Original Article

Days Spent at Home near the End of Life in Japanese Elderly Patients with Lung Cancer: *Post hoc* Analysis of A Prospective Study

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ABSTRACT

Objective: Days spent at home (DASH) near the end of life is considered an important patient-centered goal and outcome because many patients want to stay at home toward the end of life. This study aimed to estimate the individual DASH near the end of life and identify its early predictors, including muscle mass and physical function, among elderly patients with advanced non-small-cell lung cancer (NSCLC). **Methods:** We conducted a *post hoc* analysis of the prospective observational study (UMIN000009768) that recruited patients aged ≥ 70 years who were scheduled to undergo first-line chemotherapy because of advanced NSCLC. We measured the muscle mass by bioelectrical impedance analysis at baseline. DASH was calculated as 30 days minus the number of days spent in hospitals, palliative care facilities, or nursing homes during the last 30 days of life. We performed linear regression analyses to evaluate the predictors of DASH. **Results:** Altogether, 16 women and 28 men with a median overall survival of 15.5 months (range: 2.9–58.9) were included. The median DASH in the last 30 days of life was 8 days (range: 0–30, interquartile range: 0–23). Men had longer DASH than women by 7.3 days. Patients who had good trunk muscle mass index and hand-grip strength had significantly longer DASH than those who did not (4.7 days per kg/m^2 increase [P = 0.017] and 0.4 days per kg increase [P = 0.032], respectively). **Conclusions:** Most elderly patients with advanced NSCLC had a limited DASH near the end of life. The risk factors for reduced DASH were women, reduced muscle mass, and poor physical function at the time of diagnosis of advanced NSCLC. Our findings would encourage early discussions about end-of-life care for patients with advanced cancers with risk factors for short DASH at the time of diagnosis, and thus, improve the quality of end-of-life care.

Key words: Days spent at home, elderly, muscle mass, non-small-cell lung cancer, physical function

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Introduction

The number of elderly people living with advanced lung cancer is increasing worldwide, owing to the aging population and advances in cancer treatment.[1,2] These patients frequently visit the emergency room and are usually hospitalized during the last few months of their lives, which reduces their quality of life and inflates health-care costs near the end of life.[3,4] Optimal psychosocial support, home care, and hospice care may alleviate this burden and improve the quality of life near the end of life for both patients and their families. Besides, it may reduce the use of health-care resources.[5-9]

Statistics on hospital deaths and hospitalizations near end of life for patients with cancer reflect the quality of end-of-life care.[10,11] Recently, days spent at home (DASH) near the end of life has drawn attention as an important quality measure.[12,13] DASH is considered an important patient-centered goal[12,13] because many cancer patients prefer to stay at home toward the end of life.[14] Identifying the predictors of DASH at the time of diagnosis could allow us to provide early support to improve the quality of end-of-life care. Women and nonusers of palliative care reportedly have less DASH.[15,16]

Elderly patients with advanced non-small-cell lung cancer (NSCLC) have been reported to have reduced skeletal muscle mass and physical function at the time of diagnosis.[17] Besides, these patients have been reported to be more frequently disabled in later life and require prolonged hospitalization.[18] Therefore, we hypothesized that reduced muscle mass and physical function at the time of diagnosis might shorten DASH near the end of life.

However, there is limited information on individually measured DASH in populations with specific cancer types. Besides, the early predictors of DASH at the time of diagnosis are not precisely known. Accordingly, this study aimed to estimate the individual DASH near the end of life and identify its early predictors, including muscle mass and physical function, among elderly patients with advanced NSCLC.

Methods

Patient selection

We performed *post hoc* analysis of the results of a prospective observational study[17] that recruited patients from January 2013 at the Shizuoka Cancer Center, Japan. This prospective observational study was approved by the institutional review board and was registered on the University Hospital Medical Information Network Clinical Trials Registry in Japan (Registration No. UMIN000009768). The eligibility criteria used in the original observational study were as follows: (1) histologically and/or cytologically proven Stage III or IV NSCLC including postoperative recurrence; (2) patients aged ≥70 years, with planned first-line systemic chemotherapy; (3) no previous systemic chemotherapy or thoracic radiotherapy (adjuvant chemotherapy was not counted as prior chemotherapy); (4) Eastern Cooperative Oncology Group performance status (PS) of 0–2; (5) ability to ambulate, read, and respond to questions without assistance; and (6) expected survival of >12 weeks. Patients were excluded if they had severe psychiatric disorder, active infectious disease, unstable cardiac disease, or untreated symptomatic brain or bone metastases that prevented safety assessment. The attending physicians screened patients with newly diagnosed advanced NSCLC to ascertain if they were eligible. Staff of the research office double checked each patient's eligibility and explained the clinical study to the patients. Finally, patients participated in the study after proving written informed consent. This *post hoc* analysis was planned and conducted from 2019 to 2020. Patients in the original observational study whose DASH and baseline measurement of muscle mass and physical function were available were included in this *post hoc* analysis.

