original contributions

Functional Status and Survival in Older Nursing Home Residents With Advanced Non–Small-Cell Lung Cancer: A SEER-Medicare Analysis

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QUESTION ASKED: Does activities of daily living (ADL) impairment prognosticate survival in older adults diagnosed with advanced non–small-cell lung cancer (NSCLC) receiving care in nursing homes?

SUMMARY ANSWER: Among older nursing home patients with advanced lung cancer, routinely measured ADL assessments independently prognosticated mortality.

WHAT WE DID: We performed a retrospective analysis using SEER-Medicare data linked with Minimum Data Set nursing home assessments on fee-for-service beneficiaries age 65 years and older with pathologically confirmed advanced NSCLC (stage IIIB-IV) from 2011 to 2015, who received care in a nursing home within 30 days of cancer diagnosis. We used Cox regression and Kaplan-Meier survival curves to examine the relationship between ADL scores and overall survival among all patients, adjusted for baseline covariates including age, sex, race/ethnicity, histology, receipt of systemic therapy, length of nursing home stay, receipt of palliative radiation, cancer surgery, and National Cancer Institute (NCI) comorbidity index.

WHAT WE FOUND: Worse ADL scores were associated with a 20% increased mortality rate per standard deviation of ADL deficit, after adjustment for baseline covariates. The results were similar when our analyses were stratified by histology, NCI comorbidity index, length of nursing home admission, sex, and age group.

BIAS, CONFOUNDING FACTOR(S): This study focused on nursing home patients and may not be generalized to community dwelling adults who have little or no skilled nursing care needs. Additionally, data on genetic mutations commonly used to guide treatment were not available. Finally, our cohort consisted of patients followed until 2015, the most recent year of SEER data at the time of the study; however, NSCLC treatment has changed over recent years with increased use of immunotherapy and personalized treatment on the basis of genetic sequencing.

REAL-LIFE IMPLICATIONS: Our conclusions support the use of ADLs to prognosticate outcomes and postacute care transitions in older patients with advanced lung cancer in nursing homes. This measure may aid discussions on the tradeoff between hospice and treatment, as only patients with ADL scores < 14 had survival over 6 months, and those with high (poor) ADL scores may have minimal benefit from treatment. Nevertheless, for all ADL groups, patients who received treatment had better survival than those who did not; thus, ADLs alone should not disqualify patients from systemic therapy, and a full geriatric assessment should be considered when ambiguity remains. Future studies should explore the predictive value of ADLs in determining which patients could benefit from selected treatments, especially in the context of novel immunotherapies, to guide shared decision making.

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Data Supplement

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CARE DELIVERY

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abstract

PURPOSE Many older patients with advanced lung cancer have functional limitations and require skilled nursing home care. Function, assessed using activities of daily living (ADL) scores, may help prognostication. We investigated the relationship between ADL impairment and overall survival among older patients with advanced non–small-cell lung cancer (NSCLC) receiving care in nursing homes.

METHODS Using the SEER-Medicare database linked with Minimum Data Set assessments, we identified patients age 65 years and older with NSCLC who received care in nursing homes from 2011 to 2015. We used Cox regression and Kaplan-Meier survival curves to examine the relationship between ADL scores and overall survival among all patients; among patients who received systemic cancer chemotherapy or immunotherapy within 3 months of NSCLC diagnosis; and among patients who did not receive any treatment.

RESULTS We included 3,174 patients (mean [standard deviation] age, 77 [7.4] years [range, 65-102 years]; 1,664 [52.4%] of female sex; 394 [12.4%] of non-Hispanic Black race/ethnicity), 415 (13.1%) of whom received systemic therapy, most commonly with carboplatin-based regimens (n = 357 [86%] patients). The median overall survival was 3.1 months for patients with ADL score < 14, 2.8 months for patients with ADL score between 14 and 17, 2.3 months for patients with ADL score between 18-19, and 1.8 months for patients with ADL score 20+ (log-rank $P < .001$). The ADL score was associated with increased risk of death (hazard ratio [HR], 1.20; 95% CI, 1.16 to 1.25 per standard deviation). One standard deviation increase in the ADL score was associated with lower overall survival rate among treated (HR, 1.14; 95% CI, 1.02 to 1.27) and untreated (HR, 1.20; 95% CI, 1.15 to 1.26) patients.

