of patients in the supportive phase who completed 90-day rehabilitation improved or maintained their performance of ADL¹¹). In addition, 239 of 301 patients with cancer undergoing rehabilitation in the palliative (defined as "terminal") phase increased the score of several items on the Barthel Index (BI) when they reached the maximum level of the performance of ADL¹²). The BI is widely used to assess functional performance of ADL¹³). Notwithstanding, there are no reports showing factors affecting the increase of total BI score of patients with advanced cancer undergoing rehabilitation in the supportive and palliative phases. We believe that finding the factors affecting the increase of total BI score of these patients may break through primary barriers to optimal delivery of rehabilitation in the supportive and palliative phases.

This study aimed to determine factors affecting the performance of ADL of patients with advanced cancer undergoing inpatient rehabilitation. We defined the patients with advanced cancer as patients who needed supportive or palliative rehabilitation under the Dietz classification⁶), and we analyzed only patients who increased or maintained their total BI score during rehabilitation.

PARTICIPANTS AND METHODS

This study was a retrospective observational study. All patients provided written informed consent. The study protocol was approved by the Institutional Review Board of our cancer center (Approval No. 405-27030) and was conducted as per the Helsinki Declaration¹⁴).

This study recruited all patients with cancer who were enrolled in our cancer center in Japan between July 8 and December 11, 2015 and who underwent inpatient rehabilitation conducted by occupational or physical therapists. The exclusion criteria were as follows: (1) death or inability to complete the rehabilitation because of worsening physical condition; and (2) being classified as having preventive or restorative needs under the Dietz classification⁶). Conversely, we included all patients with hematological malignancy because it was difficult to categorize them using the Dietz classification⁶). Moreover, we excluded 2 patients who obtained a full total BI score at the beginning of rehabilitation (the 'initial total BI score' in this study) and 4 patients who had an initial total BI score higher than the score at the end of rehabilitation (the 'final total BI score' in this study). We set these exclusion criteria because our purpose was to determine the factors affecting the increase of total BI score of patients with advanced cancer undergoing rehabilitation in the supportive and palliative phases.

We considered that the following demographic variables might be associated with performance of ADL in our patients: age, gender, marital status, living arrangement, rehabilitation intensity, type of cancer, impairment, metastasis, and active cancer treatment during rehabilitation. In this study, we defined rehabilitation intensity as the sum of rehabilitation units (one unit=20 minutes) throughout the rehabilitation intervention. In Japan, the universal healthcare insurance system allows patients with cancer to receive ≤ 6 units (120 minutes) of rehabilitation per day. Impairment was classified according to the International Classification of Functioning, Disability and Health¹⁵). Duplication in the type of cancer and impairment was permitted in this study. These patient demographics were extracted from the medical records of each patient by the authors who were occupational or physical therapists.

Generically, disability, age, gender¹⁶), marital status, and living arrangement¹⁷) affect performance of ADL. In patients with stroke, rehabilitation intensity has a good effect on increasing total BI score¹⁸). In previous studies of patients with cancer, the type of cancer, impairment, metastasis, and active cancer treatment during rehabilitation influenced the change in performance of ADL, although the conclusions differed^{4, 19, 20}).

We evaluated total BI score to assess performance of ADL. The BI consisted of 10 items: feeding, transfer, grooming, toileting, bathing, ambulation, stairs, dressing, bowels, and bladder²¹). The total BI score was calculated by summing the scores of all items²¹). The BI has been shown to be a reliable, valid, and responsive assessment of performance of ADL in patients with stroke²²). A score of 0 is given for each item when the patient cannot meet the criteria²¹). If the patient achieves a full total BI score of 100, she or he is able to live without attendant care²¹). We considered that the initial total and each

item of BI scores would be associated with an increase of total BI score and each item of BI score of patients in this study. A patients' initial total BI score is used to predict the final total BI in stroke patients^{23, 24}. In addition, there is a clear difference in the performance of each item of BI²⁵.

We also evaluated the patients' Eastern Cooperative Oncology Group Performance Status scale (PS)²⁶. The validity and reliability of PS have been shown to exhibit good results^{27, 28}. PS is ordinarily used to evaluate the severity of toxicity experienced by patients in cancer treatment trials^{27, 29}, but can also evaluate the performance of ADL³⁰, quality of life³¹, and psychological distress³² in these patients. The measurement uses a scale of 0 through 4, with 0 to 1 indicating good PS and 2 to 4 indicating poor PS^{29, 33}.

