

## THE CUMULATIVE STRUCTURE OF PERSONAL AND INSTRUMENTAL ADL

### *A Study of Elderly People in a Health Service District*

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**ABSTRACT.** Katz' Index of ADL has been supplemented by five well-defined instrumental activities, namely cooking, washing, transportation, cleaning, and shopping. Eighty-five persons, mainly elderly, who had consecutively consulted a district occupational therapist, were assessed in their homes in order to study the reliability, the scalability, and the validity of the expanded index. The inter-observer reliability was high. The coefficient of scalability was well above the acceptance level, indicating construct validity. No person was dependent in personal ADL and totally independent in instrumental ADL. Persons who were dependent in both personal and instrumental ADL were older and lived in sheltered accommodation more often than persons who were dependent only in instrumental ADL, indicating external validity. This study shows that there was a cumulative relationship between certain well-defined instrumental activities and between personal and instrumental activities. This supplemented index can be useful for assessing and differentiating the need for personal assistance and home-care among disabled elderly people.

*Key words:* activities of daily living, aged, disability evaluation, home-care, rehabilitation medicine, scalability.

The need for personal assistance and help with home-care among the elderly increases with age. In a Swedish survey (2), 49% of those aged 65-69 years received this kind of social support from the community or from relatives, while the proportions were 73% in the age group 80-84 years.

For planning purposes, either in rehabilitation or in the maintenance of actual functional levels, it is important to understand in what order the personal and home-care needs arise and disappear.

The need for personal assistance is often described in terms of dependence or independence in performing personal activities of daily living (P-ADL), for example, feeding, going to the toilet, dressing and bathing. The need for help with home-care can be described similarly, in terms of performing instrumental ADL (I-ADL), for example, cooking, shopping, cleaning.

Katz et al. (6) have shown that there is a cumulative order among the personal activities. Recently, it has been shown that two instrumental activities, shopping and transportation, can be combined with the personal activities in a cumulative scale (8).

The purpose of this article is to report the results of tests of an expanded ADL scale based on Katz' Index of personal ADL with the addition of five instrumental activities, namely cooking, washing, transportation, cleaning and shopping. Special attention has been paid to the reliability, scalability and validity of the new instrument.

### MATERIAL

This study was carried out in one of the six health service districts of Kungälv, which is situated near Göteborg, Sweden. The district serves about 10000 inhabitants and 13.5% of the population is 60 years of age or older. It is a rural district and the housing consists mainly of one-family houses. From the 1st of January to the 30th of April 1987, 90 persons consecutively consulted the district occupational therapist. Five persons were children and excluded from the study.

Table I gives the distribution of individuals by age and sex. Two thirds of the subjects were women, and 75% were 65 years of age or older.

About one fourth of both sexes lived in some type of sheltered accommodation (Table II). Sixty per cent of the women and 46% of the men lived together with a spouse.

The main medical reasons for consulting the occupational therapist varied, often due to a combination of different disorders (Table III).

Seventy-five per cent of the subjects were allowed to utilize the handicap transportation service subsidized by the community. Sixty-five per cent received home-care subsidies, which involve either remuneration of the caretaker, usually a relative, or personal assistance and help with home-care by local social welfare or health services.

### METHODS

Two occupational therapists participated as observers in the study. They were well trained in making ADL-assessments, and they had worked in the health service district

Table I. Distribution of persons by age and sex

Age (yrs)	Men n=28	Women n=57	Total n=85
30-54	4	8	12
55-64	2	8	10
65-74	6	15	21
75-84	6	20	26
85-w	10	6	16
Median age (yrs)	77	73	74

for several years. They recorded social and demographic data and reasons for consulting the occupational therapist at the first meeting, which took place in the consulting person's own home. The occupational therapists observed the persons and interviewed them carefully, to clarify whether they were independent or dependent on another person when performing the activities.

Table IV A and B give the definitions of the personal activities (P-ADL) of Katz' Index of ADL together with the five instrumental activities (I-ADL). The definitions of the instrumental activities were chosen according to a hypothesis of a cumulative order between feeding and cooking, between transfer and transportation, between dressing and washing, and between bathing and cleaning (5). The definitions of independent, partly dependent, and dependent followed the measures used by Katz et al. in the original scale of personal ADL. The purpose was to locate a persons' level of disability in the continuum from total independence to total dependence in performing an activity. The definition of "partly dependent" was of special interest when assessing individuals who were improving or deteriorating, and it increased the observer's attention as regards the definitions of independent and dependent, respectively. When the observations were summarized into grades, the responses of partly dependent was assigned independent in washing and cleaning and dependent in cooking, shopping and transportation in order to obtain the most perfect cumulative scale.

