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KATZ INDEX OF INDEPENDENCE IN ADL

Reliability and Validity in Short-term Care

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ABSTRACT. This article deals with the Katz Index of Independence in Activities of Daily Living and presents a study of its reliability and validity carried out at a Department of Internal Medicine in Sweden. Enrolled nurses assessed independently 100 aged patients. Scalability and interobserver variability were tested with Guttman scale-analysis. The results indicated that the activities are ranked according to a cumulative scale and that the index is reliable. Patients independent in ADL had shorter hospitalization and were discharged home more often than were the dependent patients. This indicates that the scale is valid. One year later most dependent patients were either dead or living in institutions: thus the index has a predictive potential. The systematic errors of scale were used to refine the index for use in short-term care. It is recommended as a basic measure of functional ability among aged abled or disabled patients also in short-term care.

Key words: Activities of daily living, acute disease, aged, disability evaluation

The increasing interest in the care of aged abled or disabled patients necessitates a common and standardized instrument for the description, screening, assessment, and prediction of functional status. Usually the nurses report the functional ability or the actual performance of the patients verbally, while the occupational therapists and the physiotherapists also assess the functional capacity or the potential performance of the patients.

To date, a vast array of measures of functional capabilities has been suggested and used, but there is still a lack of a common basic denominator. A literature review carried out by one of us (1), indicated that there apparently exists one such measure, namely the Katz Index of Independence in Activities of Daily Living (Index of ADL). This index is also recommended by Kane & Kane as "adequate for most general purposes" (6). (Kane and Kane also recommend the Barthel Index, which at the moment is widely used in the USA and elsewhere.)

The Katz Index of ADL is based on functional ability. It was developed and standardized more than 20 years ago in the USA (13, 14). Later it was accepted and used by several others beside the originators (2, 3, 5). Since the American health care system is different from the Scandinavian in many respects, it is necessary to study reliability and validity in Scandinavian health care before recommending its use there.

The purpose of this article is to present the Katz Index of ADL and the results obtained in adapting the index for use in short-term care. Studies of scalability, inter-observer variability and external validity were carried out using data collected in two wards for Internal Medicine at Enköping hospital, Sweden.

Summary of the Katz Index of ADL

The Index of ADL was developed by Katz et al. as a measure of function which could be used in objective evaluations of chronically ill and ageing populations (13, 14). To derive the hierarchical structure of the index the Katz group made detailed observations of a large set of activities of daily living using the Guttman technique of scale-analysis (4). Six activities (or actually 5 activities and 1 function) were found to be scalable, namely bathing, dressing going to the toilet, transferring, continence, and feeding (7, 11).

The index has been used as a tool to accumulate information about prognosis and about the dynamics of disability in the ageing process (5, 8, 10). It has also been used to assess the need for care, the effectiveness of treatment, and as a teaching aid in rehabilitation (3, 9, 11).

The Index of ADL summarizes overall performance in the six activities, and performance is summarized as grades A, B, C, D, E, F, and G, where A is the most independent and G the most dependent grade (Appendix).

The Swedish form and manual will be sent on request by application to Dr Kerstin Hulter Åsberg, Medicinkliniken, Enköpings lasarett, S-199 25 Enköping, Sweden.

Table I. *Number of patients by age, sex, and median length of stay before and after assessment with Katz Index of ADL*

Age	Ward A		Ward B		Median length of stay (days)	
	Males	Females	Males	Females	Before observation	After observation
55–64	7	4	6	5	7 (3–26)	2 (1–37)
65–74	7	4	6	6	10 (3–70)	6 (1–147)
75–84	4	14	9	5	11 (3–75)	17 (1–89)
85–	2	8	5	8	19 (3–66)	19 (1–179)
Total	20	30	26	24	10 (3–75)	10 (1–179)

Patients who are dependent in two or more activities but not classifiable as C, D, E, or F, are called O = 'others'. By means of observations over a definite period of time, the observer determines whether the patient is assisted or whether the patient functions on his own when performing the six activities. Assistance is defined as active personal assistance , directive assistance, or supervision. The actual existence of such assistance is considered in the evaluation, rather than the potential capacity of the patient. Thus, for example, overprotective assistance is assessed as dependent on assistance even though the observer considers the patient as capable; and refusal to perform an activity is considered as non-functioning even though the patient is deemed capable of performing it.

In each of the six activities the patients are classified—according to strict definitions—as independent, partly dependent, or dependent on assistance. These three classes are usually utilized in individual patient assessments, while they are reduced to two classes for the summary measure as shown in the Appendix.