These evaluations were scored and collected at the beginning and end of a patient's rehabilitation by authors who were occupational or physical therapists who also provided rehabilitation.

The comprehensive rehabilitation procedures are listed here, based on a report by Yoshioka¹²: performance of ADL exercise, balance exercise, cognitive functioning exercise, comfortable or relaxed positioning with pillows for the relief of pain or prevention of joint contracture, discharge support, endurance training, introduction of self-help device, massage therapy, muscle strength exercise, prevention of lymphedema, psychological support, pulmonary rehabilitation, range of motion exercise, speech rehabilitation, swallowing exercise, use of brace, and others. Patients with advanced cancer have various symptoms such as fatigue, pain, lack of energy, weakness, and loss of appetite³⁴. Therefore, these procedures were used alone or in combination with some modifications, according to each patient's condition and complaints. In addition, rehabilitation intensity varied from 0 to 6 units (from 0 to 120 minutes) each day, based on the judgment of the occupational or physical therapist according to the patient's overall status. Rehabilitation was conducted either in the rehabilitation room or at the patient's residence. If their condition was well enough to continue the rehabilitation, it was continued until their hospital discharge or until their rehabilitation goal was achieved.

The increase of BI score was calculated as the final score minus the initial score. As dependent variables, we selected the increase of total BI score as well as the increase of each item of BI score. We used Spearman's rank correlation coefficient to explore correlations between an increase of total BI score and each item of BI score, as BI scores were not normally distributed. The obtained coefficient of correlation values was used to select the dependent variables from 10-increase of each item of BI. Although BI score was not normally distributed, to determine which variables were independently associated with the increase of total BI score and each item of BI score, a stepwise multiple regression analysis was performed. This was based on previous studies using multiple regression analysis to investigate predictive factors that were significantly associated with the change of total BI score, while noting that the BI score was not normally distributed^{35–37}.

We used the following items as independent variables: patient age, gender (1=male, 0=female), marital status (married, widowed, divorced, single, and unknown; 1=presence of each category, 0=absence of each category), living arrangements (living with family, living alone, and others; 1=presence of each category, 0=absence of each category), rehabilitation intensity, types of cancer (hematological malignancy, gastrointestinal, lung, genitourinary, breast, head and neck, and others; 1=presence of each category, 0=absence of each category), impairments (neuromusculoskeletal and movement-related functions; sensory functions and pain; functions of the cardiovascular, hematological, immunological and respiratory systems; mental functions; functions of the digestive, metabolic and endocrine systems; and structures of the nervous system; 1=presence of each category, 0=absence of each category), metastasis (1=yes, 0=no), active cancer treatments during rehabilitation (supportive care, chemotherapy, radiation therapy, and combination of chemotherapy and radiation therapy; 1=presence of each category, 0=absence of each category), and initial total BI score and each item of BI score. The reason we selected initial total BI score and each item of BI score as the independent variables was to evaluate the increase from baseline for total BI score and each item of BI score. Multicollinearity diagnostic testing was performed, and residual distribution was checked.

Statistical significance was set at a p-value of less than 0.05. All statistical analyses were performed using IBM SPSS Statistics version 25.

RESULTS

Initially, 120 Japanese patients who underwent inpatient rehabilitation were included in this study. The authors were able to obtain complete data for 119 of the patients. Rehabilitation was discontinued in 21 patients who died during hospitalization, and in 22 patients because of worsening condition. Eleven patients were identified as being in the prevention phase and another 11 as in the restorative phase. Two patients received a full initial total BI score, and 4 patients had lower final scores than the initial scores because of their worsening condition. Finally, 48 patients (21 males [44%]) with an average age of 69.0 years (SD=12.2, range 31–91 years) were included in this study (Fig. 1).

The basic demographic characteristics at baseline are shown in Table 1. Thirty-eight patients (79%) had metastasis. Active cancer treatment during rehabilitation was as follows: supportive care (n=23, 48%), chemotherapy (n=18, 38%), radiation therapy (n=4, 8%), and a combination of chemotherapy and radiation therapy (n=3, 6%).

