Published in final edited form as:

Disabil Health J. 2016 January ; 9(1): 64–73. doi:10.1016/j.dhjo.2015.08.006.

Comparison of Predictive Value of Activity Limitation Staging Systems Based on Dichotomous Versus Trichotomous Responses in the Medicare Current Beneficiary Survey

Jibby E. Kurichi, MPH^a, Joel E. Streim, MD^{b,c}, Hillary R. Bogner, MD, MSCE^a, Dawei Xie, PhD^a, Pui L. Kwong, MPH^a, and Sean Hennessy, PharmD, PhD^{a,d}

^aCenter for Clinical Epidemiology and Biostatistics, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania

^bGeriatric Psychiatry Section of the Department of Psychiatry, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania

^cVISN 4 Mental Illness Research Education and Clinical Center (MIRECC), Philadelphia VA Medical Center, Philadelphia, Pennsylvania

^dCenter for Pharmacoepidemiology Research and Training, University of Pennsylvania, Philadelphia, Pennsylvania

Abstract

Background—Traditional ways of measuring disability include summary indices, binary expressions, or counts of limitations. However, counts of activity of daily living (ADL) or instrumental activity of daily living (IADL) limitations do not specify which activities are limited. Activity limitation staging systems within the ADL and IADL domains depict both the severity and types of limitations experienced and specify clinically meaningful patterns of increasing difficulty with self-care.

Objective—To compare the predictive value and utility of ADL and IADL stages based on dichotomous versus trichotomous responses to ADL and IADL questions based on “difficulty” and “receive help” responses.

Methods—Data were analyzed from the 2005, 2006, and 2007 Medicare Current Beneficiary Survey (MCBS) entry panels on 11,706 beneficiaries. This was a prospective cohort study that examined time to inpatient admission, all-cause mortality, skilled nursing facility (SNF) admission, and long-term care (LTC) facility admission based on dichotomous versus trichotomous stages.

Corresponding author: Jibby E. Kurichi, MPH; 907 Blockley Hall; 423 Guardian Drive; Philadelphia, PA 19104-6021. The email address is jkurichi@mailmed.upenn.edu, the office phone number is (215) 898-8490, and the fax number is (215) 573-2017..

Disclosures:

We certify that no party having a direct interest in the results of the research supporting this article has or will confer a benefit on us or on any organization with which we are associated AND, if applicable, we certify that all financial and material support for this research (i.e., NIH grants) and work are clearly identified in the title page of the manuscript.

This material has not been previously presented at a meeting.

There are no personal conflicts of interest of any of the authors, and no authors reported disclosures beyond the funding source. The opinions and conclusions of the authors are not necessarily those of the sponsoring agencies.

Results—For both ADLs and IADLs, Akaike information criteria for most outcomes were lower (indicating better-performing models) for the trichotomous staging systems than the dichotomous staging systems. The hazard ratios (HRs) and 95% confidence intervals (CIs) of the dichotomous ADL staging system increased as disability increased, whereas the HRs of the other staging systems fluctuated.

Conclusions—Both staging systems have strong associations with each outcome. The dichotomous staging system is more clinically relevant while the trichotomous staging system may provide utility for clinicians, healthcare organizations, and policy makers seeking to predict death or admission to a hospital, SNF, or LTC facility.

Keywords

staging; disability; Medicare Current Beneficiary Survey; activities of daily living

INTRODUCTION

According to the United States Census Bureau, approximately 37.5 million US adults had a disability in 2011 (1) and these disabilities were associated with almost \$400 billion in related healthcare costs. Persons with disabilities have higher rates of social isolation, poverty, and other social factors that challenge them in obtaining health services.(2) Although people today appear to be living longer, disability does not need to be part of the aging process. Disability rates have declined due to a number of reasons, including higher education levels leading to improvements in socioeconomic status, behavioral changes, and improved medical technology.(3) However, people who have a disability may struggle completing even the most trivial task. Thus, it is important to have a mechanism to measure disability.