Data collection

Body mass index (BMI, kg/m^2), incremental shuttle walking distance (ISWD, m), hand-grip strength (kg), muscle mass (kg), age, PS, stage, treatment, comorbidities, and family structures were assessed at baseline in the original prospective observational study. The baseline period was between enrollment into the study to initiation of the first session of chemotherapy. The attending physicians and physiotherapists assessed the BMI, ISWD, hand-grip strength, and muscle mass of the patients. These variables were treated as potential predictors of DASH in the *post hoc* analysis, according to the previous studies.[15,16,19] DASH, place of death, and frequency of hospitalization were collected retrospectively from electronic medical records and used in this *post hoc* analysis.

Assessment of physical function

Physiotherapists assessed the ISWD and hand-grip strength on the dominant side. An incremental shuttle walking test was conducted based on the recent guideline[20] and the original protocol presented by Singh *et al*.[21] We set a 10-m course in the hospital corridor. The walking speed was dictated by a timed signal played on a compact disc recorder provided by the manufacturer (Japanese version, the Graduate School of Biomedical Sciences, Nagasaki University, Japan, 2000). Assessments for all patients were conducted once under standardized conditions while ensuring that the patients did not exceed their exercise

limit. An instructor accompanied the patients along the course during the assessments but did not interfere with the process by providing encouragement. The assessment was concluded (1) by the patient when they were exhausted and unable to maintain the required walking speed, (2) by the instructor when the patient could not complete a shuttle within the allotted time (i.e., walk for >0.5 m away from the cone within the set time), or (3) when the patient presented a heart rate ≥85% of the predicted maximal heart rate derived using the formula (210 − [0.65 × age]). ISWD denotes the maximum walking distance. Hand-grip strength was measured using a grip strength dynamometer (GRIP-D, Takei Scientific Instruments Co., LTD, Niigata, Japan). The patients stood in an upright position and held the dynamometer in one hand in accordance with the adjusted grip range to ensure that the second joint of the forefinger was bent at 90°. The instrument was then held down beside the patient, with the arm completely extended and not touching the body. The patients were then asked to exert complete force with their hand for approximately 3 s to yield the maximum kilogram-force. Here, the instructor provided verbal encouragement to elicit a maximum response from the patients. A trial was performed for each hand, and the result from the dominant hand was used for the analysis.

Anthropometric and muscle mass measurements

The body weight (kg) was measured to the nearest 0.1 kg, and the BMI was subsequently calculated. The muscle mass (kg) and body weight were measured by bioelectrical impedance analysis using the Body Composition Analyzer BC-118 (Tanita Corp., Tokyo, Japan). The recommended conditions for bioelectrical impedance analysis measurement were explained to the subjects: (1) fasting for 4 h and no consumption of alcohol for 8 h before measurement; (2) bladder to be voided before measurement; and (3) no exercise to be performed within 8 h before the measurement.[22] Patients stood on the footplate electrodes and grasped the hand-grip electrodes with both hands. The electrodes emitted current through both feet and hands distally, and the current was detected at the heels of both feet and palms of both hands. This system applies electricity at frequencies of 5, 50, 250, and 500 kHz through the body. The whole-body impedance was measured using an ipsilateral foot–hand electrical pathway. Appendicular skeletal muscle mass (kg) was derived as the sum of the muscle mass of the arms and legs. Trunk muscle mass (kg) was calculated by subtracting the appendicular skeletal muscle mass from the overall muscle mass. The overall muscle mass, trunk muscle mass, and appendicular skeletal muscle mass were converted to an overall muscle mass index, trunk muscle mass index, and appendicular skeletal muscle mass index, respectively, by dividing them by the square of height in meters (kg/m^2).[23] Muscle depletion was defined as appendicular skeletal muscle mass index of <7.0 kg/m^2 in men and <5.8 kg/m^2 in women.[24]

Calculation of days spent at home

The data on days between admission and discharge from the health-care facilities were obtained from electronic medical records. DASH was defined as 30 days minus the number of days spent in health-care facilities in the last 30 days of life including the date of death. Health-care facilities included a hospital, palliative care facility, or nursing home. The date of admission and the date of discharge were considered as days spent in health-care facilities. In the case of multiple admissions and discharges, the total number of days spent in the facilities was defined as the sum of the number of days in each facility.

Place of death and frequency of hospitalization

The place of death and the number of hospitalizations in the last 30 days of life were obtained from electronic medical records.

Statistical analysis

Patient baseline characteristics were presented as medians, ranges, counts, and percentages for the entire cohort and then by sex. The median, first and third quartiles, and range of DASH were calculated. Distributions of the place of death and the number of hospitalizations in the last 30 days of life were evaluated. We performed univariate linear regression analyses to evaluate the predictors of DASH. Candidate predictors included age, gender, PS, stage, treatment, comorbidities, sarcopenia, family structures, muscle mass indexes, physical function, and BMI. To adjust for confounding factors, we performed multivariate linear regression analyses with DASH as the outcome variable. In multivariate regression analyses, sex was used as a predictor variable because it was considered a potential confounding factor and a significant variable in the univariate regression analysis. Muscle mass indexes and physical function were separately included in multivariate regression analyses to avoid multicollinearity. In summary, we conducted multivariate linear regression analyses five times with two predictor variables (one was sex, and the other was one of muscle mass indexes and physical function). The R^2 values were calculated to evaluate the goodness of fit in the multivariate linear regression models. A two-sided $P < 0.05$ was considered statistically significant. We used the R statistical package version 3.5.1 (R Core Team, July 2018; www.r-project.org) for statistical analyses.

