



## Validation of Katz index of independence in activities of daily living in Turkish older adults



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### ABSTRACT

**Objective:** Katz Index of Independence in Activities of Daily Living Scale (Katz ADL) is a widely used tool to assess the level of independency in older adults. The objective of this study was to assess the validity and reliability of the Turkish version of the six item Katz ADL in geriatric patients aged 65 years and older. **Methods:** The participants were recruited in a geriatric medicine outpatient clinic ( $n = 211$ ). The Katz ADL was translated to Turkish and it was administered with the Barthel index (BI) and SF-36 physical functioning subscale (SF-36 PF) which are already validated in Turkish. Reliability was assessed by internal consistency, interrater and test–retest analysis. Construct validity was assessed by Spearman correlations between the Katz ADL and other functional status indices.

**Results:** The internal consistency was high (Cronbach's  $\alpha = 0.838$ ). The test–retest reliability and interrater reliability were excellent (ICC 0.999 [0.999–1.000 95% CI]). Regarding the convergent validity strong associations between Katz ADL, BI and SF-36 PF were demonstrated ( $r_s = 0.988$ ,  $p < 0.001$  and  $r_s = 0.674$ ,  $p < 0.001$ ).

**Conclusion:** Validating an instrument, which has originally been developed in a different culture, is a complex but necessary task. It provides an opportunity for comparison of information across different cultures. To our knowledge, this is the only study to demonstrate reliability and validity of the Katz ADL-six item version in the geriatric population living in Turkey. Turkish version of the Katz ADL is a valid and reliable scale to detect the disability status in the basic activities of daily living in older adults.

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## 1. Introduction

Functional status of a person is a measure of his or her overall health. Functional status reflects the ability of an individual to perform the physical and social tasks necessary for maintaining self-care and usual daily activities. Functional status is determined by three levels of activities: basic activities of daily living (BADLs), instrumental activities of daily living (IADLs) and advanced activities of daily living (AADLs). BADLs include bathing, grooming,

dressings, toileting, transferring, maintaining continence, and feeding. IADLs include higher level activities such as handling finances, using the telephone, doing housework, driving or using public transportation, taking medications, preparing meals, doing laundry and shopping. AADLs include occupational, recreational, and travel activities requiring a higher level of cognitive functioning and involvement in the community roles (Katz, Downs, Cash, & Grotz, 1970; Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963; Lawton & Brody, 1969; Mahoney & Barthel, 1965). Decline in functional abilities with aging leads to loss of independence. Impairment of functional status could be the first sign of a disease process. Therefore, understanding the functional status is an important component of geriatric assessment. Many scales have been developed and used to determine functional status. Among instruments used to assess BADLs, Katz ADL is the best known one in clinical practice and the most widely used one in clinical studies. The Katz ADL was developed by Katz et al. in 1960s (Katz et al., 1970, 1963). It has been used with community dwelling older

**Abbreviations:** Katz ADL, Katz index of independence in activities of daily living scale; BI, Barthel index; SF-36, the medical outcomes study 36 item short form; SF-36 PF, SF-36 physical functioning subscale; BADLs, basic activities of daily living; IADLs, instrumental activities of daily living; LB-IADLs, Lawton–Brody IADLs; AADLs, advanced activities of daily living; MMSE, mini-mental state examination; GDS, geriatric depression scale; MNA-sf, mini-nutritional assessment short form; CHD, coronary heart disease; CHF, congestive heart failure.

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adults. The Katz ADL measures self-care tasks including; bathing, dressing, toileting, transferring to and from a chair, maintaining continence and feeding. The six item Katz ADL is short and can be administered by interview. However, when caring for the older adults, administering Katz ADL may require special training or clinical experience in certain cases. Especially, cognitively impaired individuals require more extensive evaluation. Therefore functional assessment can sometimes be very challenging in geriatric population.

Another scale for BADLs is the Barthel index (BI). It was first developed by Mahoney and Barthel (1965). The validity and reliability of the Turkish version of the BI was assessed by Kucukdeveci et al. (2000) in patients with stroke and spinal cord injury. The medical outcomes study 36 item short form (SF-36) is a measure of quality of life and health status (McHorney, Ware, Lu, & Sherbourne, 1994; Tarlov et al., 1989). It measures eight health domains: physical functioning, role limitation due to physical problems, bodily pain, general health perception, vitality, social functioning, role limitation due to emotional problems and mental health. The validity of SF-36 item was assessed by previous studies in general population (Brazier et al., 1992). The reliability and construct validity of SF-36 was assessed in Turkish cancer patients by Pinar (2005).