Traditional ways of measuring disability include summary indices, binary expressions, or counts of limitations. However, counts of activity of daily living (ADL) or instrumental activity of daily living (IADL) limitations do not specify which activities are limited.(4-6) For example, person A may be limited in two items, while person B may only be limited in one item. Not knowing which item(s) the person is limited in makes it difficult to project specific service needs. People with different levels of disability will probably have very different care needs and clinical trajectories. To address this shortcoming of existing disability measures, separate systems were derived for staging ADL and IADL limitations such that each stage was defined by the activities older persons are able to do without difficulty based on the International Classification of Functioning, Disability and Health (ICF) concepts of activity and participation.(7-9) Stineman et al. used data from the Medicare Current Beneficiary Survey (MCBS) to derive activity limitation staging systems within the ADL and IADL domains that depict both the severity and types of limitations experienced, and specified clinically meaningful patterns of increasing difficulty with self-care.(8) By distinguishing activities that older people are still able to do without difficulty from those that they find difficult, these systems enable a more fine-grained description of disability at the patient and population levels, and can thus serve as a foundation for developing specific strategies to reduce disparities in the care and support of older adults with disabilities. Each domain (ADL and IADL) includes six activities. The ADLs are

eating, toileting, dressing, bathing/showering, getting in or out of bed/chairs, and walking. The IADLs are using the telephone, managing money, preparing meals, doing light housework, shopping for personal items, and doing heavy housework. Stineman et al. originally derived activity limitation stages based on the level of difficulty a person experiences when performing each of the six activities in a given domain.(8) The relevant question in the MCBS asks, “Because of a health or physical problem, (do you/does sample person) have any difficulty with the following?” Each respondent (or her/his proxy) indicates that the person either has “no difficulty” or “difficulty” performing each activity. (10)

However, assessment of activity limitations can be based not only on “difficulty experienced” but also on “help received,” as reflected in the MCBS question, “You said that (ADL/IADL) is something that (you have difficulty doing/you don't do/sample person has difficulty doing/sample person doesn't do). (Do you/Does sample person) receive help from another person with (ADL/IADL)?” However, receiving help from a second person to carry out ADLs or IADLs may or may not indicate severe activity limitation in the respondent. (11). In general, *receiving* help may or may not reflect a *need* for help. This makes it important to determine whether the predictive value or utility of stages can be improved by asking people if, in addition to having difficulty doing the activity, the respondent receives help from a second person to accomplish the ADL or IADL. The objectives of this paper are (1) to describe the derivation of a new staging system that incorporates the response to survey questions about receiving help; and (2) to compare ADL and IADL staging systems based on dichotomous responses (“no difficulty” or “difficulty”) to trichotomous responses (“no difficulty,” “difficulty,” or “receive help”) in terms of their capacity to predict each of four events or outcomes: inpatient admission, all-cause mortality, skilled nursing facility admission, and long-term care facility admission. We hypothesized that the predictive capacity of the dichotomous versus trichotomous staging systems will be similar. To our knowledge, no published research to date has compared the association of MCBS-derived dichotomous and trichotomous ADL and IADL staging systems with clinical events or outcomes.

METHODS

This study was approved by the Institutional Review Board of the University of Pennsylvania.

Data source

Data for this study were from the MCBS which is conducted by the Centers for Medicare and Medicaid Services (CMS). The sample is representative of the national Medicare population and is drawn from the Medicare enrollment file.(10, 12, 13) Survey data are combined with information from Medicare administrative files and other sources of data such as the Minimum Data Set for beneficiaries in nursing facilities. The MCBS uses survey weights to account for non-response and oversampling of people under 65 years of age and those 80 years and older.(13) Sample persons or their proxies are interviewed about their health status and functioning in the autumn of their entry year and each subsequent autumn,

and about their healthcare utilization starting January 1st following their autumn interview. Each respondent is interviewed for a maximum of four years. The MCBS is released as two data sets: Access to Care and Cost and Use. The Access to Care files contain the baseline health status and functioning interview. The Cost and Use files contain healthcare utilization information from Medicare claims. These two files are directly linkable.

Study cohort

The baseline sample was defined as the entry panels of the 2005, 2006, and 2007 MCBS Access to Care files (n=11,713). Seven people were missing baseline IADL information. Thus, 11,706 beneficiaries were included in all the analyses.