Results

Patient characteristics at baseline

In the original observational study, a total of 61 patients were screened between January 2013 and November 2014, and sixty were enrolled in the study [Figure 1]. In this *post hoc* analysis, 15 patients were excluded from the analysis because DASH could not be measured in: (1) patients who were transferred to other hospitals (n = 11), (2) patients who were alive until the cutoff date (n = 3), and (3) patient who died within 30 days from enrollment (n = 1). One patient was excluded from this analysis because of missing data on muscle mass and physical function. Finally, 44 patients were included in this *post hoc* analysis. The median age at diagnosis was 76 years [range, 70–87; Table 1]. Twenty-eight patients (64%) were men, and 16 (36%) were women. A majority of the patients had PS of 0–1 (97%). Eighteen patients with locally advanced disease (41%) received curative intent radiotherapy with or without chemotherapy, while 26 with metastatic disease (59%) received palliative chemotherapy. The chemotherapy regimens included carboplatin (n = 11), docetaxel (n = 8), carboplatin + paclitaxel (n = 5), gefitinib (n = 6), cisplatin + pemetrexed (n = 4), cisplatin + vinorelbine (n = 2), carboplatin + paclitaxel + motesanib (n = 2), and cisplatin + gemcitabine (n = 1). The most common comorbidities were chronic obstructive pulmonary disease in 22 patients (50%) and Type 2 diabetes mellitus in ten patients (23%). Men had a higher incidence of comorbidities than women. Most of the patients (n = 41, 93%) lived with their families, whereas three patients (7%) lived alone. There were no gender differences in terms of age, BMI, PS, stage, initial treatment, and family structure. The overall, trunk, and appendicular skeletal muscle mass index and hand-grip strength were higher among men than among women [Table 2]. Muscle depletion was diagnosed in 26 (59%) patients at baseline and was comparable between

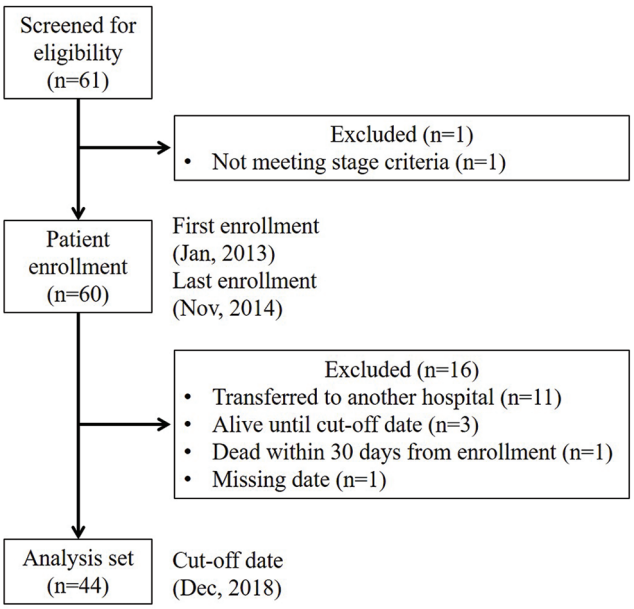

Figure 1: Flow diagram of patient screening, enrollment, follow-up, and analysis set

Table 1: Baseline characteristics of the patients

Variables	All (n=44), n (%)	Men (n=28), n (%)	Women (n=16), n (%)
Age, years, median (range)	76 (70-87)	75 (70-87)	76 (70-86)
BMI, kg/m^2 median (range)	21.7 (14.4-29.3)	22.3 (16.1-29.3)	21.4 (14.4-27.0)
ECOG-PS			
0	16 (36)	10 (36)	6 (38)
1	27 (61)	18 (64)	9 (56)
2	1 (2)	0 (0)	1 (6)
Stage‡			
Locally advanced	18 (41)	12 (43)	6 (38)
Metastatic	26 (59)	16 (57)	10 (63)
Treatment			
Curative radiotherapy±chemotherapy	18 (41)	12 (43)	6 (38)
Palliative chemotherapy	26 (59)	16 (57)	10 (63)
Comorbidities			
COPD	22 (50)	17 (61)	5 (31)
Type 2 diabetes mellitus	10 (23)	9 (32)	1 (6)
Ischemic heart disease	6 (14)	4 (14)	2 (13)
Cerebrovascular disease	3 (7)	3 (11)	0 (0)
Family structures			
Living alone	3 (7)	1 (4)	2 (13)
Living with family	41 (93)	27 (96)	14 (88)

‡Locally advanced means Stage IIIA or IIIB and metastatic means Stage IV or postoperative recurrence. BMI: Body mass index, ECOG-PS: Eastern Cooperative Oncology Group performance status, COPD: Chronic obstructive pulmonary disease

Table 2: Baseline body composition and physical function

Variables	All ($n=44$)	Men ($n=28$)	Women ($n=16$)
Body composition*, kg/m^2, median (range)			
Overall muscle mass index	14.7 (10.5-19.2)	15.8 (13.4-19.2)	13.8 (10.5-14.8)
Trunk muscle mass index†	8.5 (6.5-10.7)	9.0 (7.7-10.7)	8.0 (6.5-8.5)
Appendicular skeletal muscle mass index	6.3 (4.0-8.5)	6.9 (5.6-8.5)	5.6 (4.0-6.6)
Muscle depletion‡, *n* (%)	26 (59)	16 (57)	10 (63)
Physical function, median (range)			
Hand-grip strength, dominant side (kg)	28.3 (14.6-46.9)	31.5 (14.6-46.9)	20.8 (16.3-29.8)
ISWD (m)	290 (80-640)	290 (80-640)	280 (170-450)