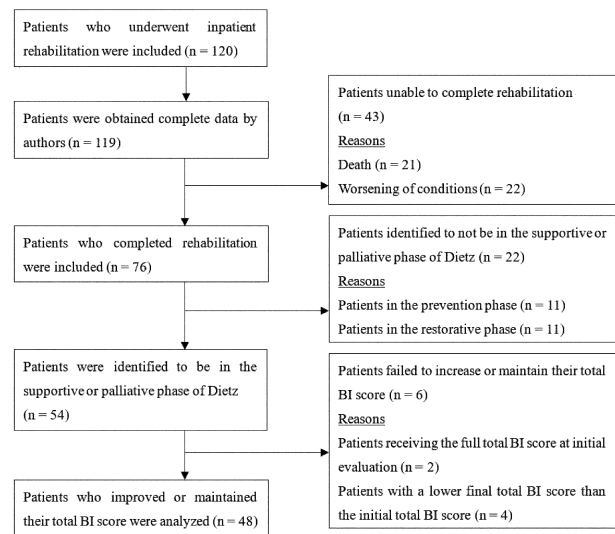
The median rehabilitation intensity was 320 (40–1,240) minutes. The PS at final evaluation was as follows: 0 (n=0, 0%), 1 (n=1, 2%), 2 (n=17, 35%), 3 (n=24, 50%), and 4 (n=6, 13%). The total BI score increased in 37 patients, while the initial BI scores were maintained in 11 patients. The initial and final BI scores are shown in Table 2.

The correlation coefficient between the increase of total BI score and increase of transfer score ($r=0.736$), ambulation

Table 1. Patient demographics at baseline (n=48)

Age in years, mean \pm SD (range)	69.0 \pm 12.2 (31–91)
Gender, n (%)	
Male	21 (44%)
Female	27 (56%)
PS, n (%)	
0	0 (0%)
1	1 (2%)
2	5 (10%)
3	34 (71%)
4	8 (17%)
Type of cancer, n (%)	
Hematological malignancy	19 (35%)
Gastrointestinal	11 (20%)
Lung	10 (18%)
Genitourinary	6 (11%)
Breast	3 (5%)
Head and neck	2 (4%)
Others	4 (7%)
Impairments classified according to ICF, n (%)	
Neuromusculoskeletal and movement-related functions	18 (32%)
Sensory function and pain	16 (29%)
Functions of the cardiovascular, hematological, immunological, and respiratory systems	10 (18%)
Mental functions	10 (18%)
Functions of the digestive, metabolic and endocrine systems	1 (2%)
Structures of the nervous system	1 (2%)
Marital status, n (%)	
Married	31 (65%)
Widowed	6 (13%)
Divorced	2 (4%)
Single	3 (6%)
Unknown	6 (13%)
Living arrangement, n (%)	
Living with family	40 (83%)
Living alone	6 (13%)
Others	2 (4%)

PS: Eastern Cooperative Oncology Group Performance Status scale; ICF: the International Classification of Functioning, Disability and Health.

**Fig. 1.** Study flow chart.

BI: Barthel Index.

Table 2. Median Barthel Index score of patients (n=48)

Each item (score range)	Initial		Final	
	Median	Range	Median	Range
Total (0–100)	45	5–95	72.5	5–100
Feeding (0–10)	10	0–10	10	0–10
Transfer (0–15)	10	0–15	12.5	0–15
Grooming (0–5)	0	0–5	5	0–5
Toileting (0–10)	5	0–10	10	0–10
Bathing (0–5)	0	0–5	0	0–5
Ambulation (0–15)	0	0–15	10	0–15
Stairs (0–10)	0	0–5	0	0–10
Dressing (0–10)	5	0–10	5	0–10
Bowels (0–10)	10	0–10	10	0–10
Bladder (0–10)	10	0–10	10	0–10

score ($r=0.706$), and toileting score ($r=0.614$) were particularly high ($p<0.001$).

The increase of total BI score was positively associated with rehabilitation intensity ($\beta=0.350$, $p=0.012$) and negatively associated with initial grooming score ($\beta=-0.277$, $p=0.042$) (Table 3).