Primary exposure

Baseline ADL and IADL stages (i.e., those measured from the first survey for each respondent) were the primary exposures and were derived separately. Stages were defined in two ways. The dichotomous staging system was based on a person's level of difficulty performing an activity and has been described previously.(8) In brief, the sample person's or close proxy's responses to questions in the MCBS Access to Care file are coded as 0 = not difficult and 1 = difficult. The stages are ordered by the probability that individuals with mild (stage I), moderate (stage II), severe (stage III), and complete limitations (stage IV) would describe difficulty performing each activity. Stage 0 is absence of ADL or IADL limitation. The stage definitions indicate the most common patterns of activity limitation based on the prevalence of those patterns in the Medicare sample. The concept of "receives help" is not coded in the dichotomous staging systems.

Here, we describe the trichotomous staging systems which incorporate information about the receipt of help from a second person and are summarized in Table 1. A person can have no difficulty doing an activity (coded as 0), has difficulty (coded as 1), or receives help if he/she has difficulty and needs help performing the task (coded as 2). The trichotomous staging system (has no difficulty, has difficulty, or receives help performing the task) has 9 stages within each domain: 0, Ia, Ib, Ic, IIa, IIb, IIIa, IIIb/IVa, and IVb. People who are at stage 0 in the ADL domain have no difficulty performing all 6 activities within that domain; the same is true in the IADL domain. Those who are at stage IVb receive help doing all 6 activities within the domain. Thus, higher numbered stages reflect greater disabilities. People who do not follow the typical hierarchy of loss of function are assigned to a non-fitting stage, stage IIIb/IVa. Table 1 shows the stage definitions for the trichotomous ADL and IADL stages. For example, beneficiaries at trichotomous stage ADL-0 have no difficulty eating, toileting, dressing, bathing/showering, getting in or out of bed/chairs, or walking. Similarly, those at trichotomous IADL stage 0 have no difficulty using the telephone, managing money, preparing meals, doing light housework, shopping for personal items, or doing heavy housework. As another example, to be categorized at the trichotomous stage ADL-IIb, a person must have no difficulty eating or toileting; but they may have difficulty or need help bathing/showing, getting in or out of bed/chairs, and/or walking.

Outcomes

We included four time-to-event outcomes: time to the first inpatient admission, time to all-cause mortality, time to the first skilled nursing facility (SNF) admission, and time to long-term care (LTC) facility admission within three-years. Outcomes were ascertained from the Cost and Use files from 2006-2010. LTC facility admission is intended to capture a permanent placement as opposed to a shorter episode of sub-acute, rehabilitative, or respite care in a SNF after which the beneficiary may return home. The MCBS defines LTC facility use broadly. Such a facility must have three or more LTC beds and provide personal care, continuous supervision, or long-term care.

Covariates

Demographic variables included age groups (<65, 65-74, 75-84, and ≥85), sex, and race or ethnic group (non-Hispanic white, non-Hispanic black, Hispanic, and other), all ascertained from the Access to Care files.

Analysis

To determine whether the trichotomous staging systems (based on three response options: no difficulty versus has difficulty versus receives help) are more predictive of the outcomes than the dichotomous staging systems (based on only two response options: no difficulty versus has difficulty), Cox proportional hazard models were fit for each of the four outcomes separately. Death was treated as a censoring event for the three non-death events. Hazard ratios (HRs) and 95% confidence intervals (CIs) for each staging system were calculated, adjusting for age, gender, and race/ethnicity. Only age, gender, and race/ethnicity were used for adjustment in the models because the main focus of this study was to compare the capacity of the two staging systems in predicting the outcomes. As the dichotomous and trichotomous staging systems have different number of stages which would introduce different number of parameters in models, we used Akaike information criteria (AIC) to compare model fit as AIC takes into account not only the likelihood for a model but also penalizes the score if there is a higher number of parameters in the model.⁽¹⁴⁾ Within each outcome, the model with a lower AIC is considered a better fit.

Analyses were performed using SAS 9.4 (SAS Institute, Inc.) and accounted for complex sampling including weighting, clustering, stratification, and sub-population.⁽¹⁵⁾ P-values were two-sided, with statistical significance at $p < 0.05$ in the final models.

RESULTS

The average age of the sample was 71.6 years (SD=14.3). The majority of the beneficiaries were female (n=6356, 54.5 weighted percent) and non-Hispanic white (n=9246, 79.4 weighted percent).

