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Using Claims Data to Predict Dependency in Activities of Daily Living as a Proxy for Frailty

Keturah R. Faurot, PA, MPH, PhD[1,2], **Michele Jonsson Funk, PhD**[2], **Virginia Pate, MS**[2], **M. Alan Brookhart**[2], **Amanda Patrick, MS**[3], **Laura C. Hanson, MD, MPH**[4], **Wendy Camelo Castillo, MD, PhD**[2,5], and **Til Stürmer, MD, PhD**[2]

[1]Department of Physical Medicine and Rehabilitation, School of Medicine, University of North Carolina at Chapel Hill [2]Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill [3]Division of Pharmacoepidemiology, Brigham and Women's Hospital [4]Division of Geriatric Medicine, School of Medicine, University of North Carolina at Chapel Hill [5]Pharmaceutical Health Services Research, School of Pharmacy, University of Maryland

Abstract

Purpose—Estimating drug effectiveness and safety among older adults in population-based studies using administrative healthcare claims can be hampered by unmeasured confounding due to frailty. A claims-based algorithm that identifies patients likely to be dependent, a proxy for frailty, may improve confounding control. Our objective was to develop an algorithm to predict dependency in activities of daily living (ADL) in a sample of Medicare beneficiaries.

Methods—Community-dwelling respondents to the 2006 Medicare Current Beneficiary Survey, >65 years old, with Medicare Part A, B, home health, and hospice claims were included. ADL dependency was defined as needing help with bathing, eating, walking, dressing, toileting, or transferring. Potential predictors were demographics, ICD-9 diagnosis/procedure and durable medical equipment codes for frailty-associated conditions. Multivariable logistic regression was to predict ADL dependency. Cox models estimated hazard ratios for death as a function of observed and predicted ADL dependency.

Results—Of 6391 respondents, 57% were female, 88% white, and 38% were ≥80. The prevalence of ADL dependency was 9.5%. Strong predictors of ADL dependency were charges for a home hospital bed (OR=5.44, 95% CI=3.28–9.03) and wheelchair (OR=3.91, 95% CI=2.78–5.51). The c-statistic of the final model was 0.845. Model-predicted ADL dependency of 20% or greater was associated with a hazard ratio for death of 3.19 (95% CI: 2.78, 3.68).

Corresponding author: Keturah Faurot, 336 Emergency Room Drive, Department of Physical Medicine & Rehabilitation, Campus Box #7200, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-7200, faurot@med.unc.edu.

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Versions of this work were presented at the International Conference on Pharmacoepidemiology & Therapeutic Risk Management in 2012 and 2013. Related work was also presented at the 2012 Scientific Meeting of the Gerontological Society of America.

Conclusions—An algorithm for predicting ADL dependency using healthcare claims was developed to measure some aspects of frailty. Accounting for variation in frailty among older adults could lead to more valid conclusions about treatment use, safety, and effectiveness.

Keywords

unmeasured confounding; frailty; functional limitation; epidemiologic methods

INTRODUCTION

In research based on population-based, administrative claims data of older adults, e.g., the Medicare population, unmeasured or residual confounding by frailty may be profound. Frailty is a physiologic state of increased vulnerability to resulting from age and disease-associated decreased physiologic reserves in multiple systems. It is characterized by nutritional decline, fatigue, decreased activity, and weakness.[1] Frailty is strongly associated with adverse health outcomes including death.[2] It differs from co-morbidity in that it is not linked to a specific diagnosis or to the number of chronic diseases[1] and, although it increases with age, it can occur at any age past 65. [3] Although age and comorbidity are relatively easy to assess and therefore adjust for, control for frailty in administrative claims data studies falls woefully short. In a study of the effects of lipid-lowering therapy, evidence for unmeasured confounding by frailty was expected to account for a large proportion of the reduction in mortality. [4] Frail people are less likely to receive or persist on preventative treatments than their non-frail counterparts, independent of age and comorbidity. [1] For example, in a case-control study, controlling for functional limitations in a study of influenza vaccine effectiveness resulted in estimates closer to the null.[5]” In another study, older individuals who received the flu vaccine had a lower risk of mortality prior to the onset of the influenza season, a finding most plausibly explained by unmeasured confounding by frailty.[6]