The increase of ambulation score was positively associated with the initial total BI score ($\beta=0.452$, $p=0.041$) and negatively associated with initial ambulation score ($\beta=-0.728$, $p=0.001$) (Table 3). The increase of toileting score was negatively associated with being male ($\beta=-0.294$, $p=0.021$) and the initial toileting score ($\beta=-0.480$, $p<0.001$) (Table 3).

DISCUSSION

The increase of total BI score was positively associated with rehabilitation intensity and negatively associated with initial grooming score. Several studies have reported that intensive inpatient rehabilitation increases total BI score of patients with

Table 3. Result of stepwise multiple regression analysis of increase of total and each item of Barthel Index score (n=48)

Dependent variables	Independent variables	B	95% CI for β		Standardised β	p value	Adjusted R ²
			Lower limit	Upper limit			
Increase of total BI score	Rehabilitation intensity	0.525	0.123	0.926	0.350	0.012	0.202
	Initial grooming score	-2.265	-4.450	-0.080	-0.277	0.042	
Increase of transfer score	None						
Increase of ambulation score	Initial total BI score	0.090	0.004	0.175	0.452	0.041	0.180
	Initial ambulation score	-0.630	-1.005	-0.256	-0.728	0.001	
Increase of toileting score	Male	-1.499	-2.766	-0.233	-0.294	0.021	0.287
	Initial toileting score	-0.322	-0.489	-0.155	-0.480	<0.001	

CI: confidence interval.

stroke^{18, 38}). Similar results have been reported in stroke patients who had undergone post-discharge rehabilitation³⁹). Higher intensity rehabilitation increases total BI score of patients in post-acute care facilities^{40–43}). The effects of early rehabilitation intervention in an intensive care unit are still obscure⁴⁴). Our results suggest that even patients with advanced cancer enjoy benefits from adequate rehabilitation, as is the case with patients with other diseases. Cheville et al.⁹) suggest that rehabilitation should be considered for all patients with advanced cancer who are experiencing functional decline. We believe this novel finding will promote the utilization of cancer rehabilitation, regardless of the phase of patients. In this study we noticed an improvement of PS score, which includes the assessment of psychological aspects^{32, 45}). Psychological effects may partly contribute to the beneficial effects of rehabilitation for patients with advanced cancer. Therefore, rehabilitation may be beneficial for patients with advanced cancer.

We also found that increase of total BI score was influenced by grooming ability as assessed at the onset of rehabilitation. Grooming requires patients to use devices or instruments, such as razors for shaving⁴⁶). In addition, grooming is the ADL which is most affected in patients with cancer, along with walking and transfer⁴⁷). This result shows that the initial grooming score may be a predictor of increase of total BI score in patients with advanced cancer.

Being male negatively affected increase of toileting score. Despite increased attention on gender, obstacles remain to measuring the influence of gender differences in health research⁴⁸). In patients with stroke, multivariate analyses found that male patients had a three times higher probability than female patients of reaching a final high total BI score⁴⁹). Male as well as increased comorbidity and greater age are considered to indicate a lower capacity for functional recovery in patients with hip fracture⁵⁰). In recovery following mild traumatic brain injury, gender is not a strong prognostic indicator for recovery⁵¹). Adequate rehabilitation may improve the toileting ability of male cancer patients, although these reports suggest that there is insufficient evidence for a gender-specific effect, particularly because the correlation coefficient between the increase of total BI score and toileting score was high.

Our retrospective observational study with no control group has several limitations. First, we were unable to control for the following items. Our study population was heterogeneous in terms of cancer type, so that the cancers were of different severity and had varying speeds of progression. Our rehabilitation procedure was adjusted to individual needs. We did not evaluate physiological function such as handgrip strength and submaximal exercise capacity, but these factors may affect the increase of BI score. Accordingly, we were unable to rule out which factor is the most effective for determining the performance of ADL in our patients. Second, there was a selection bias. We included a small number of patients who underwent rehabilitation at a single institution in Japan. From this, the statistical power of the results was limited, and a type II error might have occurred. We analyzed only patients who increased or maintained their total BI score during rehabilitation. Therefore, we cannot generalize the present results for all patients with advanced cancer. Third, there is an information bias. The assessment, rehabilitation procedures, and data collection were conducted by authors who were occupational or physical therapists because of rehabilitation staff shortages. Finally, rehabilitation intensity may be affected by the duration of hospitalization and rehabilitation intervention, as well as rehabilitation frequency. We have to illuminate the relation between these items and increase of total BI score in further studies.