CONCLUSION ADL assessment stratified mortality outcomes among older nursing home adults with NSCLC, and may be a useful clinical consideration in this population.

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INTRODUCTION

Lung cancer incidence and mortality rates are highest among older adults, with a median age of diagnosis at 71 years and median age at death of 72 years in the United States.[1] Although many factors contribute to high mortality rates observed among older adults with cancer, there is evidence linking impaired functional status with higher mortality.[2,3] Currently, leading organizations such as the National Comprehensive Cancer Network (NCCN) and ASCO recommend routine geriatric assessment in the care of older adults with cancer.[4,5] The rationale for these assessments is their ability to identify deficits in a patient's functional ability, physical health, cognition and mental health, and socioenvironmental circumstances.

Activities of daily living (ADL) are an integral component of geriatric assessments and closely related to a patient's performance status scale, which is extensively used in oncologic care.[6] However, the latter lacks the granularity that can be achieved when considering many ADLs jointly. Similar to decreased performance status, impairments in ADLs are associated with worse survival among hospitalized patients with advanced cancers[7]; however, some studies have differed, showing nonsignificant results.[8,9] Importantly, most of what we currently know about the association between functional impairments and patient outcomes is based on data from community-dwelling adults among whom these[7-9] and other[10] studies were conducted. Although many patients with advanced lung

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cancer receive nursing home care during the course of their illness, there is a paucity of research specific to nursing home patients.[11,12] These patients differ from those living in the community by virtue of the fact that they require skilled nursing care for their substantial functional limitations and comorbidities.

Because nursing home patients are clinically heterogeneous compared with those living in the community,[13,14] the magnitude of the association between ADL impairments and overall survival remains unclear. To address this gap, we analyzed a large, national population–based registry aiming to determine whether ADL impairments stratify survival outcomes as expected during the first year after diagnosis among older adults with advanced non–small-cell lung cancer (NSCLC) who receive care in a nursing home.

METHODS

Data Source

We used secondary health data that are routinely collected for administrative and disease surveillance purposes. No informed consent was required. The study was reviewed by the Brown University Institutional Review Board, which determined it to be exempt from the regulations of 45 CFR 46 regarding the inclusion of human participants in research.

We used data from the National Cancer Institute's (NCI's) SEER-Medicare database linked with Minimum Data Set (MDS) 3.0 assessment data.[12] SEER data are derived from population-based cancer registries representing more than 30% of the US population; they include mandatory reporting on all incident diagnoses of malignant tumors along with demographic, clinical, and survival information. Medicare data include demographic and vital status information on all Medicare beneficiaries along with administrative claims on health care services provided in the inpatient and outpatient settings including skilled nursing care and cancer therapies. Recently, the SEER-Medicare data set was enriched with MDS assessment data, which capture health services utilization, physical and mental health, and physical and cognitive function for all individuals who received care in Medicare and/or Medicaid-certified nursing homes.

Eligibility Criteria

We included all fee-for-service Medicare beneficiaries age 65 years and older with pathologically confirmed advanced NSCLC (stage IIIB-IV) diagnosed in SEER from 2011 to 2015 (ie, the most recently available data at the time of the study) who received care in a nursing home within 30 days after cancer diagnosis, or up to 15 days before, and had available MDS assessment data (Data Supplement, online only). We selected stages IIIB and IV owing to their similar prognosis[15] and the fact that treatment goals for both stages are primarily palliative with principally systemic therapies; by contrast, earlier-stage disease (stages I, II, and IIIA) is potentially resectable and treated with curative goals using different paradigms (particularly with regard to the use of systemic therapy). Of note, we did not include stage IIIC as the dates for the data occurred before the American Joint Committee on Cancer version 8 and therefore only included stage IIIA and IIIB.[16] We excluded patients with no continuous enrollment in Medicare parts A/B for 12 months before cancer diagnosis, enrollment in managed care plans in the year following diagnosis, diagnosis at autopsy, or enrollment in hospice care at the time of nursing home admission. We also excluded patients who received systemic therapy before MDS assessment because it may affect functional status.[17,18] This study was deemed exempt by the Brown University Institutional Review Board.

