Simple Counts of the Number of Basic ADL Dependencies for Long-Term Care Research and Practice

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General acceptance of a patterned progression of dependency in activities of daily living has led to the widespread practice of simply counting the individual's basic ADL dependencies to reflect his or her self-care needs and level of impairment. This method is convenient, and it is practical to the extent that individuals do fit a scaled pattern of dependency that allows some meaningful comparison among individuals and between groups to be made. This research, based on 3,611 Medicaid cases in Virginia, reports that 36 percent of those individuals screened for nursing home admission do not match a commonly accepted pattern of dependency. The analyses include a logistic regression procedure to explain the characteristics of the "ADL divergent" cases and a Guttman scaling procedure on the ADL data for the sample. Results of the analyses indicate that a Guttman scaling procedure does as well as, but not better than, the original Katz ADL scale, with both scales describing approximately two-thirds of the cases in the sample.

The first attempt to conceptualize a classification scheme for patients at various times during the course of illness and one that took into account host and environmental factors began in the mid-1950s (Benjamin Rose Hospital Staff 1958). Consistent with the recommendations by the Commission on Chronic Illness (1956), this early attempt at classification emphasized functional status of activities of daily living

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by the commission's recommendation for a single measure of functional status in ADL, the research group constructed the "Index of Independence in Activities of Daily Living," later popularized to the "Index of ADL" (Benjamin Rose Hospital Staff 1959). The index included six activities of daily living (bathing, dressing, using the toilet, transferring in and out of a bed or a chair, continence, and feeding) and provided the first established method for obtaining quantitative information about the progressive loss of ADL or return to independence in response to health care intervention and rehabilitative services.

According to Katz and his colleagues, three of the items (transferring, continence, and feeding) were reflective of the locomotor and neurologic aspects of basic "vegetative" functioning, exclusive of the more complex cultural and learned aspects of human functioning (Katz, Ford, Moskowitz, et al. 1963, 917). In contrast, the other three ADL items (bathing, dressing, and going to the toilet) reflected a prominent influence of culture and learning in addition to requirements for locomotor and neurologic functioning (p. 917). It appeared that decline and recovery from a disabling illness in later life paralleled early childhood development. That is, functions that were most essential for survival and least complex (such as feeding) were acquired first and retained longest, while those that were most complex and least basic to survival (for example, bathing) were acquired later and lost sooner (Katz, Ford, Moskowitz, et al. 1963; Katz and Akpom 1976; Katz et al. 1970).

Measuring functional disability in the older adult population has become synonymous with activities of daily living and the original or some modified version of the work by Katz (German 1981). Researchers and practitioners familiar with the scalability of the items of the ADL hierarchy simply began to use the convenient method of counting ADL dependencies to reflect levels of self-care need. However, during the development of the Index of ADL it was recognized that the study populations were in a formalized, structured health care setting. The researchers acknowledged that the social environment of an individual (in this case a rehabilitation hospital) might affect how an individual's needs are met as well as which needs are met by available caregivers (Katz, Ford, Downs, et al. 1972). Functional loss could sometimes be attributed to characteristics of helping relationships in the environment rather than to biological causes. The effect of social-environmental factors on functional status was termed "environmental artifact" (Katz, Ford, Moskowitz, et al. 1963, 916).

Subsequent revision of the Index of ADL published in 1976 (Katz and Akpom 1976) reflected over ten years of experience with the origi-

nal index. The revised Index of ADL was a less stringent hierarchy of ADL dependency that accommodated the psychological and social factors in an individual's ability for self-care in ADL. The revised version essentially served to accommodate environmental artifact by providing for variations from the ADL hierarchy. Although the revised Index of ADL no longer represents an inherent hierarchy of ADL, practitioners and researchers continue to count ADL dependencies to reflect a scale that may or may not be present in their target population.

The goals of this project were to determine (1) the extent of "ADL divergent" individuals in a long-term care (LTC) elderly Medicaid population (thus the appropriateness of simple counts of ADL dependencies for certain eligibility requirements and determinants of self-care need); (2) if another ADL scale existed in this long-term care population; and (3) the value of certain background, social-environmental, and impairment variables for developing an explanatory model for ADL divergence.