In conclusion, rehabilitation intensity had a positive effect regarding the increase of total BI score in this retrospective, observational study of patients with advanced cancer undergoing inpatient rehabilitation. Our results suggest that adequate rehabilitation has a positive effect on performance of ADL, especially when grooming ability is lost at the onset of rehabilitation. We believe that the current study supports rehabilitation for patients with advanced cancer. Nevertheless, further randomized control studies are needed to determine factors affecting the performance of ADL of patients with advanced cancer.

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Conflict of interest

None.

REFERENCES

- 1) Silver JK, Baima J, Mayer RS: Impairment-driven cancer rehabilitation: an essential component of quality care and survivorship. *CA Cancer J Clin*, 2013, 63: 295–317. [Medline] [CrossRef]
- 2) Miller KD, Siegel RL, Lin CC, et al.: Cancer treatment and survivorship statistics, 2016. *CA Cancer J Clin*, 2016, 66: 271–289. [Medline] [CrossRef]
- 3) Loescher LJ, Welch-McCaffrey D, Leigh SA, et al.: Surviving adult cancers. Part 1: Physiologic effects. *Ann Intern Med*, 1989, 111: 411–432. [Medline] [CrossRef]
- 4) Cole RP, Scialla SJ, Bednarz L: Functional recovery in cancer rehabilitation. *Arch Phys Med Rehabil*, 2000, 81: 623–627. [Medline] [CrossRef]
- 5) Kasven-Gonzalez N, Souverain R, Miale S: Improving quality of life through rehabilitation in palliative care: case report. *Palliat Support Care*, 2010, 8: 359–369. [Medline] [CrossRef]
- 6) Dietz JH Jr: *Rehabilitation Oncology*. New York: John Wiley & Sons, 1981.
- 7) Silver JK, Raj VS, Fu JB, et al.: Cancer rehabilitation and palliative care: critical components in the delivery of high-quality oncology services. *Support Care Cancer*, 2015, 23: 3633–3643. [Medline] [CrossRef]
- 8) Barawid E, Covarrubias N, Tribuzio B, et al.: The benefits of rehabilitation for palliative care patients. *Am J Hosp Palliat Care*, 2015, 32: 34–43. [Medline] [CrossRef]
- 9) Cheville AL, Kornblith AB, Basford JR: An examination of the causes for the underutilization of rehabilitation services among people with advanced cancer. *Am J Phys Med Rehabil*, 2011, 90: S27–S37. [Medline] [CrossRef]
- 10) Santiago-Palma J, Payne R: Palliative care and rehabilitation. *Cancer*, 2001, 92: 1049–1052. [Medline] [CrossRef]
- 11) O'Toole DM, Golden AM: Evaluating cancer patients for rehabilitation potential. *West J Med*, 1991, 155: 384–387. [Medline]
- 12) Yoshioka H: Rehabilitation for the terminal cancer patient. *Am J Phys Med Rehabil*, 1994, 73: 199–206. [Medline] [CrossRef]
- 13) Liu W, Unick J, Galik E, et al.: Barthel Index of activities of daily living: item response theory analysis of ratings for long-term care residents. *Nurs Res*, 2015, 64: 88–99. [Medline] [CrossRef]
- 14) World Medical Association: <https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/> (Accessed Apr. 26, 2019)
- 15) World Health Organization: ICF: International Classification of Functioning, Disability and Health; International Classification of Impairments, Disabilities and Handicaps revised and renamed [in Japanese], 3rd ed. Tokyo: Chouhoki Shuppan, 2002.
- 16) Spector WD, Fleishman JA: Combining activities of daily living with instrumental activities of daily living to measure functional disability. *J Gerontol B Psychol Sci Soc Sci*, 1998, 53: S46–S57. [Medline] [CrossRef]