The trichotomous ADL and IADL staging systems were derived in 11,706 beneficiaries. Table 2 shows the most prevalent profiles and the weighted percentages that fall within trichotomous ADL-IIb. As shown in Table 2, one can have different patterns of limitation and still be categorized at trichotomous ADL-IIb, provided that the person meets the

requirement that the person does not have difficulty eating or toileting, which is part of the definition to be at that stage.

Table 3 shows the unweighted sample count and weighted percent cross tabulations of the dichotomous versus trichotomous ADL and IADL staging systems. Stages Ia, Ib, and Ic of the trichotomous systems are nested within stage I of the dichotomous systems. Stages IIa and IIb of the trichotomous systems are nested within stage II of the dichotomous systems. Stage IIIa of the trichotomous systems share some similarities with stage III of the dichotomous systems. Because of the non-fitting nature and definition of stage IIIb/IVa of the trichotomous systems, these stages traverse stages III and IV of the dichotomous systems. Finally, beneficiaries at stage IVb of the trichotomous systems correspond to some beneficiaries of stage IV of the dichotomous systems.

AICs from the Cox models were used to determine whether the dichotomous or trichotomous model had a better fit for each outcome. For all-cause mortality, as an example, the AIC for the dichotomous ADL system was 108245748 and the AIC for the trichotomous ADL system was 108183472. As demonstrated in Table 4, the AICs were lower (i.e., better) for most of the trichotomous staging systems compared to the corresponding dichotomous systems for both the ADLs and IADLs for the event or outcome (i.e., inpatient admission, all-cause mortality, SNF admission, and LTC admission). The dichotomous ADL staging system had a lower AIC predicting LTC admission compared to the trichotomous ADL staging system. The dichotomous IADL system had a lower AIC predicting inpatient admission compared to the trichotomous IADL staging system. Overall, the trichotomous staging systems have a better model fit in predicting most outcomes.

Figure 1 and Figure 2 show the hazard ratios and 95% confidence intervals for each dichotomous and trichotomous stage (versus stage 0) and each event or outcome. The HRs and 95% CIs of the dichotomous ADL staging system increased monotonically as disability increased. In the dichotomous IADL staging system, hazard ratios increased with stage except for stage III, which by definition is non-fitting. With respect to the trichotomous ADL and IADL staging systems, there was no consistent pattern of HRs across stage.

DISCUSSION

The principal finding of this study is that both the dichotomous ADL and IADL staging systems and the trichotomous ADL and IADL staging systems, when applied at baseline, strongly predicted inpatient admission, all-cause mortality, skilled nursing facility admission, and long-term care facility admission over the subsequent three years. Although not hypothesized, the trichotomous ADL staging systems provided better model fit according to AIC for most outcomes. There was a clearer relationship between the dichotomous stage and increasing hazards of the study outcomes, with the exception of IADL-III, which was designed to be non-fitting.

More specifically, most of the AICs from the Cox proportional hazard models were lower for the trichotomous ADL staging system compared to the dichotomous ADL staging system for each outcome. Statistically, this implies that the models which include the

trichotomous ADL staging system predict the outcomes better than the models with the dichotomous ADL staging system. For the ADLs, the AICs were lower in the models using the trichotomous stages rather than the dichotomous systems for inpatient admission, all-cause mortality, and skilled nursing facility admission. For the IADLs, the AICs for the trichotomous staging system were lower for all-cause mortality, skilled nursing facility admission, and long-term care admission compared to the models using dichotomous stages. Conversely, the AIC was lower for the dichotomous ADL staging system predicting long-term care compared to the trichotomous ADL staging system. Moreover, the dichotomous IADL staging system compared to the trichotomous IADL staging system predicting inpatient admission had a lower AIC.

Measurement of ADL and IADL stages may have utility at both the individual and population levels. Potential users of these activity limitation stages include clinicians care for individual patients, or health services researchers, policy makers, or health systems that want to predict the needs of an aging and disabled population. The relative utility of stages based on dichotomous versus trichotomous responses depends on who will be using the staging systems, and for what purpose.

Clinicians are not likely to realize added value from the extra information incorporated in a trichotomous system based on the verbatim questions in the MCBS when treating an individual patient, as the response “receives help” for an ADL or IADL that is reportedly difficult to perform does not necessarily help identify unmet needs or point to an opportunity for providing needed care or services. Rather, activity limitation staging applied to care planning for individual patients might be more useful if based on assessment questions about “help needed” rather than “help received.” From a pragmatic standpoint, clinicians may prefer to use a version of the staging system with simpler response items if they are conducting the assessment of function by themselves in a clinical setting.