Operational definitions of frailty, developed for clinical prognosis and research, typically include both performance (e.g., grip strength, walking speed) and self-report measures (e.g., exhaustion, self-reported physical activity).[7] Although these components of frailty are measured in specialty clinical and research settings, they are impractical in the typical clinical encounter from which claims data result.[8] Both resulting from (and possibly contributing to) frailty is functional disability,[9–11] defined as a limitation in activities required for self-care (Appendix 1). More than 70% of older adults identified as frail in the Cardiovascular Health Study had either at least one disability or more than one comorbid condition.[7] Disability, especially if marked, is readily recognized in the non-specialty clinical setting and is likely to generate claims, such as rehabilitation care or durable medical equipment. Hence, advanced stages of disability such as dependency in basic activities of daily living (ADL) may trigger differential claims more reliably than phenotypic frailty. Also, ADL dependency is strongly associated with early mortality.[12, 13] Therefore, despite the incomplete overlap of the conditions, claims that identify ADL dependency—used in conjunction with those referring to comorbidity—may serve as proxy for frailty for the purpose of improving confounding control.

Our objective was to develop an operational definition of frailty in claims data using ADL dependency as a proxy outcome (Appendix 1). A validation of this method is described, both in terms of its ability to identify consistent markers of ADL dependency and its ability to predict early mortality. It is hoped that the model will prove useful in controlling for ADL dependency in settings in which functional status was not measured. This study was conducted in parallel with one focusing on identifying functional status in older cancer patients based on procedure codes.[14] The current study incorporates both procedures and diagnosis codes to identify a range of diagnosis and procedure claims associated with ADL dependency in the general population.

METHODS

Data sources

We used the 2006 Medicare Current Beneficiary Survey (MCBS) Cost and Use files as the data source for the analysis. The MCBS is a rotating panel survey in which a representative sample of the Medicare population, including older and disabled US citizens, is enrolled every year and followed for four years. The survey, conducted face to face, is designed to assess utilization and cost of medical care, but also includes both self-reported functional status and linked Medicare claims. Claims include those for treatments and durable medical equipment as well as accompanying diagnoses. Sources of claims included acute care hospitals, long-term care facilities, outpatient services, home health care and ambulance services, and medical equipment providers. Limited information was available on prescription drug use; about half of the data in 2006 originated in the survey and does not include drug service dates while the other half, coming from Medicare Part D, contains complete data on prescription drug use. Identifying markers of ADL dependency in Medicare claims data is possible through the utilization of this unique dataset.

Study design and Sample population

We constructed the sample based on individuals living in the community at the time of their MCBS Health Survey in the fall of 2006. Eligible individuals met the following additional criteria: 1) were 65 or older at the time of the survey; 2) had claims data for 8 months prior to the survey (those enrolled in managed care plans were excluded); 3) were alive at the time of the interview (proxy interviews allowed for individuals who were alive, but unable to provide information); and 4) were not missing data for assessment of functional status.

Definition of outcome

The comprehensive Health Survey included multiple questions about both instrumental and basic activities of daily living (ADLs) based on a modified Katz Index of Activities of Daily Living.[15] To identify a more advanced level of functional decline, we defined our outcome as a dependency in at least one basic activity of daily living. We constructed this outcome from MCBS questions*: Because of a health or physical problem, do you have any difficulty with the following? Bathing or showering? Dressing? Eating? Getting in or out of bed or chairs? Walking? Using the toilet?* In follow-up questions, those who reported an ADL difficulty were asked if they needed help from another person to complete the activity or if they were unable to complete the activity because of their health. The MCBS assessment of disability diverge from the Katz Index only in a substitution of questions about mobility (walking) rather than bowel and/or bladder continence.[16] For the purposes of this analysis, ADL dependency was defined as needing help from another person or not being able to complete at least one of the six basic activities of daily living.

Definition of predictors

Predictors of ADL dependency included International Classification of Diseases, Ninth Revision Clinical Modification (ICD-9) diagnosis and procedure codes as well as Current Procedural Terminology (CPT) and Healthcare Common Procedure Coding System (HCPC) codes. Codes were captured in the 8 month window prior to the Health Survey administered in the last four months of 2006. Because the same diagnostic or procedure construct can be described with multiple codes and the number of outcomes was limited relative to the number of potential covariates, similar codes were aggregated. For example, all strokes and head injury codes were considered together. We chose codes congruent with frailty theories, such as codes for weakness, difficulty walking, and weight loss. Additional diagnosis codes were chosen based on their likely association with frailty, including decubitus ulcers, heart failure, and dementia. All candidate aggregated claims codes formed indicator variables for inclusion in the models and are listing in Appendix 2. Our final potential predictors included demographics (age—centered at age 65, age-centered squared, sex, and race) and diagnostic codes (present or absent) related to high-risk disease states (stroke, heart failure, cancer), geriatric syndromes (falls, hip fracture, pneumonia, dehydration, fecal impaction, delirium), durable medical equipment charges (home hospital bed, wheelchair, home oxygen, walker). Also added were codes thought to be inversely associated with frailty, such as cancer screening and coronary revascularization.[17] After initial aggregation, all code groups were examined for prevalence in the sample. Those with less than 1% prevalence were re-aggregated or dropped from consideration. Finally, because race may not always be available in administrative claims data, the model was evaluated again without this variable. We also checked the performance of the models across the four census-defined regions of the United States: Northeast, Midwest, South, and West.