*The muscle mass index was defined as the muscle mass (kg) divided by the square of height (m), †The trunk muscle mass was defined as the overall muscle mass minus the appendicular skeletal muscle mass, ‡Muscle depletion was defined as appendicular skeletal muscle mass index<7.0 kg/m^2 in men and<5.8 kg/m^2 in women. ISWD: Incremental shuttle walking distance

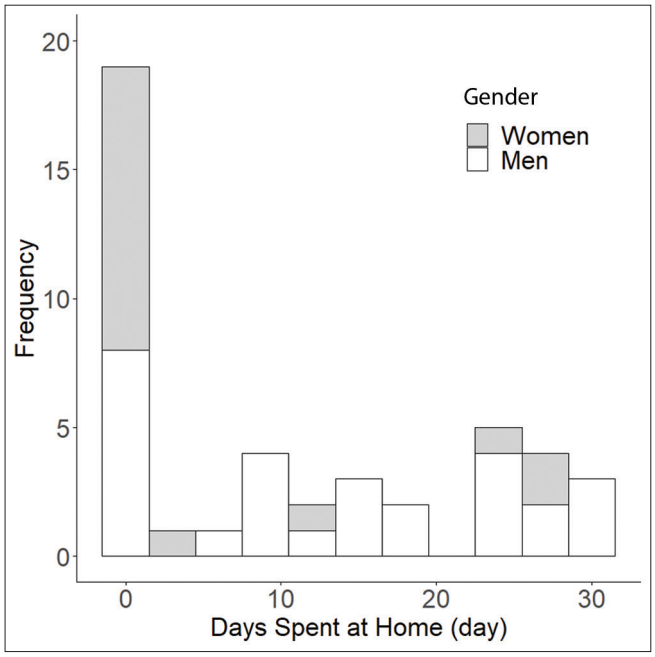

Figure 2: Distribution of days spent at home in the last 30 days of life ($n = 44$). Women and men are represented by the gray and white colors, respectively

men and women (57% in men and 63% in women) according to the gender-specific diagnostic criteria. There was no difference in ISWD between men and women.

Days spent at home and other end-of-life situations

All 44 patients in the analyses died before the data cutoff date (December 2018). The median overall survival was 15.5 months (range: 2.9–58.9). A majority of the patients died at the hospital (n = 25, 57%) or palliative care unit [$n = 17$, 39%; Table 3]. One patient died at home and a nursing facility each. Thirty-nine patients (89%) were hospitalized once, whereas four (9%) were hospitalized twice in the last 30 days of their life. Only one patient did not require hospitalization and died at home. Nineteen patients (43%) did not spend a single day at home in the 30 days of life [Figure 2]. The median DASH in the last 30 days of life was 8 days (range: 0–30; interquartile range: 0–23).

Table 3: Place of death and frequency of hospitalization in the last 30 days of life

Variables	All ($n=44$), *n* (%)
Place of death	
Hospital	25 (57)
Palliative care unit	17 (39)
Nursing facility	1 (2)
Home	1 (2)
Frequency of hospitalization	
0	1 (2)
1	39 (89)
2	4 (9)

Clinical predictors of days spent at home near the end of life

Men had a longer DASH than women by 7.3 days [$P = 0.035$, Table 4 and Figure 3]. Patients who had good trunk muscle mass index and hand-grip strength had longer DASH than those who did not (4.7 days per kg/m^2 increase [$P = 0.017$] and 0.4 days per kg increase [$P = 0.032$] respectively). Finally, muscle mass indices and physical function were found to be positively associated with DASH after adjustment for gender in the multivariate linear regression analysis, although the association was not statistically significant [Figure 4]. In all multivariate analyses, men had longer DASH than women, but the association was not statistically significant except ISWD. The R^2 values were near 0.1 in all multivariate linear regression analyses.

Discussion

To the best of our knowledge, this is the first study to investigate DASH and end-of-life care among elderly patients with advanced NSCLC. We found that our study population stayed at home for a median of 8 days in the last 30 days of life, and only 2% of the patients died at home. The risk factors for reduced DASH were women gender, reduced muscle mass, and poor physical function at the time of diagnosis for advanced NSCLC.