- 17) Wang D, Zheng J, Kurosawa M, et al.: Changes in activities of daily living (ADL) among elderly Chinese by marital status, living arrangement, and availability of healthcare over a 3-year period. *Environ Health Prev Med*, 2009, 14: 128–141. [Medline] [CrossRef]
- 18) Kwakkel G, van Peppen R, Wagenaar RC, et al.: Effects of augmented exercise therapy time after stroke: a meta-analysis. *Stroke*, 2004, 35: 2529–2539. [Medline] [CrossRef]
- 19) Marciniak CM, Sliwa JA, Spill G, et al.: Functional outcome following rehabilitation of the cancer patient. *Arch Phys Med Rehabil*, 1996, 77: 54–57. [Medline] [CrossRef]
- 20) Sabers SR, Kokal JE, Girardi JC, et al.: Evaluation of consultation-based rehabilitation for hospitalized cancer patients with functional impairment. *Mayo Clin Proc*, 1999, 74: 855–861. [Medline] [CrossRef]
- 21) Mahoney FI, Barthel DW: Functional evaluation: The Barthel Index. *Md State Med J*, 1965, 14: 61–65. [Medline]
- 22) Hsueh IP, Lee MM, Hsieh CL: Psychometric characteristics of the Barthel activities of daily living index in stroke patients. *J Formos Med Assoc*, 2001, 100: 526–532. [Medline]
- 23) Kwakkel G, Veerbeek JM, Harmeling-van der Wel BC, et al. Early Prediction of functional Outcome after Stroke (EPOS) Investigators: Diagnostic accuracy of the Barthel Index for measuring activities of daily living outcome after ischemic hemispheric stroke: does early poststroke timing of assessment matter? *Stroke*, 2011, 42: 342–346. [Medline] [CrossRef]
- 24) Loewen SC, Anderson BA: Predictors of stroke outcome using objective measurement scales. *Stroke*, 1990, 21: 78–81. [Medline] [CrossRef]
- 25) Wade DT, Hower RL: Functional abilities after stroke: measurement, natural history and prognosis. *J Neurol Neurosurg Psychiatry*, 1987, 50: 177–182. [Medline] [CrossRef]
- 26) Oken MM, Creech RH, Tormey DC, et al.: Toxicity and response criteria of the Eastern Cooperative Oncology Group. *Am J Clin Oncol*, 1982, 5: 649–655. [Medline] [CrossRef]
- 27) Conill C, Verger E, Salamero M: Performance status assessment in cancer patients. *Cancer*, 1990, 65: 1864–1866. [Medline] [CrossRef]
- 28) Guyatt GH: Measurement of health-related quality of life in heart failure. *J Am Coll Cardiol*, 1993, 22: 185A–191A. [Medline] [CrossRef]
- 29) Atkinson TM, Andreotti CF, Roberts KE, et al.: The level of association between functional performance status measures and patient-reported outcomes in cancer patients: a systematic review. *Support Care Cancer*, 2015, 23: 3645–3652. [Medline] [CrossRef]
- 30) West HJ, Jin JO: JAMA Oncology Patient Page. Performance status in patients with cancer. *JAMA Oncol*, 2015, 1: 998. [Medline] [CrossRef]
- 31) Ganz PA, Haskell CM, Figlin RA, et al.: Estimating the quality of life in a clinical trial of patients with metastatic lung cancer using the Karnofsky performance status and the Functional Living Index—Cancer. *Cancer*, 1988, 61: 849–856. [Medline] [CrossRef]
- 32) Mei Hsien CC, Wan Azman WA, Md Yusof M, et al.: Discrepancy in patient-rated and oncologist-rated performance status on depression and anxiety in cancer: a prospective study protocol. *BMJ Open*, 2012, 2: 2. [Medline] [CrossRef]
- 33) Tian J, Chen ZC, Hang LF: Effects of nutritional and psychological status of the patients with advanced stomach cancer on physical performance status. *Support Care Cancer*, 2009, 17: 1263–1268. [Medline] [CrossRef]