Katz' Index of ADL summarizes overall performance in P-ADL as grades A, B, C, D, E, F, and G, of which A is the most independent and G the most dependent grade. Performance in I-ADL is summarized as grades U, V, X, Y, and Z, where U is the most independent and Z the most dependent grade. Table V gives the definitions ac-

Table II. Type of accommodation by sex

Residence	Men n=28	Women n=57	Total n=85
Own home	20	43	63
Sheltered accommodation			
Service apartments	3	12	15
Old peoples home	4	1	5
Nursing home	1	1	2

Table III. Disorders in the patients consulting the occupational therapist

Type of disorder	Men n=28	Women n=57	Total n=85
Neurological disorders	10	7	17
Locomotor disorders	11	29	40
Accidents	4	9	13
Tumors	1	2	3
Mental disorders	0	3	3
Medical internal disorders	1	3	4
Visual disorders	1	4	5

ording to a cumulative scale both as regards the relationship between the activities and between P-ADL and I-ADL.

The observers assessed a person's actual performance of the activities and not whether he/she was capable of performing them. Dependence means that another person is involved with active personal assistance, directive assistance, or supervision.

Thus, for example, over-protective assistance is assessed as dependence on assistance even though the observer considers the person as capable; and refusal to perform an activity is considered as non-functioning even though the person is deemed capable of performing it.

#### Scale-analysis technique

The cumulative characteristics or the construct validity of the scale of P-ADL and I-ADL was analyzed by the scale analysis technique (3, 9).

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. However, when there is a skewness in the distribution either of items or of patients, it would be possible to obtain a high coefficient just by naming the items which were most frequently scored disabled. Although our results showed almost no skewness in the distribution of items, we decided to rely on the coefficient of scalability (C of S) suggested by Menzel (7) as the main measure of construct validity. C of S is defined thus:

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

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 formulae for computing the two maximum error figures are:



Table IV A. Definitions of the six personal activities included in Katz' Index of ADL

Independence = without supervision, direction, or active personal assistance except as specifically noted below

<hr/>	
<i>Bathing</i>	Sponge bath, tub bath, or shower
Independent	Receives no assistance (gets in and out of tub by self if tub is usual means of bathing)
Partly dependent	Receives assistance in bathing only one part of the body (such as back or a leg)
Dependent	Receives assistance in bathing more than one part of the body (or does not bathe self)
<hr/>	
<i>Dressing</i>	Getting all needed clothing from closets and drawers and getting dressed, includes using fasteners, and putting on a brace if worn
Independent	Gets clothes and gets completely dressed without assistance
Partly dependent	Gets clothes and gets dressed without assistance except for help with tying shoes
Dependent	Receives assistance in getting clothes or in getting dressed, or stays partly or completely undressed
<hr/>	
<i>Toileting</i>	Going to the "toilet room" for bowel and urine elimination, cleaning self after evacuation, and arranging clothes
Independent	Goes to "toilet room", cleans self and arranges clothes without assistance. (May use support object such as cane, walker, or wheelchair, and may manage a night bedpan or commode, emptying it in the morning)
Partly dependent	Receives assistance in going to "toilet room" or in cleaning self or in arranging clothes after evacuation, or in using the night bedpan or commode
Dependent	Doesn't go to the "toilet room" for evacuation
<hr/>	
<i>Transfer</i>	Moving in and out of bed and in and out of chair
Independent	Moves in and out of bed and in and out of chair without assistance. (May use support object such as a cane or walker)
Partly dependent	Moves in and out of bed or chair with assistance
Dependent	Doesn't get out of bed
<hr/>	
<i>Continenence</i>	Function of controlling elimination from the bladder and bowel
Independent	Controls urination and bowel movement completely by self

Partly dependent Dependent Has occasional "accidents"  
Supervision helps keep urine or bowel control, or catheter is used, or is incontinent

*Feeding*  
Independent Partly dependent Dependent  
Basic process of getting food from plate or equivalent into the mouth  
Feeds self without assistance  
Feeds self except for getting assistance in cutting meat or buttering bread  
Receives assistance in feeding or is fed partly or completely through tubes or with intravenous fluids

Partly dependent is assessed as dependent in toileting, transfer and continence, and as independent in bathing, dressing and feeding.

for maximum errors by items:

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

for maximum errors by individuals:

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

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.