We wish to cite an observation on the construct validity of the Index of ADL made by its originator, Dr Sidney Katz:

"Comparison of the elements of the Index of ADL and their inherent order with the independent descriptions of childhood, growth, and development and with the behavior of primitive peoples suggests that the Index is based on primary biological and psychosocial functions. In an ordered fashion, the Index reflects the level of neurological and locomotor activity in primary phylogenetic functions as they are influenced by environmental and cultural forces. Individual grades of the Index can be thought of as 'final common path' expressions that describe the adequacy of organized neurological and locomotor response of the organism." (7)

MATERIAL

Data for this study were collected in two similar and adjacent wards for internal medicine at Enköping hospital, which is a county general hospital, between December 1979 and February 1980.

The two wards had 60 beds and rehabilitation and ADL training were carried out by one occupational therapist and one physiotherapist along with the nurses.

A resident selected 100 patients, 50 from each of the two wards and 10 patients once a week, stratified according to a subjective estimation of need for care to avoid merely totally independent or totally dependent patients.

They were required to have been on the ward for at least 3 days and to be at least 55 years of age. Table I presents the observed patients by age, sex, and median length of stay before and after assessment. Seventy-eight of the patients were 65 years and older. Fifty patients were observed within 10 days and 75 within 19 days after admission to the ward.

The most common diagnoses were circulatory diseases (52%), endocrine, nutritional, and metabolic diseases (13%), malignant neoplasms (9%), respiratory diseases (6%) and neurological disorders (5%). Most of the patients had more than one diagnosis, and some will be described individually later. The majority of the patients were discharged home. Eleven patients died during their stay on the ward.

METHODS

Enrolled nurses were chosen as observers, since they have the most frequent daily contacts with the patients. Two nurses from each of the two wards were given extensive instructions on the interpretation of the instrument and some pilot training on the rating task. The nurses then observed the patients and made their ratings independently of each other. They were informed about the importance of making the evaluations independently.

As most of the observations were made during day-time the nurses were instructed also to check the patient's status with the staff who worked the night before. The observation task was carried out as a part of the regular work. The nurses spent one full working day on the ward

observing the patients, and they were instructed to note down the most dependent performance during the last 24 hours.

Some instruments of ADL include special measures of mental function. In this study a measure of the patient's orientation was added to the end of the original activities. A slight disorientation as to time was accepted as full orientation, while disorientation as to person and place was not.

Scale-analysis technique

The cumulative characteristics or the construct validity of the Index of ADL was analysed by the scale-analysis technique (4, 15).

A perfect scale of activities would show a cumulative order of recovery for a sick person, but such a perfect scale is improbable because of measurement errors and random variation among individuals. Therefore the conventional level for acceptable errors is measured by the coefficient of reproducibility, which gives the ratio of successful reproductions to total responses made on the hypothesis of perfect scalability. A reproducibility of 0.90 confirms the existence of a valid cumulative and unidimensional Guttman scale (4).

However, when there is a skewness of the distribution either of items or of patients it would be possible to get a high coefficient just by naming the items which were most frequently scored disabled.

As our results showed a skewness of the distribution of some items, we decided to rely on the coefficient of scalability (C of S), suggested by Menzel (12), as the main measure of construct validity. C of S is defined thus:

$$\text{C of S} = 1 - \frac{\text{Total number of errors}}{\text{Maximum number of errors}}$$

The maximum numbers of errors can be computed for patients and for items. The more extreme the patients or the items are, the lower the resulting maximum number of errors.

Either type of maximum error will be equal to total observations minus the respective number of minimum successful reproductions. It follows that the formulas for computing the two maximum error figures are:
for maximum errors by items:

$$\text{ME (items)} = I \times N - \sum_{\text{item 1}}^{\text{item } I} f_{\max}$$

for maximum errors by individuals:

$$\text{ME (individuals)} = I \times N - \sum_{\text{individual 1}}^{\text{individual } N} S_{\max}$$

where I = number of items, N = number of individuals, $f_{\max}$ = frequency of responses for the modal category of an item, $S_{\max}$ = frequency of responses for the modal category of an individual.

We now have two alternative values for maximum errors. It is the smaller of these that must be inserted into the formula for the C of S, since it is the smaller of two presumptive maxima which is the effective one.

Menzel (12) has suggested a level of 0.60 or higher as indicating a valid Guttman scale.