Table 4: Clinical predictors of days spent at home (univariate analysis)

Variables	β*	95% CI	*P*
Age (years, per 1 year increase)	−0.1	−0.9-0.8	0.901
Gender			
Men (reference, women)	7.3	0.6-14.1	0.035
ECOG-PS (reference, 0)			
1	2.5	−4.6-9.7	0.479
2	−9.3	−32.6-14.1	0.429
Stage			
Metastatic (reference, locally advanced)	0.2	−6.7-7.2	0.943
Treatment			
Curative radiotherapy±chemotherapy (reference, palliative chemotherapy)	−0.2	−7.2-6.7	0.943
Comorbidities			
COPD (reference, no COPD)	−0.9	−7.8-5.9	0.790
Type 2 diabetes mellitus (reference, no Type 2 diabetes mellitus)	7.6	−0.2-15.5	0.056
Ischemic heart disease (reference, no ischemic heart disease)	3.8	−6.2-13.7	0.450
Cerebrovascular disease (reference, no cerebrovascular)	−2.1	−15.7-11.5	0.761
Sarcopenia: muscle depletion (reference, no muscle depletion)	−3.7	−10.6-3.2	0.284
Family structures			
Living with family (reference, living alone)	2.1	−11.5-15.7	0.761
Body composition (per 1 unit increase)			
Overall muscle mass index (kg/m^2)	2.1	0.2-4.0	0.028
Trunk muscle mass index (kg/m^2)	4.7	0.9-8.5	0.017
Appendicular skeletal muscle mass index (kg/m^2)	3.5	−0.1-7.0	0.054
Physical function (per 1 unit increase)			
Hand-grip strength, dominant side (kg)	0.4	0.0-0.8	0.032
ISWD (m)	0.0	0.0-0.0	0.274
BMI (kg/m^2, per 1 unit increase)	0.3	−0.7-1.4	0.518

*β: Regression coefficient. For a continuous variable such as a muscle mass index, DASH increased by β on the average if the continuous variable increased by one unit. For a nominal variable such as sex and stage, DASH increased by β on the average compared with the reference The predictive variables were measured at baseline. CI: Confidence interval, ECOG-PS: Eastern Cooperative Oncology Group performance status was considered as a continuous variable, COPD: Chronic obstructive pulmonary disease, BMI: Body mass index, DASH: Days spent at home, ISWD: Incremental shuttle walking distance

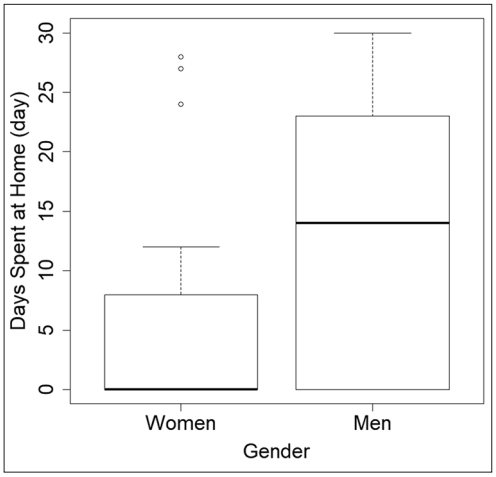

Figure 3: Comparison of days spent at home in the last 30 days of life between men and women. The bold line inside the box indicates the median. The top and bottom of each box represent the third and first quartile (Q3 and Q1), respectively. The two bars outside the box represent the lowest datum still within 1.5 × (Q3 – Q1) of Q1, and the highest datum still within 1.5 w (Q3 – Q1) of Q3. Any data not within the two bars are outliers and are represented by empty circles

Although most Japanese people desire home to be the place for end-of-life care or dying,[11,25,26] only 12.4% of Japanese people died at home in 2009.[27] The remaining people died at the hospitals (78.4%), nursing homes (4.3%), or other health-care facilities (2.4%).[27] Similar gaps between the preferred places of death and the actual places of death were reported in other countries including the UK and Korea.[14,28-31] In our study population, patients stayed at home for a median of 8 days in their last 30 days of life, and only 2% of the patients died at home. Oosterveld-Vlug *et al.* reported that patients with solid tumors who were receiving active cancer treatment near the end of life tended to get hospitalized in the last 30 days of life (odds ratio of 4.32) and die in a hospital (odds ratio of 3.98) more often than those receiving palliative care alone.[32] In addition, lung cancer led to a higher number of hospitalizations in the last 30 days of life and death in a hospital than other cancers.[32] The peculiarities of lung cancer as mentioned above may have contributed to the reduced rate of dying at home and short DASH in our study population.