For policy makers, the information from a trichotomous system with more stages could be used to make finer-grained predictions of the need for rehabilitation services, personal care, and environmental and social support for populations of older adults with specific disability profiles and patterns of activity limitation. This might include durable medical equipment usage or the need to use a home health agency. Also, healthcare systems that assume risk for defined populations (such as accountable care organizations) as well as health policy makers using activity limitation staging at the population level may choose a system that captures “receives help” if it is readily available in a regularly administered survey such as the MCBS. One limitation of the MCBS data is that they may not be sufficiently current for some applications. For home health agencies, the choice of staging system may depend on whether this tool is being used for assessment of individual patients, or planning resource needs and costs for a defined population.

The end user will need to evaluate if added precision in the trichotomous systems is worth the complexity compared to a system based on only two levels of response. The advantages of the dichotomous approach are that the assessment questions require less time, the system is simpler, and it predicts clinical events and outcomes well. However, as is the case with individual level care, it could be argued that omission of consideration for “receives help”

from a health systems or policy perspective might limit opportunities to improve population health and well-being in those who experience difficulty but report not receiving help. One might argue that omission of a “receives help” question may limit opportunities to provide targeted help and referral to rehabilitation and support services.

Although prevention of disabilities is a primary focus of public health, disability has been recognized as part of the normal human experience. Thus, the promotion of the health of people with disabilities has become a focus of public health by identifying and closing reducible gaps between the health of those with and without disabilities.(16, 17) The Centers for Disease Control and Prevention (CDC) programs, policies, and surveys include people with disabilities.(18) Public health organizations such as the CDC could include either one of the ADL and IADL staging systems into their mainstream programs or surveys to help policy makers identify the severity and type of limitations people have, and the types of services they require to reduce the risk of admission to hospitals, SNFs, and LTC facilities, and to reduce mortality.

This study has several limitations. First, stages were developed using a sample that included only community-dwelling Medicare beneficiaries, in recognition that beneficiaries residing in long-term care facilities represent a different population. Second, the survey data used in this study are based on self- or proxy-reports, and there is the potential error associated with retrospective interview data, including imperfect recall and response bias (i.e., socially desirable responding). Responses provided by proxy interviews may not reflect how the sampled persons themselves would have responded. However, we intentionally chose to include proxy responses, since excluding the substantial proportion of beneficiaries for whom proxies report could introduce substantial bias.(19) Third, perceptions about difficulty experienced or help received (in the performance of ADLs and IADLs) are subjective, and this may limit the accuracy of conclusions about the unmet needs of individuals or populations. The extent of heterogeneity in survey respondents’ perceptions of what constitutes difficulty is not known. Finally, the MCBS asks the question if the person receives help rather than about the person’s need for help.

CONCLUSION

Activity limitation staging systems can aid health services researchers, healthcare organizations, and healthcare policy makers in their shared mission to identify Medicare beneficiaries with disabilities that put them at risk for inpatient admissions, skilled nursing facility admissions, long-term care facility admissions, and all-cause mortality. While both staging systems strongly predict all four clinical events or outcomes in this study, the more complex trichotomous staging system may provide additional utility, while the simple dichotomous staging system is highly clinically relevant. The relative utility of activity limitation stages based on dichotomous versus trichotomous responses depends on who will be using the staging systems, and their questions and goals for addressing individual level and population level needs of older adults with disabilities.

Acknowledgements

We would like to thank Dr. Margaret G. Stineman for her conceptual design of the study, and Ms. Mary Leonard for her graphical skills in creating the figures.

The research for this manuscript was supported by grants from the National Institutes of Health (AG040105 and HD074756) for Drs. Hennessy, Streim, and Xie, Ms. Kwong, and Ms. Kurichi. Dr. Bogner was supported by NIMH grants MH082799 and MH047447.