The study design includes two independent assessments of each of the patients. Errors of scale obtained by only one of the observers are considered random or measurement errors, while errors of scale obtained by both observers are considered as indicating non-unidimensionality or less than perfect construct validity. In order to collect more information about the errors, patient-scores containing one error of scale were also designated as belonging to grade O (others), although the Katz group permits one error of scale per patient.

One measure of the external validity of the Index of ADL is its potential to serve as a base for predictions. Thus the results of the ADL assessments were compared with length of stay in the hospital, type of discharge from the hospital and actual residence one year after the assessment and mortality within one year after the assessment.

RESULTS

Detailed results obtained by observer 1 on ward A are presented in Table II. As can be seen, most patients are found in the extreme grades: A and E, F, G. Four errors of scale were found for this observer. One of them concerns toileting, one concerns continence and two have to do with the ability to bathe independently. To estimate the coefficient of scalability (C of S) the maximum number of errors (ME) was computed by items and by patients (Table III). ME was found to be $300-185=115$ for items and $300-267=33$ for individuals. Since we choose the smaller ME, the C of S will be:

$$\text{C of S} = 1 - \frac{4}{33}$$

$$\text{C of S} = 0.88$$

The results obtained by all four observers are summarized in the table. As can be seen the other three observers obtained 6, 8 and 9 errors of scale respectively. The C of S for the two observers on ward A is 0.88 and 0.81 respectively. On ward B the level of the C of S is somewhat lower, 0.76 and 0.74 respectively. However, all measures of the C of S are well above the lower acceptance limit suggested by Menzel. The inter-observer variability was low and the results indicate that the activities are scalable. Thus, the Index of ADL is reliable.

In all, 27 errors of scale were recorded among 1 200 assessments made by four observers on 100 patients. No errors of scale were found for the activity of feeding. Five errors were found for the function of continence, six for the activity of trans-

Table II. *Number of patients distributed by index grade*

Observations made by observer 1 on ward A. Errors of scale marked with circles

Number of patients	Feeding	Continence	Transfer	Going to toilet	Dressing	Bathing	Grade[a]	Sum of modal subscores
23	+	+	+	+	+	+	A	138
1	+	+	+	⊖	+	+	O	5
1	+	+	+	+	+	−	B	5
1	+	+	+	+	−	−	C	4
1	+	⊖	+	+	−	−	O	3
1	+	+	+	−	+	−	D	3
2	+	+	+	−	−	⊕	O	8
4	+	+	−	−	−	−	E	16
11	+	−	−	−	−	−	F	55
5	−	−	−	−	−	−	G	30
Sum of modal category frequencies	45	33	30	26	25	26	185	267

[a] A non-scale type of observation is designated O.

Table III. *Number of errors, maximum number of errors (ME) distributed by items and by patients and coefficients of scalability (C of S) obtained by four observers*

Observer	Total number of assessments (I×N)	Total number of errors	ME items	ME patients	C of S
Ward A					
Observer 1	300	4	115	33	0.88
Observer 2	300	6	111	31	0.81
Ward B					
Observer 3	300	8	118	33	0.76
Observer 4	300	9	122	34	0.74
Total	1 200	27			

fer, three for toileting, two for dressing, and eleven errors of scale for the activity of bathing.

Inter-observer errors of scale (= both observers recorded the same errors of scale on the same patient) were found eight times on 7 patients. Thus, sixteen of the 27 errors were recorded when assessing 7 of the 100 patients.

Both observers on ward A recorded one patient with a brain tumour as incontinent and dependent in dressing and bathing, but independent in transfer and toileting. Another patient was recorded as independent in all activities but toileting.

On ward B, 3 patients with ischaemic heart disease were classified by both observers as independent in bathing and dependent in one or more of the other activities. Likewise, a very old lady with an infection was classified as dependent in dressing and independent in all other activities. One patient with intravenous drug infusion was wrongly classified dependent in transfer, although he was able to as soon as the infusion was finished.

These errors are considered as indicative of less than perfect construct validity, while the other 11 errors of scale could be considered as caused by measurement errors of random variation.

Table IV shows the number of patients in each index grade by age, and median length of stay by index grade. The results are those arrived at by the observer obtaining the smallest number of errors on each ward. As can be seen, 44 of the 100 patients are classified as belonging to grade A. This means that they are independent in all activities assessed. Most of these patients were less than 75 years old. On the other hand, 44 of the 55 patients aged 75 or

Table IV. *Number of patients of each index grade distributed by age and median length of stay by index grade*

Age	Index grade A	B	C	D	E	F	G	O[a]	Total
55–64	16	–	–	–	1	–	2	3	22
65–74	17	–	–	–	3	1	1	1	23
75–84	9	–	1	1	4	6	6	5	32
85–	2	–	–	–	1	11	6	3	23
Total	44	–	1	1	9	18	15	12	100
Length of stay (days)	14	22	23	30	25	32	44	28	21

[a] Patients classified as belonging to non-scale types.