Data analysis

Prior to modeling, univariate distributions and bivariable associations were examined. We used multivariable logistic regression with backward elimination to identify independent predictors statistically significantly associated with ADL dependency controlling for all other predictors in the model. In addition to demographic variables, all 57 aggregated candidate predictors were added to the model; after backward elimination, only variables with a p value of 0.05 or less were retained as significant, independent predictors.

We used bootstrapping for internal validation of the model. Bootstrapping (1000 samples with replacement) allowed an estimation of the consistency of statistical significance of the predictors across bootstrapped samples. Variables that were statistically significant in 50% or more of the bootstrapped datasets were chosen for the final model.

MCBS survey and non-response weights were applied as a final step after model validation and final models were chosen. All analyses were completed in SAS 9.3 (*SAS Institute, Inc.,* *Cary NC*). Reported values include weighted odds ratios, model-based predicted probabilities, as well as the area under the receiver operating characteristics (ROC) curve for the initial predictive model and for the model restricted to statistically significant predictors in 50% or more of bootstrapped samples.

To check our assumptions about the importance of ADL dependency as a marker for frailty, we examined the association between ADL dependency (as the exposure) and mortality (as the outcome). After examining the crude association between ADL dependency and death with Kaplan-Meier curves, we constructed a Cox proportional hazards model controlling for age (continuous with quadratic term), sex, and race (Hispanic, Non-Hispanic White, Non-Hispanic Black, Other) to estimate the hazard ratio for mortality comparing those with and without ADL dependency. A similar procedure was applied using two different exposures: 1) predicted probability of ADL dependency (highest vs. the lowest category) and 2) aggregated claims. An additional logistic regression procedure was used to examine the associations between: 1) ADL-D and mortality, 2) predicted probability of ADL dependency and mortality (in five categories, <5% probability as referent), and 3) claims associated with ADL dependency and mortality. C- statistics were calculated from these models.

RESULTS

Sample description

The 2006 MCBS sample consisted of 11,984 individuals. Of these, 10,008 participated in the fall interview; an additional 3,691were excluded due to: age less than 66 (1768), participation in an HMO (1711), dead (97) or in a facility at the time of the Health Survey (20), or missing data for activities of daily living (21), leaving 6,391 for analysis. Of the 6,391 respondents, 57% were female, 88% white, and 38% were 80 or older. Overall, 9.5% of respondents were ADL dependent in at least one activity of daily living. As expected, those with ADL dependence were more likely to be female, older, and non-white (Table 1). Of those who were ADL dependent, 49% were dependent in walking, 69% in bathing, 51% in dressing, 23% in toileting, 41% in transferring from bed to chair, and 13% in eating. Almost 57% were dependent in more than one ADL.

Predictors of ADL dependency

In bivariable analyses, use of a home hospital bed or wheelchair was particularly strongly associated with ADL dependency. Other associated procedure codes included those for home oxygen, podiatry and rehabilitation care. Diagnoses associated with ADL dependency included difficulty walking, dementia, stroke, and heart failure. Included codes inversely associated with ADL dependency were those for cancer screening, rehabilitation therapy, and treatment of lipid abnormalities and coagulation deficiencies. Code groups eliminated from the models included those for 1) serious illnesses, such as coronary or valvular heart disease, lung disease (e.g., COPD, pneumonia), liver disease, and renal failure; 2) code groups consistent with frailty theories such as falls, hip fracture, anemia, electrolyte abnormalities, abnormal x-ray, medication reaction, dysphagia, delirium, dehydration, and weight loss; and 3) other code groups associated with disability, such as walker, inflammatory arthritis conditions (e.g., rheumatoid arthritis, polymyalgia rheumatic), and other fractures. (For details of excluded code groups, please see Appendix 2c). When race was not included in the models, most of the diagnosis groups selected remained the same. Additional variables were selected as important predictors, however, including abnormal x-ray and bladder dysfunction. Please See Appendix 2b for parameter estimates excluding race.