REFERENCES

1. Services UDoHaH. Implementation guidance on data collection standards for race, ethnicity, sex, primary language and disability status. Washington, DC: 2012. Available from: <http://aspe.hhs.gov/datacnci/standards/aca/4302/index.pdf> [2015 July 27]
2. Organization, WH. World report on disability. World Health Organization; Geneva, Switzerland: 2011. 2013. Available from: http://www.who.int/disabilities/world_report/2011/en/index.html [2015 February 23]
3. US Department of Health & Human Services. [2015 July 28] Disability in Older Adults. 2013. Available from: <http://report.nih.gov/nihfactsheets/ViewFactSheet.aspx?csid=37>
4. Culler SD, Parchman ML, Przybylski M. Factors related to potentially preventable hospitalizations among the elderly. Medical care. Jun; 1998 36(6):804–17. PubMed PMID: 9630122. Epub 1998/06/18. eng. [PubMed: 9630122]
5. John, SD.; Clemens, KM. Projected Medicare Expenditures under an Illustrative Scenario with Alternative Payment Updates to Medicare Providers. Vol. 28. Center for Medicaid and Medicare Services (CMS): Center for Medicaid and Medicare Services (CMS); Nov. 2011 p. 2011 Available from: <https://www.cms.gov/ReportsTrustFunds/downloads/2011TRAlternativeScenario.pdf>
6. Lubitz J, Cai L, Kramarow E, Lentzner H. Health, life expectancy, and health care spending among the elderly. N Engl J Med. Sep 11; 2003 349(11):1048–55. PubMed PMID: 12968089. [PubMed: 12968089]
7. [2010 January 15] Patient Reported Outcomes Measurement Information System (PROMIS).. Dynamic Tools to Measure Health from the Patient Perspective. Available from: <http://www.nihpromis.org/default.aspx>
8. Stineman MG, Streim JE, Pan Q, Kurichi JE, Schussler-Fiorenza Rose SM, Xie D. Activity Limitation Stages empirically derived for Activities of Daily Living (ADL) and Instrumental ADL in the U.S. Adult community-dwelling Medicare population. PM & R : the journal of injury, function, and rehabilitation. Nov; 2014 6(11):976–87. quiz 87. PubMed PMID: 24798263. Pubmed Central PMCID: 4216780.
9. Stineman MG, Henry-Sánchez JT, Kurichi JE, Pan Q, Xie D, Saliba D, et al. Staging Activity Limitation and Participation Restriction in Elderly Community-dwelling Persons According to Difficulties in Self-care and Domestic Life Functioning. Am J Phys Med Rehabil. 2012; 92(2):126–40. [PubMed: 22248806]
10. US Department of Health & Human Services. [2013 March 26] Medicare Current Beneficiary Survey (MCBS). 2010. Available from: <http://www.cms.hhs.gov/MCBS/>
11. Government of Western Australia. [2015 February 23] Disability Access and Inclusion Plans. Available from: www.disability.wa.gov.au
12. Health and Health Care of the Medicare Population. Technical Documentation for the Medicare Current Beneficiary Survey- Appendix A page. 2006:2.
13. Kautter J, Khatutsky G, Pope GC, Chromy JR, Adler GS. Impact of nonresponse on Medicare Current Beneficiary Survey estimates. Health Care Financ Rev. 2006; 27(4):71–93. Summer PubMed PMID: 17290659. [PubMed: 17290659]
14. Burnham, KP. Anderson DR Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach. 2nd ed.. Springer-Verlag; New York: 2002.
15. Lo A, Ghu A. Variance Estimation and the Components of Variance for the Medicare Current Beneficiary Survey Sample. American Statistical Association Section on Survey Research Methods. 2005:3333–41.

16. Smeltzer, SC. [2015 July 30] Improving Health and Wellness of People with Disabilities. 2010. Available from: <http://cirrie.buffalo.edu/encyclopedia/en/article/300/>
17. US Department of Health and Human Services. The Surgeon General's call to action to improve the health and wellness of persons with disabilities. Washington, DC: 2005.
18. Centers for Disease Control and Prevention. [2015 February 27] Disability and health programs Atlanta. p. GA2012 Available from: <http://www.cdc.gov/ncbddd/disabilityandhealth/partners.html>
19. Stineman MG, Ross RN, Maislin G. Functional status measures for integrating medical and social care. International journal of integrated care. 2005; 5:e07. PubMed PMID: 16773164. Pubmed Central PMCID: 1475730. [PubMed: 16773164]

Figure 1.