Functional Status

Functional status was measured using the validated Morris ADL scale derived from the MDS.[19] The MDS ADL score ranges from 0-28 and represents a composite score relaying the level of assistance needed for dressing, eating, toileting, hygiene, transfers, bed mobility, and locomotion on unit; the Data Supplement shows the Likert-scale scoring methodology for each ADL. Higher ADL score values indicate worse functional status. Each component receives a score from 0 to 4 as follows: 0—total independence, no help or staff oversight; 1—supervision provided three or more times in last 7 days; 2—limited assistance by staff, resident highly involved in the activity; 3—extensive assistance by staff with resident performing part of the activity; and 4—total dependence and full staff participation in the activity during entire 7 days.

Follow-Up Time

Because our interest was in outcomes within the first year of diagnosis, each patient was followed up for 1 year from the time of diagnosis, until the date of death, or the administrative end of follow-up on December 31, 2016, whichever occurred first.

Outcome

Overall survival was the outcome of interest because it is typically the primary end point is oncologic trials, is most often used for therapeutic decision making, and is not subject to measurement error because of misclassification. It was defined as the time from cancer diagnosis until the end of the follow-up. We ascertained the date of death from Medicare's Master Beneficiary Summary File, which includes vital status validated by the National Death Index.

Additional Variables

We ascertained the following variables at the time of diagnosis, including age (continuous), sex (male or female), race/ethnicity (non-Hispanic White, non-Hispanic Black, or other), histology (squamous cell carcinoma [SCC], adenocarcinoma, adenosquamous carcinoma, lepidic adenocarcinoma, carcinoid tumor, malignant non–small-cell carcinoma not otherwise specified, and carcinoma not otherwise specified), whether the patient had received

treatment with systemic cancer chemotherapy or immunotherapy within 3 months of diagnosis (see the Data Supplement for a detailed list of regimens), whether the patient was a long-stay (defined as a stay > 90 consecutive days) or a short-stay (defined as a stay of 90 or fewer consecutive days) nursing home (NH) resident, receipt of palliative radiation, cancer surgery, and the NCI comorbidity index, ie, a cancer-specific version of the Charlson comorbidity score calculated using Medicare claims from 1 year before NSCLC diagnosis.[20]

Statistical Analysis

We estimated the overall survival probability for patients in each quartile of the MDS score (< 14, 14-17, 18-19, ≥ 20) using the Kaplan-Meier estimator and compared overall survival rates across quartiles with the log-rank test; we also calculated the median and 1-year survival for each MDS quartile. To define ADL score cutpoints, we used the quartiles of the ADL distribution following previous work.[21,22] Our rationale for using cutpoints over the continuous score was that they are useful for the visualization of the survival curves and their application to a clinical context, eg, for risk stratification purposes; this operationalization is similar to how a biomarker is used as a dichotomous variable (expressed *v* not expressed) over its absolute values.[23]

We fitted Cox proportional hazard ratio models on time since diagnosis to calculate hazards ratios (HR) and corresponding 95% CI for the association between ADL and survival. Models were adjusted for factors presumed to correlate with the independent variable (ADL) and outcome (survival), ie, age, sex, race/ethnicity, histology, whether the patient had received treatment with systemic cancer chemotherapy or immunotherapy within 3 months of diagnosis, whether the patient was a long-stay or a short-stay NH resident, receipt of palliative radiation, cancer surgery, and the NCI comorbidity index; all factors were determined a priori on the basis of clinical knowledge as recommended in the statistical modeling literature.[24] The proportionality of hazards assumption was verified by Schoenfeld residuals (Data Supplement). Parameterization of the ADL was selected on the basis of the Akaike information criterion, ie, we fitted models where ADL was parameterized as a continuous variable and models where it was parameterized as a categorical variable and selected the continuous parameterization because it resulted in the lowest Akaike information criterion. This linearity in the ADL score documented by this parameterization further supported the notion that quartiles are a reasonable approach to identify groups on the basis of their gradient of risk.