There are thus two alternative values for maximum errors. The smaller of these must be inserted into the formula for the C of S, as the smaller of two presumptive maxima is the effective one. Menzel (7) has suggested a level of 0.60 or higher as indicating a valid Guttman scale.

In order to study inter-observer reliability, each of the two occupational therapists observed 12 persons within two days and independently of each other.

The discriminative and the concordant validity of the P- and I-ADL-grades was studied by comparisons with age, type of accommodation, handicap transport service, and home-care subsidies.

The results of the ADL-assessments are reported either as ADL-grades or as independent in both P- and I-ADL, dependent only in I-ADL, or dependent in both P- and I-ADL.

## RESULTS

Detailed results for all of the observed persons are presented in Table VI. One person belonged to the most dependent grade G. Thirty-two persons belonged to grades B and C, and 9 of them were independent with respect to cooking. Nineteen persons were assessed as belonging to grades D, E, or

Table IVB. *Definitions of the five instrumental activities and of independent, partly dependent and dependent*

<i>Shopping</i>	Gets to store, manages stairs or other obstacles, takes out groceries, pays for them and carries them home
Independent	Performs the activity at least once a week
Partly dependent	Gets to the store but accompanied by another person
Dependent	Does not perform the activity or needs assistance with some part of the activity
<i>Cleaning</i>	Performs dusting, vacuum-cleaning, washing floors, takes the carpets outdoors
Independent	Performs the activity at least once in a fortnight
Partly dependent	Gets assistance in taking the carpets outdoors
Dependent	Does not perform the activity or gets assistance with some part of the activity
<i>Transportation</i>	Goes by bus, tram or train
Independent	Performs the activity
Partly dependent	Performs the activity but accompanied by another person
Dependent	Does not perform the activity
<i>Washing</i>	Brings the laundry to the washbasin or to the washing-machine, adds washing-detergent, takes the laundry and hangs it up
Independent	Performs the activity at least once a month
Partly dependent	Gets assistance in hanging it up
Dependent	Does not perform the activity or gets assistance in some part of the activity except in hanging it up
<i>Cooking</i>	Gets to the kitchen, prepares dinner, manages the stove
Independent	Performs the activity at least 3 times a week
Partly dependent	Needs assistance with some part of the activity
Dependent	Does not perform the activity at all

Partly dependent is assessed as dependent in cooking, shopping, and transportation, and as independent in washing and cleaning.

F, and not one of them was independent in instrumental activities.

Thirty-three persons would have been classified as belonging to grade A by Katz, but with the expanded scale, 29 of them were differentiated as

Table V. *Definitions of the personal and instrumental ADL-grades according to a cumulative scale*

Grade	Definition
U	Independent in all eleven I- and P-ADL
V	Dependent in one I-ADL
X	Dependent in shopping and one more I-ADL
Y	Dependent in shopping, cleaning and one more I-ADL
Z	Dependent in all I-ADL but cooking, and independent in P-ADL
A	Dependent in all I-ADL and independent in all six P-ADL
B	Dependent in one P-ADL
C	Dependent in bathing and one more P-ADL
D	Dependent in bathing, dressing and one more P-ADL
E	Dependent in bathing, dressing, going to toilet and one more P-ADL
F	Dependent in bathing, dressing, going to toilet, transfer and one more P-ADL
G	Dependent in all six P-ADL
O	Other; dependent in two or more activities but not classifiable as above

follows: grade U (5 persons), V (8 persons), X (6 persons), Y (7 persons) and Z (3 persons).

Twenty-eight deviations from an ideal scale were found. Four of them concerned continence, four dressing, eight bathing, one cooking, two washing, five transportation, three cleaning and one had to do with shopping. Sixteen of these "errors of scale" belonged to the original Katz' Index of ADL. All of them could be accepted to fit into a perfect scale by the definitions of the gradings, which permitted one activity to be unnamed. Twelve errors belonged to the I-ADL-scale, and 10 of them could be accepted by a similar definition of the combined P- and I-ADL-gradings.

To estimate the coefficient of scalability (C of S) the maximum number of errors (ME) was computed by items and by patients (Table VI). ME was found to be  $935-714=221$  for items and  $935-681=254$  for individuals. Since we chose the smaller ME, the C of S was:

$$C \text{ of } S = 1 - \frac{28}{221}; \quad C \text{ of } S = 0.87$$

This result is well above the lower acceptance limit suggested by Menzel, and the activities can be accepted as scalable. No person was dependent in personal ADL and totally independent in instrumental ADL.