Comparison of hazard ratios (HRs) and 95% confidence limits of four different outcomes from dichotomous and trichotomous Activity of Daily Living (ADL) Limitation staging systems

Key for Figure 1: Note: reference=stage 0; all models were adjusted for age, gender, and race/ethnicity. The y-axis is the HRs and x-axis is the ADL stages.

* The upper confidence limits for stage IV (dichotomous) and stage IVb (trichotomous) were truncated for graphical purposes.

Figure 2.

Comparison of hazard ratios (HRs) and 95% confidence limits of four different outcomes from dichotomous and trichotomous Instrumental Activity of Daily (IADL) Limitation staging systems

Key for Figure 2: Note: reference=stage 0; all models were adjusted for age, gender, and race/ethnicity. The y-axis is the HRs and x-axis is the IADL stages.

* The upper confidence limits for stage IV (dichotomous) and stage IVb (trichotomous) were truncated for graphical purposes.

Activity of Daily Living Trichotomous Stage definitions for the Medicare Current Beneficiary Survey

Table 1

Stage	Definitions	Most prevalent profile within the stage					
Stage 0	No difficulty: eating, toileting, dressing, bathing/showering, getting in or out of bed/chairs, walking
Stage Ia	No difficulty: eating, toileting, dressing, bathing/showering, getting in or out of bed/chairs Difficulty: walking (but does not need help)
Stage Ib	No difficulty: eating, toileting, dressing, bathing/showering Difficulty: getting in or out of bed/chairs and/or walking (but does not need help)
Stage Ic	No difficulty: eating, toileting, dressing Difficulty or receives help: getting in or out of bed/chairs and/or walking
Stage IIa	No difficulty: eating, toileting Difficulty or receives help: bathing/showering, getting in or out of bed/chairs, and/or walking
Stage IIb	No difficulty: eating, toileting Difficulty or receives help: dressing, bathing/showering, getting in or out of bed/chairs, and/or walking
Stage IIIa	No difficulty: eating Difficulty or receives help: toileting, dressing, bathing/showering, getting in or out of bed/chairs and/or walking
Stage IIIb/IVa*	Difficulty: eating AND Difficulty or receives help with none, one or more, but not all of the following: toileting, dressing, bathing/showering, getting in or out of bed/chairs, walking
Stage IVb	Receives help: eating, toileting, dressing, bathing/showering, getting in or out of bed/chairs, walking

Note: Clear icon denotes no difficulty; light blue icon denotes difficulty; dark blue icon denotes receives help. In the dichotomous system, both difficulty and receives help equivalently denote difficulty with that ADL.* denotes the non-fitting stage, by definition

= eating;
 = toileting;
 = dressing;
 = bathing/showering;
 = getting in or out of bed/chairs;
 = walking

Instrumental Activity of Daily Living Trichotomous Stage definitions for the Medicare Current Beneficiary Survey

Stage	Definitions	Most prevalent profile within the stage			
Stage 0	No difficulty: using the telephone, managing money, preparing meals, doing light housework, shopping for personal items, doing heavy housework
Stage Ia	No difficulty: using the telephone, managing money, preparing meals, doing light housework, shopping for personal items Difficulty: heavy housework (but does not need help)
Stage Ib	No difficulty: using the telephone, managing money, preparing meals, doing light housework, shopping for personal items Difficulty or receives help: doing heavy housework
Stage Ic	No difficulty: using the telephone, managing money, preparing meals, doing light housework Difficulty or receives help: shopping for personal items and/or doing heavy housework
Stage IIa	No difficulty: using the telephone, managing money, preparing meals Difficulty or receives help: doing light housework, shopping for personal items, and/or doing heavy housework
Stage IIb	No difficulty: using the telephone, managing money Difficulty or receives help: preparing meals doing light housework, shopping for personal items, and/or doing heavy housework
Stage IIIa	No difficulty: using the telephone Difficulty or receives help: managing money, preparing meals, doing light housework, shopping for personal items, and/or doing heavy housework
Stage IIIb/IVa*	Difficulty: using the telephone AND Difficulty or receives help with none, one or more, but not with all of the following: preparing meals, doing light housework, shopping for personal items, doing heavy housework
Stage IVb	Receives help: using the telephone, managing money, preparing meals, doing light housework, shopping for personal items, doing heavy housework