To assess the consistency of the association between ADL and overall survival across levels of major and clinically relevant patient characteristics, we performed subgroup analyses by receipt of systemic therapy (yes *v* no), histology (SCC, adenocarcinoma, or other), NCI comorbidity index (0-

TABLE 1. Characteristics of Nursing Home Residents With Advanced Non–Small-Cell Lung Cancer

Characteristic	Nursing Home Residents (N = 3,174)
Age, years	
Mean (SD)	76.9 (7.4)
Median (IQR)	76 (71-83)
Range	65-102
Sex, No. (%)	
Female	1,664 (52.4)
Male	1,510 (47.6)
Race/ethnicity, No. (%)	
Non-Hispanic White	2,499 (78.7)
Non-Hispanic Black	394 (12.4)
Other	281 (8.9)
NCI comorbidity index	
Mean (SD)	2.5 (2.4)
Median (IQR)	1.7 (0-3.6)
Range	0-13.5
Systemic therapy, No. (%)	
Yes	415 (13.1)
No	2,759 (86.9)
Palliative radiation, No. (%)	
Yes	1,178 (37.1)
No	1,996 (62.9)
Cancer histology, No. (%)	
Adenocarcinoma	1,932 (60.9)
SCC	801 (25.2)
Adenosquamous carcinoma	50 (1.6)
Non–small-cell carcinoma, not otherwise specified	338 (10.7)
Other[a]	53 (1.7)
Surgery, No. (%)	
Yes	68 (2.1)
No	3,106 (97.9)
Length of stay, No. (%)	
Short stay	2,889 (91.0)
Long stay	284 (9.0)
ADL score	
Mean (SD)	17.3 (5.0)
ADL score, quartiles, No. (%)	
< 14	627 (19.8)
14-17	584 (18.4)
18-19	940 (29.6)
≥ 20	1,023 (32.2)

Abbreviations: ADL, activities of daily living; IQR, interquartile range; NCI, National Cancer Institute; SCC, squamous cell carcinoma; SD, standard deviation.

[a]The Other category includes lepidic adenocarcinoma; carcinoid tumor, malignant; and carcinoma, not otherwise specified.

1 $v \geq 2$), length of nursing home admission (< 90 $v \geq 90$ consecutive days), sex, and age (65-75 years old $v > 75$ years old). We did not test for effect moderation by means of statistical interactions because our interest was in assessing whether ADL is consistently associated with overall survival in each subgroup rather than identifying patients for whom ADL may have the highest prognostic value.

All analyses were performed using SAS 9.4. *P* values are two-tailed at a type I error rate $\alpha = .05$.

RESULTS

We identified 3,174 patients with advanced NSCLC who met our eligibility criteria (Data Supplement). The mean age was 76.9 (standard deviation [SD], 7.4) years; 1,664 (52.4%) patients were of female sex and 394 (12.4%) were of non-Hispanic Black race/ethnicity (Table 1). The majority (91%) of patients were short-stay nursing home residents, and the median (interquartile range) length of stay during the follow-up period was 22 (11-51) days. The mean ADL score was 17.3 (SD, 5.0), and the mean NCI Comorbidity Index was 2.5 (SD, 2.4). A total of 415 (13.1%) patients received systemic chemotherapy or immunotherapy within 3 months of diagnosis (Data Supplement). The median follow-up time was 69 days, and 2,863 (90.2%) patients died during the follow-up.

As shown in Table 2, the median overall survival among all patients was 2.3 months (95% CI, 2.2 to 2.4) and it was higher among patients receiving any cancer systemic therapy (6.3 months; 95% CI, 5.6 to 6.8), than those who did not (2 months; 95% CI, 2 to 2.1). The 6-month and 1-year overall survival rates were, respectively, 21.9% (95% CI, 20.5 to 23.3) and 9.8% (95% CI, 8.8 to 10.8) among all patients; 17.4% (95% CI, 16.0 to 18.8) and 7.6% (95% CI, 6.6 to 8.6) among patients not receiving treatment; and 51.6% (95% CI, 48.7 to 54.5) and 23.9% (95% CI, 19.7 to 28.1) among patients who received treatment.

Among all patients, overall survival was lower in patients with higher compared to those with lower ADL scores (log-rank $P < .001$; Fig 1). The median overall survival was 3.1 months (95% CI, 2.7 to 3.5) for patients with ADL score < 14, 2.8 months (95% CI, 2.5 to 3.1) for patients with ADL score between 14 and 17, 2.3 months (95% CI, 2.1 to 2.5) for patients with ADL score between 18 and19, and 1.8 months (95% CI, 1.7 to 2.0) for patients with ADL score 20+. As shown in Table 2, the 6-month and 1-year survival rates, respectively, were 31.7% and 15.6% for ADL score < 14, 27.2% and 11.8% for ADL score between 14 and 17%, 19.7% and 9.4% for ADL score between 18 and19%, and 14.8% and 5.5% for ADL score 20+. In adjusted Cox models, a standard deviation increase in the ADL score was associated with 1.2-fold lower overall survival rate (HR, 1.20; 95% CI, 1.15 to 1.25).