METHODOLOGY

THE SAMPLE

This study examined data from the computerized data files of the Preadmission Screening Program of the Virginia Department of Medical Assistance Services (DMAS). The sample consisted of a computer-selected random sample of 3,611 Medicaid-eligible persons 59 years of age and older entering the long-term care system as new cases. Medicaid-eligible applicants were current Medicaid recipients or individuals who would be eligible for Medicaid within 180 days of admission to a nursing home.

Virginia has had a statewide nursing home preadmission screening program since 1977. In May 1983, the screening requirements were changed to (1) include acute care as well as community applicants to nursing homes and (2) implement the Long-Term Care Information System (LTCIS) assessment process (Falcone 1979). The LTCIS assessments yield standardized data on sociodemographic variables, medical status, functional status, and services an individual is receiving at the time of the assessment. Items on the ability to perform basic activities of daily living are derived from the definitions of functioning on the original Index of ADL (Katz, Ford, Moskowitz, et al. 1963).

The demographic characteristics of the sample reflected the unique nature of a long-term care elderly population. As expected, a

large proportion of the sample were female (68.7 percent) and most were widowed (59.1 percent). There was an unexpectedly large percentage of nonwhite cases in the sample (37 percent), perhaps because nonwhites in Virginia were more likely to meet financial criteria for Medicaid. The majority of the cases were 75 years of age and over. Fully 40 percent of the total sample were in the 75–84 years of age category, while 28 percent were age 85 years and over. In addition, nearly 72 percent of the women were age 75 and over while only 59 percent of the men fell into this age group.

STUDY VARIABLES

The dependent variable in the analyses was "ADL divergence" operationalized as cases that did not match the hierarchy of dependency in the original Index of ADL, as shown in Figure 1.

Table 1 provides brief descriptions of the background, social environment, and impairment variables in the logistic regression analysis of "ADL divergence." In addition to the variables derived directly from the preadmission screening instrument, the analysis included two variables with operational definitions that require additional explanation:

Figure 1: Original Katz Hierachy of ADL Dependency

Improvement/Independence

- Functional Level (0) — Independent
- Functional Level (1) — Dependent Bathing
- Functional Level (2) — Dependent Bathing and Dressing
- Functional Level (3) — Dependent Bathing, Dressing, and Toileting
- Functional Level (4) — Dependent Bathing, Dressing, Toileting, and Transferring
- Functional Level (5) — Dependent Bathing, Dressing, Toileting, Transferring, and Continence
- Functional Level (6) — Dependent Bathing, Dressing, Toileting, Transferring, Continence, and Feeding

Deterioration/Dependence

Adapted from: S. Katz, A. B. Ford, R. W. Moskowitz, B. A. Jackson, and M. W. Jaffe. "Studies of Illness in the Aged: The Index of ADL." *Journal of the American Medical Association* 183 no. 12 (September 21, 1963):914–19.

Table 1: Explanatory Variables Used in the Regression Analysis

Variable	*Description*	*Mean*	*S.D.*
Background Variables			
Sex	0 = male, 1 = female	.69	.46
Race	0 = nonwhite, 1 = white	.63	.48
Age	0 = 59, 1 = 60-69 2 = 70-79, 3 = 80-89, 4 = 90 and above	2.44	.94
Location of patient	0 = acute care screening 1 = community screening	.30	.46
Marital status			
Married	0 = not married, 1 = married	.21	.41
Widowed	0 = not widowed, 1 = widowed	.60	.49
Social Environment Variables			
Available living space	0 = not available 1 = available	.72	.45
Living arrangement	0 = does not live alone 1 = lives alone	.30	.46
Daughters	Number of living daughters: range 0-7	1.14	1.40
Informal support	Count of number of available informal supports for activities of daily living, housekeeping, living space, meal preparation, shopping, transportation, and other support: range 0-7	2.34	2.38
Impairment Variables			
ADL count	Number of ADL dependencies: range 0-6	4.91	1.53
Physical impairments	Count of areas of impairment for speech, sight, hearing, joint motion, fractures/dislocations, missing limbs, paralysis/paresis, and dentition: range 0-8	1.54	1.21
Behavior/Orientation	The highest score on separate behavior and orientation measures: 0 = appropriate/oriented 1 = wandering/disoriented less than weekly 2 = wandering/disoriented weekly or more 3 = abusive/aggresive less than weekly 4 = abusive/aggresive weekly or more 5 = comatose	1.57	1.55