In the whole sample, backward elimination procedures identified several variables independently positively associated with ADL dependency including: use of a home hospital bed or wheelchair, home oxygen therapy, ambulance transport, stroke, heart failure, diabetes complications, decubitus ulcer, paralysis, psychiatric illness, arthritis, weakness, difficulty walking, bladder dysfunction (incontinence), sepsis, and podiatric care (Figure 1). Codes for vertigo, cancer screening, rehabilitation, and lipid abnormalities were inversely associated with ADL- dependency. Using this model, predicted probabilities for ADL dependency ranged from 0.011 to 0.995.

Validation procedures identified a subset of the predictors as consistently associated with ADL dependency across bootstrapped samples. Based on bootstrapped validation procedures, aside from age, sex, and race/ethnicity, the following diagnosis and procedure code groups are chosen as likely to be stable predictors of ADL dependency as defined in our model: 1) use of a home hospital bed; 2) use of a wheelchair: 3) home oxygen therapy; 4) ambulance transport/CPR; 5) stroke/brain injury; 6) heart failure; 7) diabetes complications; 8) decubitus ulcer; 9) paralysis; 10) weakness; 11) difficulty walking; 12); 13) sepsis; and 14) podiatric care. A prior nursing home stay was also predictive. In addition, cancer screening and lipid abnormalities were inversely associated with ADL dependency (c-statistic 0.84, ROC curve, Appendix 3). C-statistics based on models weighted with sample and nonresponse weights are also provided for the model restricted to the stable predictors of ADL dependency (0.845), a model with demographic characteristics only (0.70), and a model restricting to demographics and components of the Charlson Comorbidity Index (0.78).

Model c-statistics varied slightly across regions, from 0.83 in the West, to 0.86 in the South and Midwest to 0.87 in the Northeast. However, individual predictors varied more widely. For example, although home hospital bed and oxygen therapy were strong predictors of ADL dependency in all regions, codes for weakness did not predict ADL dependency in the South, but the difficulty walking code group was a strong predictor; the opposite was true for the Midwest. Please see Appendix 2d for estimates by region.

Prediction of mortality

A total of 135 individuals died within 6-months of their survey date (64 among those with at least one dependency; 71 among those without) and 1257 died within 4-years (315 among dependent; 942 among non-dependent). Comparing those with ADL dependency to those without, the hazard ratio for death over 4 years, controlling for age, sex, and race/ethnicity was 3.21 (95% CI: 2.80, 3.67). Comparing those with a 20% or higher probability of dependency to those with <20% probability of dependency, the hazard ratio for death over 4 years, controlling for age, sex, and race/ethnicity was 3.19 (95% CI: 2.78, 3.68). Comparing those with a 40% probability of ADL dependency with a <5% probability, the hazard ratio is

7.97 (6.51, 9.77). Kaplan-Meier curve for the association of five categories of model-predicted ADL dependency and death are presented in Figure 2. Odds ratios and c-statistics associated with early (6-month) mortality are presented in Appendix 4.

DISCUSSION

Using healthcare claims, we identified several aggregated diagnosis and procedure codes that were consistently and strongly associated with ADL dependency, resulting in a predictive model with good discrimination. The strongest predictors included claims for durable medical equipment (DME), such as home hospital beds, wheelchairs, and portable oxygen which are not usually included in confounding control procedures for comparative effectiveness and safety studies, e.g. propensity scores. Both self-reported ADL dependency and a higher probability of ADL dependency based on relevant claims were associated with a marked increase in mortality hazard.

Frailty is not routinely documented in the clinical record, and is highly unlikely to become a part of administrative health data due to the lack of a standardized clinical definition. However, it remains a strong predictor of treatment use and health outcomes.

Substantial evidence exists for confounding by factors related to frailty, and the absence of a good method of adjustment has limited the validity of analyses of treatment and outcomes for older patients using administrative datasets. For example, in a Medicare claims study, using propensity score methods, the magnitude of decrease in the hazard for death associated with lipid-lowering medications was more than twice that noted in randomized trials.[4] Other observational studies have estimated a beneficial effect of statin lipid-lowering agents on hip fracture[17] and cancer[18], results that are biologically unlikely. Several studies have indicated a significant protective effect of influenza vaccination on mortality with risk ratios <0.5, but concerns remain about unmeasured confounding by frailty, despite multiple efforts to control for it.[19–22] Studies stratifying vaccination into pre-influenza/post-influenza time periods have documented a greater protective effect before influenza becomes evident.[6] Much smaller effect sizes were seen with direct control for functional status (OR 0.71; 0.47, 1.06).[5]