As shown in Figure 1, overall survival was lower with increasing ADL scores in both patients who received systemic cancer treatment (log-rank $P = .06$) and those who did not receive it (log-rank $P < .001$). Among patients receiving treatment with ADL < 14, 14-17, 18-19, and ≥ 20, the median overall survival was 7.0 months (95% CI, 5.8 to

TABLE 2. Survival Estimates by ADL Quartiles

Treatment Status and ADL Score	Median Overall Survival, Months (95% CI)	6-Month Survival, % (95% CI)	1-Year Survival, % (95% CI)
All patients, ADL score			
0-28	2.3 (2.2 to 2.4)	21.9 (20.5 to 23.3)	9.8 (8.8 to 10.8)
< 14	3.1 (2.7 to 3.5)	31.7 (28.1 to 35.3)	15.6 (12.7 to 18.5)
14-17	2.8 (2.5 to 3.1)	27.2 (23 to 6 to 30.8)	11.8 (9.1 to 14.3)
18-19	2.3 (2.1 to 2.5)	19.7 (17.1 to 22.3)	9.4 (8.4 to 10.4)
≥ 20	1.8 (1.7 to 1.9)	14.8 (12.6 to 17.0)	5.5 (4.1 to 6.9)
Untreated patients, ADL score			
0-28	2.0 (2.0 to 2.1)	17.4 (16.0 to 18.8)	7.6 (6.6 to 8.6)
< 14	2.4 (2.2 to 2.7)	25.3 (21.5 to 29.1)	12.1 (9.3 to 14.9)
14-17	2.3 (2.1 to 2.5)	19.9 (16.3 to 22.5)	9.2 (6.6 to 11.8)
18-19	2.1 (1.9 to 2.2)	16.9 (14.3 to 19.5)	7.6 (5.8 to 9.4)
≥ 20	1.7 (1.6 to 1.8)	12.5 (11.4 to 13.6)	4.6 (3.2 to 6.0)
Treated patients, ADL score			
0-28	6.3 (5.6 to 6.8)	51.6 (48.7 to 54.5)	23.9 (19.7 to 28.1)
< 14	7.0 (5.8 to 8.1)	58.1 (49.3 to 66.9)	29.8 (21.6 to 38.0)
14-17	6.9 (6.0 to 8.9)	60.3 (50.9 to 69.7)	24.5 (16.2 to 32.8)
18-19	4.9 (3.7 to 5.9)	40.5 (31.3 to 49.7)	21.6 (13.8 to 29.4)
≥ 20	5.6 (4.7 to 6.9)	44.6 (38.8 to 50.4)	16.2 (14.0 to 18.4)

Abbreviation: ADL, activities of daily living.