Table V. *Number of patients distributed by index grade and type of discharge*

Type of discharge	Index grade A	B	C	D	E	F	G	O[a]	Ward A	Ward B	Total
To home	39	–	–	–	5	6	1	10	28	33	61
To other short-term care	1	–	–	–	–	2	–	1	4	–	4
To old people's home	4	–	1	–	–	6	2	–	7	6	13
To long-term care	–	–	–	1	1	4	4	1	6	5	11
Dead	–	–	–	–	3	–	8	–	5	6	11
Total	44	–	1	1	9	18	15	12	50	50	100

[a] Patients classified as belonging to non-scale types.

Table VI. *Number of patients distributed by index grade and place of residence one year after assessment*

Type of discharge	Index grade A	B	C	D	E	F	G	O[a]	Ward A	Ward B	Total
To home	32	–	–	–	4	3	1	4	20	24	44
To other short-term care	1	–	–	–	–	3	–	–	1	3	4
To old people's home	3	–	–	–	–	2	–	2	5	2	7
To long-term care	–	–	–	1	–	5	1	–	7	–	7
Dead	8	–	1	–	5	5	13	6	17	21	38
Total	44	–	1	1	9	18	15	12	50	50	100

[a] Patients classified as belonging to non-scale types.

more were classified as dependent in at least one activity and 39 in more than three activities. Twelve patients were classified as "Others", i.e. belonging to non-scale types in our terminology. The median length of stay was 14 days in grade A and 44 days in grade G.

Table V presents the results of the assessments by type of discharge from the wards. Thirty-nine of the 44 patients in grade A were discharged home, while all 11 patients who died while in the ward were assessed as belonging to grades E or G. The 11 patients transferred to institutions for long-term care were all in grades C–G.

In addition to functional status ability of orientation as to time, person, and place was assessed. The results of this assessment closely followed the index gradings. Eighteen of 20 disorientated patients were classified as belonging to grade F or G.

The predictive capacity was studied by a follow up of the actual place of residence one year after the initial assessments. The results are shown in Table VI. As can be seen, 62 of the 100 patients were alive at the followup. Thirty-two of the 44 patients assessed as grade A were living in their homes, and 8 were dead. On the other hand, only 8 of the 42 patients assessed as grade E, F, or G were living in their homes, and 23 were dead.

DISCUSSION

This article presents the results from some tests of the reliability and validity of the Index of Independence in Activities of Daily Living, which were carried out in two wards for internal medicine.

The original definitions for the Katz index permit one error of scale. In this study we used the most restrictive criteria of scalability to collect more information about the systematic errors of scale. For other purposes we think it sufficient to use the Katz group recommendation and permit one error of scale.

The construct validity of the Index of ADL was measured by the coefficient of scalability, and the results comfortably exceeded the acceptance limit. No definite explanation for the difference between the two wards has been found. In all, only 27 errors of scale were recorded among 1 200 assessments carried out. They were found in all activities except feeding. Eleven of them could be considered as being caused by measurement errors or random variation, and as they were so few, they were not analysed further. Thus the results indicate that the Index of ADL is reliable and has construct validity when used to assess a basic ADL status among aged abled or disabled on internal medicine wards.

Many patients were classified as belonging either to index grade A or to index grade E, F, or G, which shows that the Index of ADL has a fairly limited discriminatory power, and that it can probably be reduced to three grades for screening purposes, e.g. A, BCD, EFG.

On the other hand, the Index of ADL seems to be valid for its intended purpose, as most patients in grade A had a shorter length of stay in hospital and were discharged to their homes, whereas most patients in grade E, F, or G had a longer length of stay and were discharged to institutional care or died in the hospital.

One year after the initial assessments, most of the patients in grade A were still living in their homes, while most of the patients in grade E, F, or G were living in institutions or were dead. This predictive capacity indicates that the Index of ADL has external validity for the elderly in short-term care.

The errors of scale, which were common to two observers, can be considered as systematic errors and possibly reveal the special conditions in short-term care. Some suggestions concerning refinement and further specification of the definitions could be based on the results obtained so far.