Strengths and Limitations

Reliance on claims to identify health conditions results in variable reliability. Claims for conditions consistent with frailty definitions are less commonly captured in administrative data.[23] Nevertheless, this analysis demonstrates that construction of a predictive model of ADL dependency as a frailty marker, based solely on claims data can be successful. Conditions closely related to prevailing frailty theories, such as difficulty walking and weakness, were both captured in claims data and found to be predictive of ADL dependency. Other claims expected to be related to both ADL dependency and frailty (home hospital beds, wheelchairs) proved to be particularly strong predictors of ADL dependency. It should be noted, however, that the aggregation of claims presented in this model was a subjective process, albeit informed by frailty theory and clinical experience. A more objective process may yield different predictors.

Advantages of the current analysis approach include an ability to adjust for confounding by frailty in population-based, administrative claims data more directly, without the need to satisfy assumptions of other techniques. Disadvantages include the likelihood that control for confounding by frailty will be partial only. In addition, ADL dependency overlaps with frailty, but incompletely. ADL dependency is a proxy for frailty and claims are a proxy for ADL dependency. Because this control is only approximate, implementation of study design methods that limit the potential for confounding by frailty, e.g., active comparator new user designs,[24] or trimming[25] of patients treated contrary to prediction, in tandem are advisable.

Additional limitations include the inability to generalize this predictive model outside of the Medicare population without testing it in other datasets. It is very likely that frailty predictors vary considerably across populations and settings. We chose the Medicare population, because Medicare covers 90% of the population of older adults in the United States and confounding by frailty may have a larger impact on analyses in the Medicare population than in most other populations. However, transportability of our model may be limited: choices of diagnostic/procedure codes in other practice settings, such as health maintenance organizations serving older adults, may differ from those encouraged by Medicare reimbursement policies. Moreover, policy changes, new treatment guidelines, secular trends in the aggressiveness of treatment, and adoption of ICD-10 could be expected to influence the model variable choices. Our hope is that this work will stimulate additional investigation into similar approaches to confounding control. As Kim and Schneeweiss suggested recently, an approach to control for confounding by frailty through identifying relevant claims is not yet completely developed. Both further testing and additional strategies are warranted.[26]

Our result is consistent with a recent study in which Davidoff and colleagues constructed a model from claims for healthcare services, procedures, and durable medical equipment in the calendar year of the health survey to predict disability status in MCBS data based on an approximation to the Eastern Cooperative Oncology Group (ECOG) performance scale used in oncology practice to guide treatment decisions.[14] Our study was similar in that it used a measure of disability based on MCBS claims as an outcome and models predictive of both functional limitation and mortality. However, because our study was focused on control of confounding by frailty, we used an outcome indicative of more severe disability. In addition, since our aim was to identify incremental improvements in identifying differential treatment by frailty, we included both diagnostic and procedure codes. We included only aggregated codes with a prevalence of at least 1% in the sample population.

Future directions

Additional work is required to identify the best approach to identify predictors of differential treatment associated with frailty. The current outcome is defined solely on ADL dependency, largely in an attempt to capture a more advanced stage of functional decline. However, other outcome strategies that tap into non-disability markers of frailty could be investigated and compared with the methods developed for this study.[27] In addition, the strategy used for this study was heavily informed by theoretical and clinical judgment; our team is currently working on additional approaches.

This work implies multiple applications. First, partial control for confounding by frailty may be achieved by including the contributing constructs in a propensity score or outcome regression model. Second, the model developed for this study may be used to identify and classify patients who are more likely to be dependent. This would enable appropriate restriction of the study population based on eligibility criteria and subgroup analyses. Third, using the model, patients could be scored by their predicted probability of ADL dependency, enabling comparisons of the average degree of ADL dependency in two treatment groups. Fourth, predicted ADL dependency could become a variable in the propensity score or outcome model when sample size considerations limit the ability to adjust for the individual components of the algorithm directly. Finally, these potential applications must be tested in a setting of known unmeasured confounding by frailty.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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KEY POINTS

- Unmeasured and residual confounding by frailty can bias estimates of therapy effectiveness and safety based on administrative claims data.
- Frailty is a complex construct, difficult to operationalize in epidemiologic studies, but at least partially captured by measures of dependency in basic activities of daily living.
- An algorithm for predicting dependent status using healthcare claims provided a means for measuring some aspects of frailty and was strongly predictive of all-cause mortality
- Controlling for variables predicting frailty is likely to improve confounding control in large automated healthcare databases; examining the balance of predicted ADL dependency at baseline can be used to assess the selection of non-frail patients for treatment initiation.