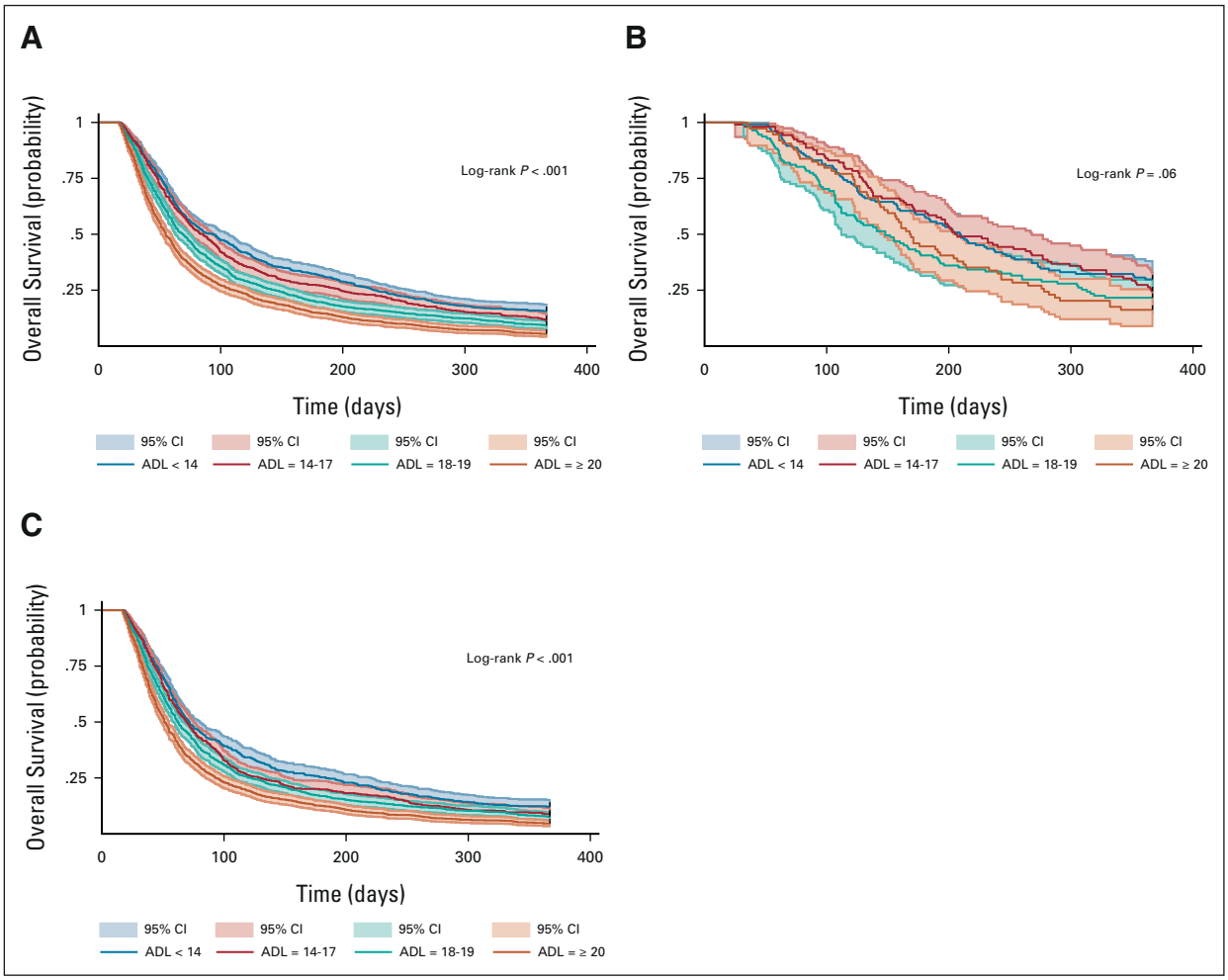

FIG 1. Kaplan-Meier overall survival curves by ADL quartile for (A) all patients, (B) patients receiving treatment, and (C) patients not receiving treatment. ADL, activities of daily living.

8.1), 6.9 months (95% CI, 6.0 to 8.9), 4.9 months (95% CI, 3.7 to 5.9), and 5.6 months (95% CI, 4.9 to 6.9), respectively. The corresponding numbers for patients who did not receive any treatment were 2.4 months (95% CI, 2.2 to 2.7), 2.3 months (95% CI, 2.1 to 2.5), 2.1 months (95% CI, 1.9 to 2.2), and 1.7 months (95% CI, 1.6 to 1.8). Survival rates at 6 months and 1 year are shown in Table 2. In adjusted Cox models, one standard deviation increase in the ADL score was associated with 1.14-fold lower overall survival rate among patients receiving treatment (HR, 1.14; 95% CI, 1.02 to 1.28) and 1.2-fold lower rate among those not receiving any therapy (HR, 1.20; 95% CI, 1.15 to 1.26).

The results were similar when we stratified our analyses by histology, NCI comorbidity index, length of nursing home admission, sex, and age groups (Table 3).