Table VI. Number of persons, distributed by index grade

Errors of scale marked with circles

Number of persons (n=85)	Grade <sup>a</sup>	Feeding	Continence	Transfer	Going to toilet	Dressing	Bathing	Cooking	Washing	Transportation	Cleaning	Shopping	Sum of modal category frequencies	Sum of modal sub-scores
5	U	+	+	+	+	+	+	+	+	+	+	+		55
3	V	+	+	+	+	+	+	+	+	+	⊖	+		30
1	V	+	+	+	+	+	+	+	+	⊖	+	+		10
4	V	+	+	+	+	+	+	+	+	+	+	-		40
4	X	+	+	+	+	+	+	+	+	⊖	+	-		36
2	X	+	+	+	+	+	+	+	+	+	-	-		18
1	Y	+	+	+	+	+	+	+	⊖	+	-	-		8
1	O	+	+	+	+	+	+	⊖	⊖	+	-	-		7
6	Y	+	+	+	+	+	+	+	+	-	-	-		48
2	B	+	+	+	+	+	⊖	+	+	-	-	-		14
1	C	+	+	+	+	⊖	⊖	+	+	-	-	-		6
1	O	+	+	+	+	+	+	+	-	-	-	⊕		8
3	Z	+	+	+	+	+	+	+	-	-	-	-		21
5	B	+	+	+	+	+	⊖	+	-	-	-	-		30
1	B	+	+	+	+	⊖	+	+	-	-	-	-		6
2	A	+	+	+	+	+	+	-	-	-	-	-		12
2	B	+	+	+	+	⊖	+	-	-	-	-	-		12
14	B	+	+	+	+	+	-	-	-	-	-	-		84
1	C	+	⊖	+	+	+	-	-	-	-	-	-		7
6	C	+	+	+	+	-	-	-	-	-	-	-		42
1	D	+	⊖	+	+	-	-	-	-	-	-	-		8
1	D	+	+	+	-	-	-	-	-	-	-	-		8
2	E	+	⊖	+	-	-	-	-	-	-	-	-		18
8	E	+	+	-	-	-	-	-	-	-	-	-		72
7	F	+	-	-	-	-	-	-	-	-	-	-		70
1	G	-	-	-	-	-	-	-	-	-	-	-		11
Sum of modal category frequencies		84	73	69	66	55	49	46	57	69	71	75	714	681

<sup>a</sup> A non-scale type of observation is designated O.

The inter-observer test gave only two discordant assessments out of a total of 108 assessments of 12 patients, that is 1.8%. Thus, the inter-observer reliability was high. The external validity was studied by comparing the level of dependency with age, type of residence and use of social services (Table VII).

There was no totally independent person in the two oldest age-groups. The majority of these old persons were dependent in both P- and I-ADL, while the relation between persons dependent only in I-ADL and persons dependent in both P- and I-ADL was more equal in the younger age groups.

The proportion of persons who had some kind of

sheltered accommodation was higher among persons dependent in both P- and I-ADL than among less dependent persons. As could be expected, no independent person lived in sheltered accommodation, used the handicap transportation service or had personal assistance and help with home-care. These results indicate an acceptable external validity.

## DISCUSSION

The need for personal assistance and help with home-care may arise suddenly due to an acute disease or accident, or gradually due to old age and chronic diseases. In both cases, it is important to

Table VII. Distribution of individuals who were assessed as independent, dependent in I-ADL, or dependent in P- and I-ADL by age, type of accommodation, and use of social services

	In- depen- dent n=5	Depen- dent I-ADL n=28	Depen- dent I-ADL and P-ADL n=52	Total n=85
<i>Age (years)</i>				
30-54	2	6	4	12
55-64	2	4	4	10
65-74	1	10	10	21
75-84	-	6	20	26
85-w	-	2	14	16
<i>Type of accommodation</i>				
Own home	5	25	33	63
Service apartment	-	3	12	15
Old persons' home	-	-	5	5
Nursing home	-	-	2	2
<i>Social services</i>				
Handicap transport. service	-	16	45	61
Personal assistance and help with home- care	-	11	44	55

restore the functional independence or maintain it at a high level as long as possible.

If we knew what the next step on the ADL-scale would be, then it would be easier to motivate both the patient and the staff to maintain the actual level and give priority to concentrating rehabilitation resources on the next higher step. Furthermore, it would be possible to define the level of dependency in a way that could be understood by all categories of nursing and rehabilitating staff. Katz' Index of ADL has been useful for such purposes in acute medical care, in long-term rehabilitation, and in home-care in Sweden (1, 4) for elderly people.