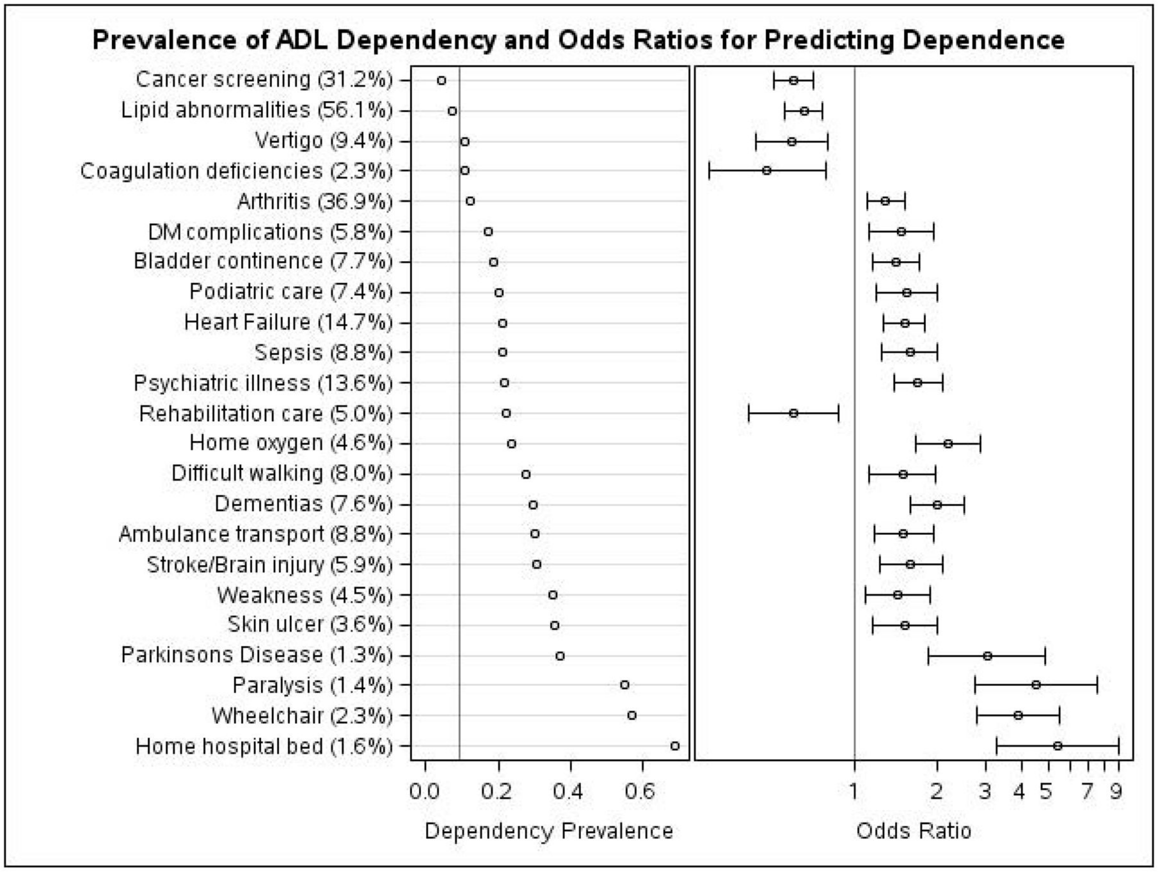

Figure 1. Prevalence of ADL Dependency and Odds Ratios for Predicting Dependency

Variable labels present the prevalence of the condition in the sample (in parentheses). The first panel presents the unadjusted prevalence of ADL dependency for individuals with the condition compared with the overall prevalence of ADL dependency (vertical reference line at 8.5%). The second panel presents the adjusted odds ratio for ADL dependency for individuals with the condition compared to those without the condition. The model is adjusted for all of the listed covariates along with age (age-65), sex, and race/ethnicity. Abbreviations: Dependency = dependency in basic activities of daily living; OR= Odds Ratio