DISCUSSION

We examined a large national cohort of older adults with advanced NSCLC who received care in nursing homes, the majority of whom did not receive cancer-directed treatment. One-year overall survival was < 10%, which is substantially lower than that in the general population; for context, in the latter group, 1-year survival for late-stage SCC and adenocarcinoma is 27.8% and 34.7%, respectively.[25] Although overall survival was low, it was markedly decreased among patients with the highest degree of functional limitations, 50% of whom survived for < 2 months compared with over 3 months for those with lower impairment. Functional limitations, as measured by the ADL score, independently stratified mortality outcomes in these patients with up to 1.2-fold higher mortality rates among patients per standard deviation of ADL deficit. The probability of survival was strongly related to ADL limitations in both treated and untreated individuals, and the association was consistent across different histology types.

Our findings are consistent with a recent study showing an association between the presence of ADL impairment and survival in patients with advanced cancers.[6] However, other studies have not demonstrated a relationship between

TABLE 3. Associations Between Activities of Daily Living Score and Overall Survival in Subgroups Defined by Clinically Important Characteristics

Subgroup	HR (95% CI)
Age, years	
65-75	1.15 (1.08 to 1.21)
≥ 75	1.25 (1.18 to 1.32)
Histology	
SCC	1.25 (1.15 to 1.34)
Adenocarcinoma	1.16 (1.10 to 1.22)
Other[a]	1.31 (1.17 to 1.46)
Nursing home length of stay	
Short stay	1.23 (1.18 to 1.29)
Long stay	1.06 (0.96 to 1.15)
Sex	
Male	1.21 (1.15 to 1.28)
Female	1.19 (1.12 to 1.26)
NCI comorbidity score	
0-1	1.23 (1.16 to 1.30)
≥ 2	1.15 (1.09 to 1.23)

Abbreviations: HR, hazard ratio; NCI, National Cancer Institute; SCC, squamous cell carcinoma.

[a]Includes the following histologies: adenosquamous carcinoma; lepidic adenocarcinoma; carcinoid tumor; malignant non–small-cell carcinoma, not otherwise specified; and carcinoma, not otherwise specified.

ADLs and clinical outcomes.[7,8] These differences in findings may be attributed to the differences in populations studied, as community-dwelling cohorts from prior investigations often are higher-functioning with little or no ADL limitations; by contrast, but in accordance with our hypothesis, most nursing home patients in our study had ADL limitations. Additionally, we find an association between progressive ADL limitations and mortality, as survival linearly decreased with increasing levels of impairment. Even among nursing home patients with advanced lung cancer, there was a nearly three-fold 1-year survival difference between the first and last quartiles of ADL limitations. Although the baseline ADL categories do separate the survival curves, they do not do so drastically since the differences in OS across ADL quartiles are small in absolute terms (ie, 3.1 months *v* 2.8 months *v* 2.3 months *v* 1.8 months for each quartile increase in the ADL score). This finding could potentially be attributed to the fact that 87% of the patients did not receive any anticancer therapy and therefore the short overall survival is determined by their cancer progressing uniformly.

It has been shown that comprehensive geriatric assessments (CGAs) better predict poor outcomes in older adults with cancer, compared with oncologists' clinical judgment or performance status.[26] However, CGA requires time and training and, to date, has been rarely implemented by oncologists.[27,28] Identifying components of the CGA that are most associated with outcomes may facilitate routine adoption of CGA into oncology practice. One such component is a patient's ADL status, and this element is captured in nursing homes through mandated, routinely performed MDS assessments and can provide prognostic information for nursing home patients with advanced NSCLC, as our findings indicate. ADL assessment is simple, fast, and familiar to most physicians such that it can easily be incorporated directly into the oncologists' history-taking. Importantly, ADL measures are validated and comparable to physical therapist evaluations in patients with cancer.[29,30] Although the relationship between ADLs and mortality is logical, such a validated scale may also be helpful in goals-of-care discussions for the nursing home patients who are physiologically frail and vulnerable after an acute hospitalization.

Our results can be used to provide realistic prognostication for NH residents with cancer and clinicians caring for them. In particular, the ADL score for patients with advanced NSCLC who do leave the skilled nursing facility and receive treatment can be useful to determine guidelines for clinicians regarding the tradeoffs between treatment and hospice. This information can be helpful because of the fallacy that care in a skilled nursing facility can make patients stronger to receive additional chemotherapy, while in fact those with a high ADL score may have little to no survival benefit from nursing home care.[31] Notably, as immunotherapies are increasingly becoming common in the treatment of NSCLC and other malignancies, our results could be compared in future studies of novel immunotherapies to evaluate whether more nursing home patients are able to receive therapy and whether the outcomes of patients receiving treatment are improved with these lower-toxicity agents.