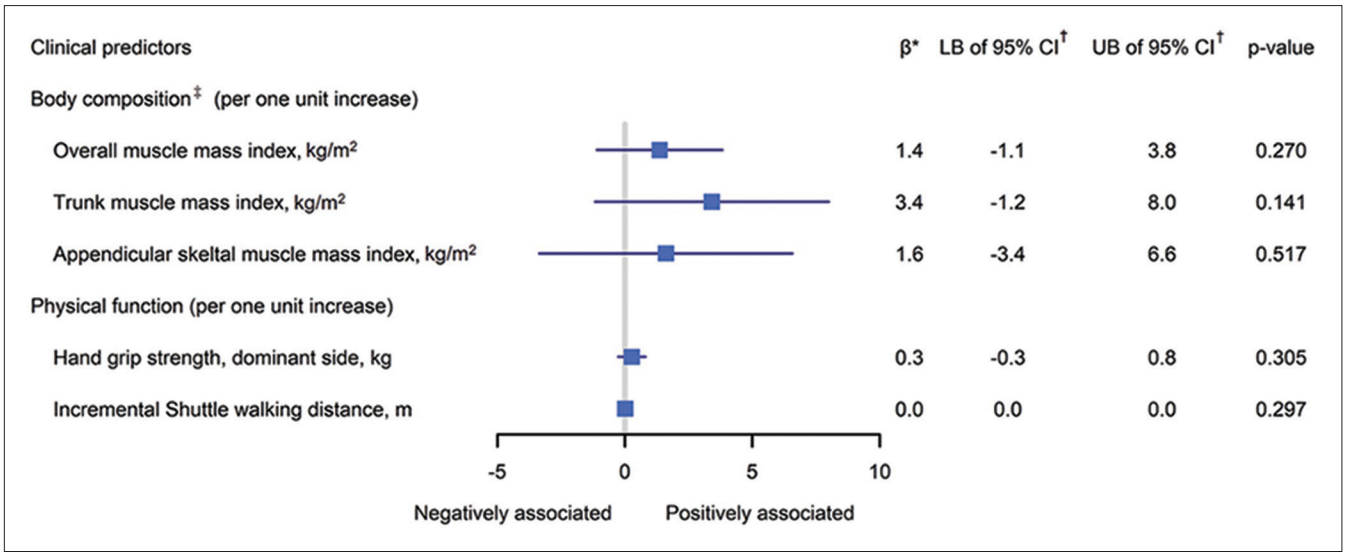

Figure 4: Clinical predictor of days spent at home (adjusted for gender). *β: Regression coefficient. For a continuous variable such as a muscle mass index, days spent at home increased by β on the average if the continuous variable increased by one unit. For a nominal variable such as sex and stage, days spent at home increased by β on the average compared with the reference. ‡The muscle mass index was defined as the muscle mass (kg) divided by the square of height (m). §The trunk muscle mass was defined as the overall muscle mass minus the appendicular skeletal muscle mass. CI: Confidence interval, LB: Lower bound, UB: Upper bound

Reduced physical function[33] and dependent activities of daily living[34] in patients may increase the caregiver's burden for home care, which negatively impacts the decision of place for care near the end of life.[26,35,36] Moreover, physical function and independence are supported by adequate muscle mass in the trunk and limbs.[17,23,37-39] We showed that a shortage of muscle mass and physical function at baseline were associated with shorter DASH in this study. We speculate that patients with a small physical reserve at baseline may run out of muscle and function to maintain physical independence until days near the end of life. Furthermore, the overall or trunk muscle mass and physical function at baseline may become the predictors of DASH at the end of life.

Previous studies have reported that women with cancer had less DASH than men with cancer.[15,16,40] Consistently, in our study population, we found that women had less DASH than men. Women generally play a central role in palliative and end-of-life care at home for family members,[34,41,42] that is, they are often more likely to be caregivers in many countries. Gender norms may exist, and women are expected to care for their families.[43] This trend in the familial role may apply to Japanese society, thereby leading to a short DASH in this study.

Our study has several limitations. First, this was a small study and included only Japanese patients who were treated at a single cancer center. Second, our study population was heterogeneous with regard to the treatment regimens received. Third, survivors at the time of analyses and patients who were transferred to another hospital were excluded from our analyses, which may have caused a selection bias. Finally, we did not consider other types of cancer or physical and social situations at the time of the patient's decision on the place of death, which were reported to be potentially confounding factors.[44] In addition, we did not ask the patient's preference of place for end-of-life care or death in this study.

Early discussion regarding end-of-life care has increasingly become important in geriatric oncology.[45-47] This discussion is part of advance care planning and enables patients, their families, and health-care providers to define goals and preferences for future medical treatment and care.[48] If patients with risk factors for short DASH are ready and able to discuss the risk, our findings may promote these discussions from the time of diagnosis and improve the quality of end-of-life care.

Naito *et al.* recently reported the feasibility of a combined regimen with exercise and nutritional interventions for elderly Japanese patients with advanced cancer.[49,50] Exploratory analysis showed preservation of physical function, skeletal muscle mass, and physical activity during the study period. The promotion of these programs could lead to improved quality of end of life for elderly patients with advanced NSCLC. Clinical trials testing the efficacy of active interventions, such as advance care planning and Nutrition and Exercise Treatment for Advanced Cancer programs, may be the next step in end-of-life care for patients with advanced lung cancer.

Conclusions

Elderly patients with advanced NSCLC had limited DASH at the end of life and died in the hospital. Women

and patients with poor muscle mass or physical function were more likely to have short DASH. These findings may promote early discussion about end-of-life care. Further prospective studies are needed to validate our findings.

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Conflicts of interest

The corresponding author, Prof. Tateaki Naito, is the editorial board member of the journal.