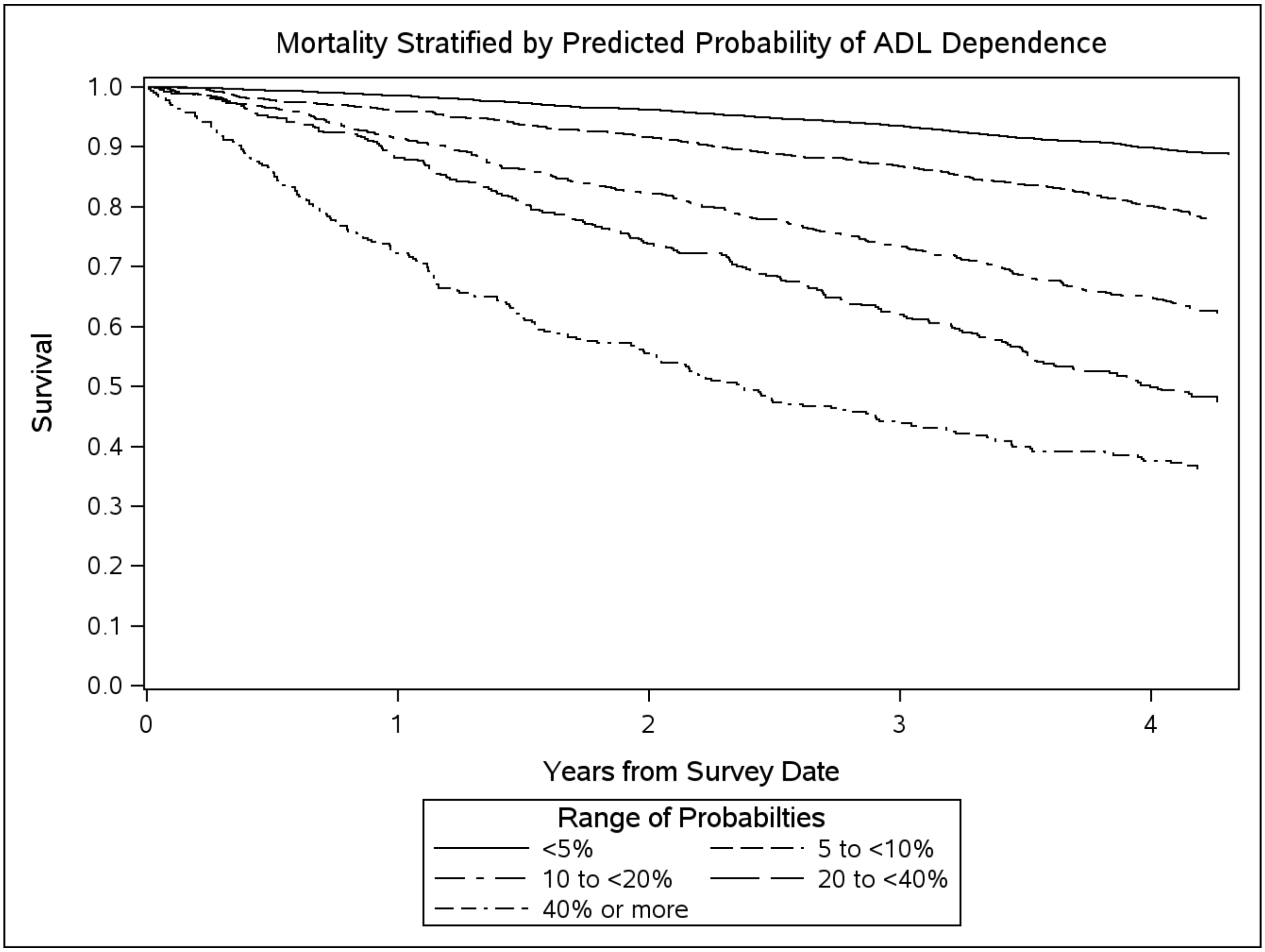

Figure 2. Mortality stratified by categories of predicted probability of ADL dependency

Kaplan-Meier curve with five categories of predicted dependence in activities of daily living.

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Table 1

Characteristics of the 2006 Medicare Current Beneficiary sample meeting criteria for inclusion