Except for patients receiving treatment who had ADL score < 14, all other patients in our study had median survival < 6 months, and they thus meet the qualifying estimated survival for hospice. This finding has implications for delivery of palliative care within the nursing home setting, ie, all patients diagnosed with advanced NSCLC may benefit from a palliative care consultation to address their symptoms, help with goals of care, and support them through treatment, should they opt to receive it.[32,33] Therefore, ADL measurements from MDS assessments are readily available when nursing home–residing patients present to the oncology clinic and can be added to other evaluations to guide clinicians and patients in their decision making for treatment, supportive care, and end-of-life care.[34]

Nevertheless, because for every ADL category, patients receiving treatment had better outcomes than untreated patients, our results also indicate that ADLs alone should not be used to disqualify a patient from systemic therapy, but need to be interpreted in a larger geriatric context

considering the findings of a full CGA, patient's comorbidities, polypharmacy, cognitive impairments, and psychosocial support. As our study shows, older patients with advanced NSCLC who receive nursing home care have short overall survival. In this context, ADL deficits identified through CGA could not only be used to assess prognosis but may inform other decisions related to the care of these patients. For example, recent data[35] demonstrate that increasing CGA domain deficits are associated with increasing burden for family caregivers and in this context, a CGA could be meaningful when considering a transition of a patient with advanced NSCLC from the nursing home setting to home. In addition, a CGA could also help identify needs for formal palliative care for nursing home residents with advanced NSCLC, especially those whose prognosis is poor regardless of whether they receive anticancer therapy.

Our study has some limitations. First, our findings may have limited generalizability to community-dwelling older adults outside of the nursing home population because, despite having some functional limitations, the latter have little to no skilled care needs and are less vulnerable. Second, SEER-Medicare does not include information on certain tumor characteristics (eg, *EGFR* mutations) that have prognostic value and could also inform treatment. Third, although our findings suggest that ADL impairment is a prognostic factor in nursing home residents, its predictive value to identify patients who will benefit from treatment should be examined in future prospective studies specific to this population. Importantly, decision making around treatment options for patients with advanced NSCLC should consider patient preferences, as some patients (especially those with short life expectancy) may opt to forego treatments that may have toxic effects. However, patient preferences and decision making are not directly measured in most real-world, routinely collected health data including SEER-Medicare. Fourth, our cohort included patients diagnosed with NSCLC up to 2015, ie, the most recent year of SEER data available at the time of the study; given that treatment of NSCLC has changed over the past few years with increased use of immunotherapy and personalized therapy guided by next-generation sequencing, our findings need to be confirmed in future studies using contemporary cohorts. Fifth, targeted oral therapies (such as EGFR inhibitors and ALK inhibitors) are not identifiable in administrative data for nursing home residents. However, these agents are applicable to only approximately 20% of patients with adenocarcinoma,[36] only a small fraction of whom receives them in the real world[37]; thus, given our sensitivity analyses with stratification by histology showing no differences, it is unlikely that the overall survival results would have been different, had we had access to data on these targeted therapies. Last, we did not examine the relationships of ADL impairments with other outcomes, including hospitalization, intensive care unit admission, or hospice use, because these outcomes were not available to us at the time of this analysis.

Overall, our study provides evidence that routinely measured ADLs among nursing home residents with NSCLC may be useful to guide prognostication and postacute care transitions. Considering that other geriatric elements (eg, depression and cognitive function) are included in MDS assessments, future research should assess their prognostic information when considered jointly with ADLs.

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DISCLAIMER

This study used the linked SEER-Medicare database. The interpretation and reporting of these data are the sole responsibility of the authors. The authors acknowledge the efforts of the National Cancer Institute; the Office of Research, Development and Information, CMS; Information Management Services (IMS), Inc; and the Surveillance, Epidemiology, and End Results (SEER) Program tumor registries in the creation of the SEER-Medicare database.
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DATA SHARING STATEMENT

Patient-level data can be obtained from the National Cancer Institute, which maintains the SEER-Medicare database. Analytical code is available and can be requested from the corresponding author.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Functional Status and Survival in Older Nursing Home Residents With Advanced Non–Small-Cell Lung Cancer: A SEER-Medicare Analysis

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