Continued

rehabilitative trajectory and seriousness of illness. Since a rehabilitative-trajectory variable might be an important explanatory variable reflecting increasing, static, or decreasing dependency, this study

Table 1: Continued

Variable	*Description*	*Mean*	*S.D.*
Medication Administration	0 = no medications 1 = self-administered 2 = administered by nonlicensed person 3 = administered by licensed person 4 = administered by R.N.	2.61	1.01
Dressings	Ranging from 0 (no dressings) to 2 (dressings on two or more sites): range 0–2	0.15	0.40
Mobility	Count of major restrictions in ability to go outside, walking, wheeling, or stair climbing: range 0–4	2.42	1.43
Nutritional services	Count of number of nutritional services currently receiving, including: diet, food/fluid intake, supplement, and dining location: range 0–4	1.11	1.10
Decubitus ulcers	Ranging from 0 (no decubitus ulcers) to 2 (ulcers on two or more sites): range 0–2	0.16	0.46
Seriousness of illness	(Based on Wyler, Masuda, and Holmes 1968) Five categories: 1 = 0–999; 2 = 1,000–1,999; 3 = 2,000–2,999; 4 = 3,000–3,999; 5 = 4,000 and above	2.34	.99
Rehabilitative trajectory	0 = nonrehabilitative 1 = rehabilitative	.42	.49
Dependent Variable Used in the Regression Analysis			
ADL divergence	0 = patterned 1 = divergent	.36	.48

used LTCIS assessment data for selected medical conditions, therapies, and time since onset to classify each individual into a rehabilitative or nonrehabilitative/maintenance track. A complete discussion of the operationalization of the variable has been previously reported by Travis and McAuley (1987).

Most often researchers have used counts of diagnoses to measure health or have included only a few major disease categories in their analyses. Wyler, Masuda, and Holmes (1968) developed a weighing scheme for 126 common medical diagnoses through ranking procedures. Although a simple measure for a complex variable, the Wyler methodology provided a means to estimate the cumulative effects of multiple diseases in the same individual from the medical diagnoses (ICD-9-CM) documented for each individual on the LTCIS assessments. In a recent project using data from the Virginia Preadmission

Screening Program (McAuley, Travis, and Taylor 1987), the Seriousness of Illness Index was employed as a determinant of long-term care placement decisions for acute care screenings. The same method was used in this project to compute seriousness of illness scores. A complete list of the weights can be obtained by writing to the authors.

RESULTS

Sixty-four percent of the sample matched the original Katz pattern of ADL, while 36 percent were "ADL divergent." Almost half of the total sample (48.2 percent) were totally dependent in all six activities of daily living. Therefore, most individuals in the sample appeared to be either totally ADL dependent or ADL divergent. A check of the number of ADL dependencies for the total sample revealed a mean number of dependencies of 4.9 compared to a mean of 4.4 for the divergent cases. Individuals screened in acute care settings were twice as likely to be ADL patterned (69.2 percent) than ADL divergent (30.8 percent), while individuals screened in the community were more evenly distributed between ADL divergence (46.4 percent) and patterned ADL (53.6 percent), perhaps because more acute care individuals were totally dependent at the time of screening and, therefore, were patterned by definition.