	Sample meeting criteria for inclusion* (n= 6,391)		Weighted Sample (N = 23,198,110)	Weighted ADL-dependent (n = 1,962,835)	Weighted Non-dependent (n = 21,235,274)
	n	%	% (se)	% (se)	% (se)
Dependency in					
At least 1 basic ADL	604	9.5	8.5 (0.28)		
2 or more basic ADLs	342	5.4	4.8 (0.20)	56.2 (1.5)	
Bathing	413	6.5	5.6 (0.22)	66.4 (1.4)	
Dressing	305	4.8	4.3 (0.21)	50.5 (1.6)	
Toileting	140	2.2	2.0 (0.14)	23.2 (1.5)	
Transferring	250	3.9	3.5 (0.15)	40.8 (1.5)	
Eating	80	1.3	1.1 (0.11)	13.6 (1.2)	
Walking	293	4.6	4.1 (0.18)	48.1 (1.4)	
Age					
66–69	1182	18.5	21.0 (0.29)	8.7 (0.84)	22.1 (0.32)
70–74	1489	23.2	26.1 (0.37)	18.6 (1.37)	26.8 (0.39)
75–79	1294	20.2	22.3 (0.35)	16.4 (1.09)	22.9 (0.37)
80–84	1295	20.2	17.1 (0.31)	23.8 (1.23)	16.5 (0.32)
≥ 85	1131	17.7	13.5 (0.22)	32.5 (1.23)	11.7 (0.24)
Gender					
Male	2759	43.2	43.3 (0.37)	32.2 (1.12)	44.4 (0.39)
Female	3632	56.8	56.7 (0.37)	67.8 (1.12)	55.6 (0.39)
Race/ethnicity					
Non-Hispanic White	5623	88.0	88.0 (0.03)	82.5 (1.10)	88.5 (0.30)
Non-Hispanic Black	486	7.6	7.6 (0.21)	10.5 (0.81)	7.3 (0.22)
Hispanic	99	1.6	1.4 (0.11)	1.3 (.38)	1.4 (0.11)
Other†	183	2.9	2.9 (0.18)	5.4 (0.69)	2.7 (0.17)
Claims					
Stroke/Brain injury	397	6.2	5.9 (0.22)	21.2 (1.16)	4.5 (0.22)
Bladder continence	509	8.0	7.7 (0.24)	17.0 (1.12)	6.8 (0.23)

	Sample meeting criteria for inclusion* (n= 6,391)		Weighted Sample (N = 23,198,110)	Weighted ADL-dependent (n = 1,962,835)	Weighted Non-dependent (n = 21,235,274)
	n	%	% (se)	% (se)	% (se)
Coagulation Deficiencies	154	2.4	2.3 (0.13)	2.9 (0.52)	2.3 (0.14)
Decubitus ulcer	260	4.1	3.6 (0.17)	15.1 (1.02)	2.5 (0.15)
Diabetes complications	378	5.9	5.8(0.22)	11.9 (1.09)	5.2 (0.23)
Dementia	541	8.5	7.6 (0.21)	16.9 (1.48)	5.8 (0.20)
Difficulty walking	561	8.8	8.0 (0.25)	26.4 (1.36)	6.3 (0.22)
Heart failure	1018	16.0	14.7 (0.35)	32.8 (1.47)	12.7 (0.36)
Arthritis	2442	38.2	38.9 (0.43)	53.7 (1.47)	35.3 (0.42)
Lipid abnormalities	3617	56.6	56.1 (0.51)	49.0 (1.6)	56.8 (0.51)
Parkinson's Disease	87	1.4	1.3 (0.10)	5.7 (0.71)	0.9 (0.09)
Paralysis	92	1.4	1.4 (0.10)	8.9 (0.87)	0.7 (0.08)
Podiatry	494	7.7	7.4 (0.22)	17.5 (1.27)	6.5 (0.22)
Psychiatric illness	914	14.3	13.6 (0.31)	35.2 (1.52)	11.6 (0.31)
Rehabilitation care	341	5.3	5.0 (0.19)	13.1 (1.14)	4.2 (0.18)
Cancer screening	1944	30.4	31.2 (0.41)	16.6 (0.94)	32.5 (0.45)
Sepsis	596	9.3	8.8 (0.27)	22.1 (1.37)	7.6 (0.28)
Vertigo	636	10.0	9.4 (0.29)	11.8 (1.05)	9.2 (0.31)
Weakness	321	5.0	4.5 (0.18)	18.8 (1.17)	3.2 (0.16)
Home hospital bed	115	1.8	1.6 (0.10)	13.4 (1.09)	0.6 (0.07)
Ambulance Transport	618	9.7	8.8 (0.25)	31.3 (1.49)	6.8 (0.25)
Home oxygen	310	4.9	4.6 (0.22)	12.8 (0.93)	3.8 (0.22)
Wheelchair	172	2.7	2.3 (0.13)	15.7 (0.97)	1.1 (0.10)

*Criteria for inclusion in the sample include: alive and living in community at time of interview, age >64 years, not enrolled in managed care plan, not missing data for assessment of functional status.

†"Other" includes Asian, American Indian, Pacific Islander, and unknown race (7 individuals)