- 34) Teunissen SC, Wesker W, Kruitwagen C, et al.: Symptom prevalence in patients with incurable cancer: a systematic review. *J Pain Symptom Manage*, 2007, 34: 94–104. [[Medline](#)] [[CrossRef](#)]
- 35) Di Monaco M, Vallero F, Di Monaco R, et al.: Muscle mass and functional recovery in men with hip fracture. *Am J Phys Med Rehabil*, 2007, 86: 818–825. [[Medline](#)] [[CrossRef](#)]
- 36) Yohannes AM, Roomi J, Waters K, et al.: A comparison of the Barthel index and Nottingham extended activities of daily living scale in the assessment of disability in chronic airflow limitation in old age. *Age Ageing*, 1998, 27: 369–374. [[CrossRef](#)]
- 37) Wakabayashi H, Sashika H: Malnutrition is associated with poor rehabilitation outcome in elderly inpatients with hospital-associated deconditioning a prospective cohort study. *J Rehabil Med*, 2014, 46: 277–282. [[Medline](#)] [[CrossRef](#)]
- 38) Yagi M, Yasunaga H, Matsui H, et al.: Impact of rehabilitation on outcomes in patients with ischemic stroke: a nationwide retrospective cohort study in Japan. *Stroke*, 2017, 48: 740–746. [[Medline](#)] [[CrossRef](#)]
- 39) Liu H, Lou VW: Functional recovery of older stroke patients discharged from hospital to home: the effects of cognitive status and different levels of therapy intensity. *J Clin Nurs*, 2019, 28: 47–55. [[Medline](#)] [[CrossRef](#)]
- 40) Lee WJ, Cheng YY, Liu CY, et al.: Dose-dependent effect of rehabilitation in functional recovery of older patients in the post-acute care unit. *Arch Gerontol Geriatr*, 2012, 54: e290–e293. [[Medline](#)] [[CrossRef](#)]
- 41) Lenze EJ, Host HH, Hildebrand MW, et al.: Enhanced medical rehabilitation increases therapy intensity and engagement and improves functional outcomes in postacute rehabilitation of older adults: a randomized-controlled trial. *J Am Med Dir Assoc*, 2012, 13: 708–712. [[Medline](#)] [[CrossRef](#)]
- 42) Chiodo LK, Gerety MB, Mulrow CD, et al.: The impact of physical therapy on nursing home patient outcomes. *Phys Ther*, 1992, 72: 168–173, discussion 173–175. [[Medline](#)] [[CrossRef](#)]
- 43) Jette DU, Warren RL, Wirtalla C: The relation between therapy intensity and outcomes of rehabilitation in skilled nursing facilities. *Arch Phys Med Rehabil*, 2005, 86: 373–379. [[Medline](#)] [[CrossRef](#)]
- 44) Doiron KA, Hoffmann TC, Beller EM: Early intervention (mobilization or active exercise) for critically ill adults in the intensive care unit. *Cochrane Database Syst Rev*, 2018, 3: CD010754. [[Medline](#)]
- 45) Sørensen JB, Klee M, Palshof T, et al.: Performance status assessment in cancer patients. An inter-observer variability study. *Br J Cancer*, 1993, 67: 773–775. [[Medline](#)] [[CrossRef](#)]
- 46) Gialanella B, Santoro R, Ferlucci C: Predicting outcome after stroke: the role of basic activities of daily living predicting outcome after stroke. *Eur J Phys Rehabil Med*, 2013, 49: 629–637. [[Medline](#)]
- 47) Neo J, Fettes L, Gao W, et al.: Disability in activities of daily living among adults with cancer: a systematic review and meta-analysis. *Cancer Treat Rev*, 2017, 61: 94–106. [[Medline](#)] [[CrossRef](#)]
- 48) Johnson JL, Greaves L, Repta R: Better science with sex and gender: facilitating the use of a sex and gender-based analysis in health research. *Int J Equity Health*, 2009, 8: 14. [[Medline](#)] [[CrossRef](#)]
- 49) Paolucci S, Bragoni M, Coiro P, et al.: Is sex a prognostic factor in stroke rehabilitation? A matched comparison. *Stroke*, 2006, 37: 2989–2994. [[Medline](#)] [[CrossRef](#)]
- 50) Radosavljevic N, Nikolic D, Lazovic M, et al.: Estimation of functional recovery in patients after hip fracture by Berg Balance Scale regarding the sex, age and comorbidity of participants. *Geriatr Gerontol Int*, 2013, 13: 365–371. [[Medline](#)] [[CrossRef](#)]
- 51) Cancelliere C, Donovan J, Cassidy JD: Is sex an indicator of prognosis after mild traumatic brain injury: a systematic analysis of the findings of the World Health Organization Collaborating Centre task force on mild traumatic brain injury and the International Collaboration on Mild Traumatic Brain Injury Prognosis. *Arch Phys Med Rehabil*, 2016, 97: S5–S18. [[Medline](#)] [[CrossRef](#)]