GUTTMAN SCALING PROCEDURE

In view of the fact that approximately one-third of the sample did not match the theoretical ADL hierarchy, results of a Guttman scaling procedure for this long-term care sample are reported. The procedure scaled the screening data for the six ADL items to total dependence (Table 2). The resulting ADL scale had an acceptable coefficient of reproducibility (.937) and an acceptable coefficient of scalability (.653). None of the items were negatively correlated on the inter-item correlation matrix. Of the total sample, 62 percent of the cases matched the ADL scale produced by the procedure, compared to a 64 percent match on the Katz Index of ADL. The pattern of dependency was in the order of: bathing, dressing, toileting, transferring, feeding, and continence. The scale differed from the original Katz pattern in the reversal of the last two items, feeding and continence. The scale was not particularly powerful, but it did demonstrate that a pattern other than the Index of ADL hierarchy was operating in this long-term

Table 2: Results of Guttman Scaling Procedure, All Cases

	Correlation Coefficients					
	Continence	*Feed*	*Transfer*	*Toilet*	*Dress*	*Bathe*
Continence	1.000	.249	.297	.326	.254	.196
Feed		1.000	.435	.448	.464	.380
Transfer			1.000	.743	.545	.440
Toilet				1.000	.613	.486
Dress					1.000	.681
Bathe						1.000

	Scale					
	Continence	*Feed*	*Transfer*	*Toilet*	*Dress*	*Bathe*
	+	+	+	+	+	+
	0	+	+	+	+	+
	0	0	+	+	+	+
	0	0	0	+	+	+
	0	0	0	0	+	+
	0	0	0	0	0	+

Note: 0 = independent; + = dependent
Coefficient of reproducibility = .937
Minimal marginal reproducibility = .819
Coefficient of Scalability = .653
N = 3,611

care population at the time of preadmission screening for nursing home admission.

FACTORS EXPLAINING ADL DIVERGENCE

Table 3 presents the results of a stepwise logistic regression of the dependent variable, ADL divergence, on the set of explanatory variables. Only those variables that were significant at the .05 level or below are reported. The regression procedure encountered 464 cases with missing data, leading to a reduction in the sample size to 3,147.

Eight variables were significant contributors to the regression model. Individuals who were ADL divergent were more likely to be female and to be residing in the community at the time of screening. In addition, ADL divergence was more likely to be associated with fewer physical impairments, less serious behavior/orientation problems, fewer mobility restrictions, fewer nutritional services being received, and the presence of fewer decubitus ulcers. The divergent cases also had greater cumulative seriousness of illness scores. Together the variables explained 12.7 percent of the variance in ADL divergence.

Table 3: Results of Stepwise Logistic Regression of ADL Divergence on Explanatory Variables

*Variables**	*Beta*	*Standard Error*	p
Sex	.40	.10	.000
Location of patient	.23	.12	.053
Physical impairments	-.09	.04	.020
Behavior/Orientation	-.26	.03	.000
Mobility	-.43	.04	.000
Nutritional services	-.10	.04	.022
Decubitus ulcers	-.37	.13	.004
Seriousness of illness	.15	.04	.000

Model chi-square = 517.96 with 20 D.F. p = .000; R^2 = .127
N = 3,147 Divergent cases = 1,140 Patterned cases = 2,007

*Only those variables significant at .05 level or below are shown.

DISCUSSION

Results of this study demonstrate that Guttman scaling procedures do not replicate the hierarchy implied by the Katz Index of ADL in this long-term care population. The scale created from this data set does as well as, but not better than, the original Katz ADL scale, with both scales describing approximately two-thirds of the cases in the sample. Results of the Guttman scaling procedure for the entire sample show a marginal scale in the order of: bathing, dressing, toileting, transferring, feeding, and continence. This scale is identical to the original Katz Index of ADL with the exception of the reversed order of the last two items (feeding and continence). Although we do not propose that the empirically derived scale should replace the original Katz ADL hierarchy, our findings do indicate that practitioners and researchers should be aware of possible inconsistencies between assumed and actual patterns of ADL in their target populations.