References

1. Miller KD, Siegel RL, Lin CC, Mariotto AB, Kramer JL, Rowland JH, *et al*. Cancer treatment and survivorship statistics, 2016. CA Cancer J Clin 2016;66:271-89.
2. Petrelli NJ, Winer EP, Brahmer J, Dubey S, Smith S, Thomas C, *et al*. Clinical cancer advances 2009: Major research advances in cancer treatment, prevention, and screening – A report from the American Society of Clinical Oncology. J Clin Oncol 2009;27:6052-69.
3. Meghani SH, Hinds PS. Policy brief: The Institute of Medicine report Dying in America: Improving quality and honoring individual preferences near the end of life. Nurs Outlook 2015;63:51-9.
4. Cheung MC, Earle CC, Rangrej J, Ho TH, Liu N, Barbera L, *et al*. Impact of aggressive management and palliative care on cancer costs in the final month of life. Cancer 2015;121:3307-15.
5. Wright AA, Keating NL, Balboni TA, Matulonis UA, Block SD, Prigerson HG. Place of death: Correlations with quality of life of patients with cancer and predictors of bereaved caregivers' mental health. J Clin Oncol 2010;28:4457-64.
6. Mitchell AJ, Chan M, Bhatti H, Halton M, Grassi L, Johansen C, *et al*. Prevalence of depression, anxiety, and adjustment disorder in oncological, haematological, and palliative-care settings: A meta-analysis of 94 interview-based studies. Lancet Oncol 2011;12:160-74.
7. Lindqvist O, Tishelman C, Hagelin CL, Clark JB, Daud ML, Dickman A, *et al*. Complexity in non-pharmacological caregiving activities at the end of life: An international qualitative study. PLoS Med 2012;9:e1001173.
8. Temel JS, Greer JA, Muzikansky A, Gallagher ER, Admane S, Jackson VA, *et al*. Early palliative care for patients with metastatic non-small-cell lung cancer. N Engl J Med 2010;363:733-42.
9. Department of Health. End of Life Care Strategy – Promoting High Quality Care for all Adults at the End of Life. London: Department of Health; 2008. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/136431/End_of_life_strategy.pdf. [Last accessed on 2020 Sep 16].
10. Barbera L, Paszat L, Chartier C. Indicators of poor quality end-of-life cancer care in Ontario. J Palliat Care 2006;22:12-7.
11. Fukui S, Yoshiuchi K, Fujita J, Sawai M, Watanabe M. Japanese people's preference for place of end-of-life care and death: A population-based nationwide survey. J Pain Symptom Manage 2011;42:882-92.
12. Groff AC, Colla CH, Lee TH. Days spent at home – A patient-centered goal and outcome. N Engl J Med 2016;375:1610-2.
13. Sayer C. "Time Spent at Home" — A Patient-Defined Outcome.: NEJM Catalyst, 2016. Available from: https://catalyst.nejm.org/doi/full/10.1056/CAT0.16.0854. [Last accessed on 2020 Sep 16].
14. Higginson IJ, Sen-Gupta GJ. Place of care in advanced cancer: A qualitative systematic literature review of patient preferences. J Palliat Med 2000;3:287-300.
15. Andersen SK, Croxford R, Earle CC, Singh S, Cheung MC. Days at home in the last 6 months of life: A patient-determined quality indicator for cancer care. J Oncol Pract 2019;15:e308-15.
16. Otsuka M. Factors associated with length of stay at home in the final month of life among advanced cancer patients: A retrospective chart review. J Palliat Med 2017;20:884-9.
17. Naito T, Okayama T, Aoyama T, Ohashi T, Masuda Y, Kimura M, *et al*. Skeletal muscle depletion during chemotherapy has a large impact on physical function in elderly Japanese patients with advanced non-small-cell lung cancer. BMC Cancer 2017;17:571.
18. Naito T, Okayama T, Aoyama T, Ohashi T, Masuda Y, Kimura M, *et al*. Unfavorable impact of cancer cachexia on activity of daily living and need for inpatient care in elderly patients with advanced non-small-cell lung cancer in Japan: A prospective longitudinal observational study. BMC Cancer 2017;17:800.
19. Gill TM, Gahbauer EA, Leo-Summers L, Murphy TE, Han L. Days spent at home in the last six months of life among community-living older persons. Am J Med 2019;132:234-9.
20. Singh SJ, Puhan MA, Andrianopoulos V, Hernandes NA, Mitchell KE, Hill CJ, *et al*. An official systematic review of the European Respiratory Society/American Thoracic Society: Measurement properties of field walking tests in chronic respiratory disease. Eur Respir J 2014;44:1447-78.
21. Singh SJ, Morgan MD, Scott S, Walters D, Hardman AE. Development of a shuttle walking test of disability in patients with chronic airways obstruction. Thorax 1992;47:1019-24.
22. Kyle UG, Bosaeus I, De Lorenzo AD, Deurenberg P, Elia M, Manuel Gómez J, *et al*. Bioelectrical impedance analysis-part II: Utilization in clinical practice. Clin Nutr 2004;23:1430-53.
23. Tanimoto Y, Watanabe M, Sun W, Hirota C, Sugiura Y, Kono R, *et al*. Association between muscle mass and disability in performing instrumental activities of daily living (IADL) in community-dwelling elderly in Japan. Arch Gerontol Geriatr 2012;54:e230-3.
24. Tanimoto Y, Watanabe M, Sun W, Sugiura Y, Hayashida I, Kusabiraki T, *et al*. Sarcopenia and falls in community-dwelling elderly subjects in Japan: Defining sarcopenia according to criteria of the European Working Group on Sarcopenia in Older People. Arch Gerontol Geriatr 2014;59:295-9.
25. Ministry of Health, Labour and Welfare; Report of the Study Group on End-of-Life Care (in Japanese); 2004. Available from: https://www.mhlw.go.jp/shingi/2004/07/s0723-8.html#mokuji. [Last accessed on 2020 Sep 16].
26. Yamagishi A, Morita T, Miyashita M, Yoshida S, Akizuki N, Shirahige Y, *et al*. Preferred place of care and place of death of the general public and cancer patients in Japan. Support