Most persons who need social support are in need of help with home-care, and for this category it was necessary to try to expand the scale of personal activities of daily living by adding a similar scale of instrumental activities.

The five activities of cooking, washing, transportation, cleaning and shopping were chosen because they are essential to most human beings who have to take care of a home. They are complex activities,

which include, for example, transfer indoors (cooking), and transfer outdoors (shopping). If a person is independent in shopping, then he can be assumed to be independent in cooking and feeding.

Washing laundry is another important activity for many people. In this study, the definition of the activity included the use of a washing machine. Many men may then be assessed as dependent since their wives usually perform this activity. By omitting the washing machine, these men can be assessed as independent, since many of them usually wash at least some of their own clothes in a washing-basin.

Transportation may be regarded as a cumulative continuation of transfer. Next after being able to get out of bed is being able to transfer indoors followed by transfer outdoors. If a person manages public transportation, then he or she can be assumed to be capable of managing transfers out of bed and indoors. These activities are all parts of the concept of mobility, and mobility is included in the definitions of, for example, going to the toilet, bathing and shopping.

Cleaning is one of the most frequent and time-consuming needs in home-care and may be the first or one of the first activities that we have to get help with, when old age limits our physical capacity. Cleaning can be defined in different ways. In order to increase the discriminative validity of the ADL-scale, we have tried to find a definition that will grade a person who is dependent in cleaning as less independent than a person who is dependent in bathing.

The ability to perform shopping may be related to the type of accommodation. Some people live far from shopping centers or on the third floor without an elevator, and obstacles in the environment may prevent them from performing shopping independently.

Such environmental factors may affect the order of the items. For example, in another environment shopping may be ranked second to cleaning instead of first, as it is in this study.

Persons who consulted a district occupational therapist were assumed to be representative of a population with a gradually increasing need for home-care assistance or technical aids. The majority of the persons seeking consultation were 65 years of age and older, and most of them lived in their own homes. Instrumental ADL is almost impossible to assess in hospitals and nursing homes.



The distribution of patients in all P- and I-ADL-grades indicates that the activities were well separated by their definitions. Thirty-five per cent of the subjects belonged to grades U, V, X, Y, Z, and they should otherwise have been classified as grade A. Eight persons were dependent in bathing, but independent in cooking. Seven of them had serious locomotor disorders, which explained the deviation from an ideal scale.

The definition of the activity of washing was problematic. Some women were dependent in washing because they could not manage to carry the laundry to the laundry-room due to locomotor problems. Some men were dependent because they were not familiar with the washing-machine or with sorting out the laundry. Thus, environment and technical know-how may affect the results.

We have tried another definition of washing by limiting the item to washing in a washing-basin. Such a definition increased the construct validity; there were fewer deviations from an ideal scale. On the other hand, this definition gave a lower discriminative validity, and it will not describe the need for assistance in all kinds of washing.

The inter-observer reliability was good, and the construct validity of the scale was confirmed by the coefficient of scalability. There was a cumulative relationship between the five well-defined instrumental activities and also between the personal activities of Katz' Index of ADL and these instrumental activities.

The size of the study population is rather small and most persons were disabled owing to locomotor disorders, which may have affected their representativity of elderly persons in the general population. But, there was no skewed distribution, either of patients or of items, and a further extension of this material could not be supposed to affect the results. The deviations from an ideal scale were also equally distributed between the original Katz' Index of ADL and the I-ADL-scale. All deviations but two could be accepted as fitting into a perfect scale by the definition of the grades, which permitted one activity to be unnamed.

Scalability can never be expected to be perfect. Beside of random errors of scale, there may be systematical errors of scale due to environmental, cultural, or medical factors. In order to generalize the results of this study, it will be necessary to

carry out further studies in general populations and in other environments with different social, medical, and cultural structures.

The instrumental activities included may also belong to different dimensions, and in that case, they cannot be expected to fit into the same cumulative scale. Yet, it is possible to hypothesize that there is a cumulative order between feeding and cooking, between transfer and transportation, between dressing and washing, and between bathing and cleaning. The results of this study will support this hypothesis (5). Furthermore, it has to be noted that no person was dependent in personal ADL and totally independent in instrumental ADL.

This group of elderly persons was well distributed in all P- and I-ADL-grades, and the concordance between the ADL-grade and age, type of accommodation and use of social services indicated that this instrument can be useful for assessing and differentiating the need for personal assistance and help with home-care among elderly and disabled people living in their own homes.

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