The cumulative structure of the index can be used to analyse why certain patients are classified as belonging to non-scale types, 'others'. It may suggest either a misunderstanding of the definitions, or specific patient disabilities such as blindness, amputations, etc. Such disabilities or handicaps should be recorded together with the ADL index.

Mental status is very important to the individual patient, and this study shows that disorientation is implicit in the index. Naturally, disorientation can be recorded as a special disability, as mentioned above.

In nursing care there is a tendency to help patients more than they actually need. The hospital routines may even prevent patients from performing their ADL. This would explain why some patients do not perform certain activities of their own accord, even though they are both able and willing to do so. Observation of ADL at hospital may thus differ from observation at home.

The results of this study make it possible to recommend the Katz Index of ADL as a basic measure of functional ability for use among aged abled or disabled patients even in short-term care. The index is also eing used in further studies on prognosis for old people in short-term care.

It was easy for the personnel to learn and to utilize the Index of ADL, since it is based on assessments of functional ability, which they report verbally in their daily work. The introduction of a standardized method to assess functional status among patients on wards for internal medicine has been beneficial for the patients in several ways. The nurses became more alert in their observations of the patients' functional status. It became apparent that the patients could be given less active assistance and more directive assistance which contrib-

uted to facilitate their recovery. The structure of the Index of ADL was found to be useful for communicating observations to other members of the staff. It has thus become a common language used also at staff meetings at the Department of Internal Medicine at Enköping hospital.

For the assessment of the different activities we suggest the following recommendations for short-term care.

Feeding: Patients who receive parenteral nutrition should be rated 'dependent', while those who get drug infusion should be rated 'independent'.

Continence: Patients who have a catheter only in order to get a measure of the urine volume should be rated 'independent'.

Transfer: Patients with ischaemic heart disease, for example, and who are ordered to be in bed should be rated 'dependent'.

Going to toilet: Patients who prefer a bedpan near the bed, even though they are able to go to the toilet should be rated 'independent'.

Dressing: Medical aids such as supportive stockings should not be assessed.

Bathing: Patients who usually do not bathe every single day should be rated 'independent' if they are able to bathe without assistance.

It should be remembered that the ability to make transfers is a prerequisite for being independent as regards going to toilet, dressing and bathing.

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Appendix

The original version of the Katz Index of Independence in ADL (10).

The Index of Independence in Activities of Daily Living is based on an evaluation of the functional independence or dependence of patients in bathing, dressing, going to toilet, transferring, continence, and feeding. Specific definitions of functional independence and dependence appear below the index.

A) Independent in feeding, continence, transferring, going to toilet, dressing, and bathing
B) Independent in all but one of these functions
C) Independent in all but bathing and one additional function
D) Independent in all but bathing, dressing, and one additional function
E) Independent in all but bathing, dressing, going to toilet, and one additional function
F) Independent in all but bathing, dressing, going to toilet, transferring, and one additional function
G) Dependent in all six functions
Other: Dependent in at least two functions, but not classifiable as C, D, E, or F

Independence means without supervision, direction, or active personal assistance, except as specifically noted below. This is based on actual status and not on ability. A patient who refuses to perform a function is considered as not performing the function, even though he is deemed able.

Bathing (sponge, shower or tub)

Independent: assistance only in bathing a single part as back, or disabled extremity) or bathes self completely

Dependent: assistance in bathing more than one part of body; assistance in getting in or out of tub, or does not bathe self

Dressing

Independent: gets clothes from closets and drawers; puts on clothes, outer garments, braces; manages fasteners; act of tying shoes is excluded

Dependent: does not dress self or remains partly undressed

Going to toilet

Independent: gets to toilet; gets on and off toilet; arranges clothes; cleans organs of excretion; (may manage own bedpan used at night only and may or may not be using mechanical supports)

Dependent: uses bedpan or commode or receives assistance in getting to and using toilet

Transfer

Independent: moves in and out of bed independently and in and out of chair independently (may or may not be using mechanical supports)

Dependent: assistance in moving in or out of bed and/or chair; does not perform one or more transfers

Continence

Independent: urination and defecation entirely self-controlled

Dependent: partial or total incontinence in urination or defecation; partial or total control by enemas, catheters, or regulated use of urinals and/or bedpans

Feeding

Independent: gets food from plate or its equivalent into mouth; (precutting of meat and preparation of food, as buttering bread, are excluded from evaluation)

Dependent: assistance in act of feeding (see above); does not eat at all or parenteral feeding