Two features of this long-term care sample need to be considered in conjunction with the results of this study. First, approximately 70 percent of the cases are acute care screenings. Second, and possibly related to the first, this is an extremely ADL dependent sample with a sample mean dependency score of 4.9 on a 6-point scale. In fact, 48.2 percent of the sample is totally dependent in all six ADLs. It is not known whether some or, perhaps, many of these cases of dependency are a function of the environment or a true reflection of the inability to

eat unassisted. However, the sign of the location variables suggests that community residence and not acute care is associated with divergence.

The regression analysis also indicates that ADL-divergent individuals are more seriously ill but less physically and behaviorally impaired than patterned cases. In other words, divergent individuals may be following a different path of illness. This may be a path in which multiple chronic illnesses (thus increasing the seriousness of illness scores) contribute to weakness and the inability to feed independently but not on the cognitive and physiological functions necessary to retain continence. An alternative explanation for the association of nondivergence with more serious behavior/orientation problems, more mobility restrictions, more nutritional services, and more decubitus ulcers is that persons with these problems are more likely to be totally dependent in all six ADL items and thus to be patterned by definition. Clearly, additional research is needed on less impaired samples with a broader range of dependencies to understand variations within ADL categories and ways in which different subtypes of dependency may be interrelated.

It is disappointing that none of the social environment variables included in the logistic regression analysis contributes to explaining ADL divergence. It may be that measures of the social environment available on the LTCIS are not adequate to represent environmental influences for altered patterns of ADL dependency. The construct of "environmental artifact" (Katz, Ford, Moskowitz, et al. 1963) may not be easily translated into a noninstitutional setting where the divergent individuals are most likely to reside. The environmental artifact variables required to explain an underlying pattern of ADL dependency in a noninstitutionalized setting may more appropriately include issues of available caregiving time, perceptions of caregiver stress and burden, and knowledge/skill level of caregivers rather than marital status, number of available social supports, or number of living daughters. This may also be another case for further research on a less impaired sample. It may be at the lower levels of dependency and care requirements that the environment has the greatest effect on the ability to perform activities of daily living.

The policy trends in long-term care have been moving toward simplistic, streamlined administrative methods for categorizing care, formulating reimbursement schedules, and determining resource allocations. Research trends employing measures of ADL have tended to follow suit. Individuals in this study who are being prescreened for institutional paths are clearly a very dependent subset of the long-term care population. A simple count of ADL dependencies that yields five

dependencies probably would not appreciably alter institutional staffing patterns and other resource considerations, whether the fifth dependency was feeding or continence. In fact, use of a three-point scale for minimal, moderate, or severe dependency as Weissert has done may be a reasonable measurement approach and would eliminate the ADL divergence in this sample (Weissert et al. 1980). It could also be concluded that using the less stringent, modified version of the Katz index (Katz and Akpom 1976) as the underlying rationale for simple counts of ADL may be adequate most of the time for very dependent populations.

In the case of community-based care, however, the need to know exactly which ADL dependencies exist may be more critical than in institutional settings. An individual in need of assistance with feeding may have a better chance of remaining in the community than one who is incontinent. Even individuals who require tube feedings and/or intravenous therapy can be supported more effectively by the abundance of home health care now available than those who have the frequent and generally distasteful care requirements of the incontinent individual. Further research and replication of this study with subjects who are less impaired or in community-based care situations, or both, would help to determine whether the existing ADL hierarchy is appropriate or if new methods of categorizing ADL dependency should be undertaken. In addition, it would be valuable to examine the nature, extent, and predictors of variation from the Katz pattern within specific categories of ADL. For example, the factors predicting divergence for those with two or three impairments may be quite different from those for people with five or six impairments.

The Index of ADL has become a nearly universal measurement tool for long-term care research and practice. It is such a simple, pervasive, and well-accepted instrument that researchers and practitioners seldom question its underlying assumptions regarding the patterning of deficits or examine its applicability to their specific target populations. Our research suggests that it is important to review how the components of the Index of ADL operate within a particular long-term care population and to consider the care-related implications of the patterns that exist. In many applications, the standard practice of counting ADL deficits may be adequate. However, there may be instances when a more appropriate method of summarizing ADL is feasible or when knowledge of those deficits that a score is actually referring to may lead to changes in the interpretation and application of the results.

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