Note: Clear icon denotes no difficulty; light blue icon denotes difficulty; dark blue icon denotes receives help. In the dichotomous system, both difficulty and receives help equivalently denote difficulty with that IADL. * denotes the non-fitting stage, by definition

= using the telephone;

= managing money;

= preparing meals;

= light housekeeping;

= shopping for personal items;

= doing heavy housework

Table 2

Examples of different profiles that meet the stage definition for Activity of Daily Living stage IIb

Stage	Definition	Top 5 most frequent profiles within the stage	Weighted percent within Medicare population
Stage IIb	No difficulty: eating, toileting Difficult or receives help: dressing, bathing/showering, getting in or out of bed/chairs, and/or walking		16.3%
		8.5%
		8.1%
		7.4%
		6.2%
Note: Clear icon denotes no difficulty; light blue icon denotes difficulty; dark blue icon denotes receives help
= eating; = toileting; = dressing; = bathing/showering; = getting in or out of bed/chairs; = walking			

Table 3

Unweighted sample and weighted percent cross tabulation of dichotomous versus trichotomous Activity Limitation Staging Systems

Activity of Daily Living (ADL) stages						
Trichotomous	Dichotomous					Total
	0	I	II	III	IV	
0	7911 (69.0%)	-	-	-	-	7911 (69.0%)
Ia	-	1113 (9.2%)	-	-	-	1113 (9.2%)
Ib	-	461 (3.9%)	-	-	-	461 (3.9%)
Ic	-	343 (2.9%)	-	-	-	343 (2.9%)
IIa	-	-	519 (4.2%)	-	-	519 (4.2%)
IIb	-	-	490 (4.0%)	-	-	490 (4.0%)
IIIa	-	-	-	517 (4.1%)	-	517 (4.1%)
IIIb/IVa	-	-	-	173 (1.4%)	76 (0.6%)	249 (2.0%)
IVb	-	-	-	-	103 (0.7%)	103 (0.7%)
Total	7911 (69.0%)	1917 (16.0%)	1009 (8.2%)	690 (5.5%)	179 (1.3%)	11706 (100%)
Instrumental Activity of Daily Living (IADL) stages						
Trichotomous	Dichotomous					Total
	0	I	II	III	IV	
0	6525 (58.3%)	-	-	-	-	6525 (58.3%)
Ia	-	541 (4.7%)	-	-	-	541 (4.7%)
Ib	-	1192 (10.4%)	-	-	-	1192 (10.4%)
Ic	-	412 (3.5%)	-	-	-	412 (3.5%)
IIa	-	-	484 (4.2%)	-	-	484 (4.2%)
IIb	-	-	570 (4.8%)	-	-	570 (4.8%)
IIIa	-	-	-	865 (6.0%)	-	865 (6.0%)
IIIb/IVa	-	-	-	730 (5.4%)	104 (0.8%)	834 (6.2%)
IVb	-	-	-	-	283 (1.9%)	283 (1.9%)
Total	6525 (58.3%)	2145 (18.5%)	1054 (9.0%)	1595 (11.5%)	387 (2.7%)	11706 (100%)

Legend: The cross tabulations show how well beneficiaries categorized in the dichotomous staging system match the categorization of the trichotomous staging system for both the Activity of Daily Living (top portion) and Instrumental Activity of Daily Living (bottom portion) stages. Numbers in each cell represent sample count (unweighted) and total percent (weighted).

Table 4

Akaike information criteria to compare the Activity Limitation Staging systems

Activity of Daily Living (ADL) staging systems		
Outcome or event	Dichotomous staging system	Trichotomous staging system
Inpatient admission	338435799	338394229
All-cause mortality	108245748	108183472
Skilled nursing facility admission	85083090	85065114
Long-term care admission	39951668	39964582
Instrumental Activity of Daily Living (IADL) staging systems		
Outcome or event	Dichotomous staging system	Trichotomous staging system
Inpatient admission	338190712	338200922
All-cause mortality	108280323	108180677
Skilled nursing facility admission	85158318	85121513
Long-term care admission	39843608	39775265

Legend: Each number represents Akaike information criteria (AIC) from a Cox proportional hazard model on that specific outcome with a particular staging system adjusted for age, gender, and race/ethnicity. Within each row, the model with a lower AIC is considered a better fit.