Care Cancer 2012;20:2575-82.
27. Ministry of Health, Labour and Welfare, Annual Change in the Number and Composition of Deaths by Place of Death (in Japanease); 2009. Available from: https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/suii09/deth5.html. [Last accessed on 2020 Sep 16].
28. Gao W, Ho YK, Verne J, Glickman M, Higginson IJ, GUIDE_Care project. Changing patterns in place of cancer death in England: A population-based study. PLoS Med 2013;10:e1001410.
29. Karlsen S, Addington-Hall J. How do cancer patients who die at home differ from those who die elsewhere? Palliat Med 1998;12:279-86.
30. Public Health England, Statistical commentary: End of Life Care Profiles, February 2018 Update. Available from: https://www.gov.uk/government/publications/end-of-life-care-profiles-february-2018update/statistical-commentary-end-of-life-care-profiles-february-2018-update. [Last accessed on 2020 Sep 16].
31. Lee JK, Jang SN. Place of death and associated gender difference in Korea 2006-2014: Evidence from exit interviews of the Korean Longitudinal Study of Ageing. Arch Gerontol Geriatr 2018;78:196-202.
32. Oosterveld-Vlug M, Donker G, Atsma F, Brom L, de Man Y, Groenewoud S, *et al*. How do treatment aims in the last phase of life relate to hospitalizations and hospital mortality? A mortality follow-back study of Dutch patients with five types of cancer. Support Care Cancer 2018;26:777-86.
33. Guerriere D, Husain A, Zagorski B, Marshall D, Seow H, Brazil K, *et al*. Predictors of caregiver burden across the home-based palliative care trajectory in Ontario, Canada. Health Soc Care Community 2016;24:428-38.
34. Brazil K, Bédard M, Willison K, Hode M. Caregiving and its impact on families of the terminally ill. Aging Ment Health 2003;7:376-82.
35. Gott M, Seymour J, Bellamy G, Clark D, Ahmedzai S. Older people's views about home as a place of care at the end of life. Palliat Med 2004;18:460-7.
36. Tang ST. When death is imminent: Where terminally ill patients with cancer prefer to die and why. Cancer Nurs 2003;26:245-51.
37. Shahtahmassebi B, Hebert JJ, Hecimovich MD, Fairchild TJ. Associations between trunk muscle morphology, strength and function in older adults. Sci Rep 2017;7:10907.
38. Granacher U, Gollhofer A, Hortobágyi T, Kressig RW, Muehlbauer T. The importance of trunk muscle strength for balance, functional performance, and fall prevention in seniors: A systematic review. Sports Med 2013;43:627-41.
39. Al Snih S, Markides KS, Ottenbacher KJ, Raji MA. Hand grip strength and incident ADL disability in elderly Mexican Americans over a seven-year period. Aging Clin Exp Res 2004;16:481-6.
40. Cheung MC, Croxford R, Earle CC, Singh S. Days spent at home in the last 6 months of life: A quality indicator of end of life care in patients with hematologic malignancies. Leuk Lymphoma 2020;61:146-55.
41. Sugiura K, Ito M, Kutsumi M, Mikami H. Gender differences in spousal caregiving in Japan. J Gerontol B Psychol Sci Soc Sci 2009;64:147-56.
42. Brazil K, Thabane L, Foster G, Bédard M. Gender differences among Canadian spousal caregivers at the end of life. Health Soc Care Community 2009;17:159-66.
43. Williams LA, Giddings LS, Bellamy G, Gott M. 'Because it's the wife who has to look after the man': A descriptive qualitative study of older women and the intersection of gender and the provision of family caregiving at the end of life. Palliat Med 2017;31:223-30.
44. Gomes B, Higginson IJ. Factors influencing death at home in terminally ill patients with cancer: Systematic review. BMJ 2006;332:515-21.
45. Lin CP, Cheng SY, Chen PJ. Advance care planning for older people with cancer and its implications in Asia: Highlighting the mental capacity and relational autonomy. Geriatrics (Basel) 2018;3:43.
46. Weathers E, O'Caoimh R, Cornally N, Fitzgerald C, Kearns T, Coffey A, *et al*. Advance care planning: A systematic review of randomised controlled trials conducted with older adults. Maturitas 2016;91:101-9.
47. O'Caoimh R, Cornally N, O'Sullivan R, Hally R, Weathers E, Lavan AH, *et al*. Advance care planning within survivorship care plans for older cancer survivors: A systematic review. Maturitas 2017;105:52-7.
48. Rietjens JA, Sudore RL, Connolly M, van Delden JJ, Drickamer MA, Droger M, *et al*. Definition and recommendations for advance care planning: An international consensus supported by the European Association for Palliative Care. Lancet Oncol 2017;18:e543-51.
49. Mouri T, Naito T, Morikawa A, Tatematsu N, Miura S, Okayama T, *et al*. Promotion of behavioral change and the impact on quality of life in elderly patients with advanced cancer: A physical activity intervention of the multimodal nutrition and exercise treatment for advanced cancer program. Asia Pac J Oncol Nurs 2018;5:383-90.
50. Naito T, Mitsunaga S, Miura S, Tatematsu N, Inano T, Mouri T, *et al*. Feasibility of early multimodal interventions for elderly patients with advanced pancreatic and non-small-cell lung cancer. J Cachexia Sarcopenia Muscle 2019;10:73-83.