The Katz ADL is a commonly used tool but the Turkish version of this scale had not been proven to be reliable and valid for the older adults living in Turkey. Although it is frequently used, evidence on its reliability and validity are scarce, with existing data mostly coming from studies focusing on the interrater reliability (McDowell, 2006; Reuben, Valle, Hays, & Siu, 1995; Rodgers & Miller, 1997). In case of cultural validity Reijneveld et al. demonstrated good internal consistencies (Cronbach's alphas: 0.84–0.94) for Dutch, Turkish, and Moroccans living in the Netherlands in 2007 (Reijneveld, Spijker, & Dijkshoorn, 2007). The Greek version of Katz ADL was also demonstrated to be valid and reliable in cancer patients (Mystakidou et al., 2013). There are other studies concentrating on cross-cultural validity in different ethnic groups (Alvarez Solar et al., 1992; Cabanero-Martinez, Cabrero-Garcia, Richart-Martinez, & Munoz-Mendoza, 2009; Cummings, Neff, & Husaini, 2003; Khoei, Akbari, Sharifi, Fakhrzadeh, & Larijani, 2013; Moss, Roubideaux, Jacobsen, Buchwald, & Manson, 2004; Raji, Al Snih, Ray, Patel, & Markides, 2004).

Culture is important in shaping our behavior, cultural norms and values influence our way of life, so influence our daily activities of living. There is a great need for cross-culturally validated and reliable scales to use both in clinical practice and in research. Such validation studies are necessary for researchers to provide adapted scales with more accurate interpretations when used in different cultures. The aim of this study is to assess the validity and reliability of the Turkish version of the Katz ADL in regards to other well-known health related scales such as BI and SF-36 PF.

## 2. Methods

### 2.1. Subjects, instruments and procedure

The study population included patients who were consecutively admitted to a geriatric medicine outpatient clinic between June 2014 and October 2014. A total of 211 patients aged 65 years and older underwent comprehensive geriatric assessment. The Katz ADL, the Folstein mini-mental state examination (MMSE) test (Gungen, Ertan, Eker, Yasar, & Engin, 2002), the Yesavage geriatric depression scale (GDS) (Burke, Roccaforte, & Wengel, 1991), the mini-nutritional assessment short form (MNA-sf) (Guigoz, Vellas, & Garry, 1996), the Lawton–Brody IADLs (Lawton & Brody, 1969), the Barthel index and SF-36 physical functioning subscale were

administered to the patients by interviewing both the patients and the primary caregivers who were taking care of the patient for at least 20 hours per week and able to give reliable information about the patient. The Katz ADL measures six self-care tasks using a dichotomous rating (dependent-0/independent-1) in hierarchical order of decreasing difficulty as listed: bathing, dressing, toileting, transferring to and from a chair, maintaining continence and feeding. Six point is considered as independent and 0 point is considered as fully dependent. The Barthel Index measures ten self-care tasks including; bathing, dressing, feeding, personal hygiene, using toilet, bladder and bowel control, walking on the level surface, transfer from chair to bed, and using stairs and scored based on the amount of physical assistance required to perform these tasks, giving a total score ranging from 0 (fully dependent) to 100 (fully independent). The SF-36 physical functioning subscale (SF-36 PF) includes ten items: (1) vigorous activities (such as running, lifting heavy objects, participating in strenuous sports), (2) moderate activities (such as moving a table, pushing a vacuum cleaner, participating in moderate physical activities), (3) lifting or carrying groceries, (4) climbing several flights of stairs, (5) climbing one flight of stairs, (6) bending, kneeling, or stooping, (7) walking more than a mile, (8) walking several blocks, (9) walking one block, (10) bathing or dressing yourself. The question of 'Does your health now limit you in these activities? If so, how much?' is asked to the participants with three level of answers; yes limited a lot (0 point), yes limited a little (5 points) and no not limited (10 points) giving a total score ranging from 0 to 100; the higher the score, the better the physical performance.

A self-reported health status question with five level of response (excellent, very good, good, fair and poor) was also included. Patients were evaluated by physical and neurological examination; routine laboratory tests, demographic data including age, gender, marital status, living arrangement, and education level were obtained from medical records. The diagnosis of dementia and delirium was made according to Diagnostic and Statistical Manual of Mental Disorders IV criteria. Comorbidities were assessed as being diagnosed for hypertension, diabetes, coronary heart disease, cerebrovascular disease, chronic respiratory disease, chronic kidney disease, malignancy, depression, osteoarthritis, and rheumatologic diseases according to the statement of patients and ICD-10 codes. We separated our sample into two age groups as 65–74 years old and  $\geq 75$  years old. We compared patient characteristics, comorbidities, distribution of scores of BADLs, IADLs and other tests used for comprehensive geriatric assessment, according to age groups. The sampling included patients with severe dementia in order to analyze known groups validity. However, the stage of dementia (global deterioration scale) was not included in the statistical analysis. Patients with acute illnesses, acute infections, or delirium were excluded from the study.

The translation of the Katz ADL was performed by two independent translators using the methodology of forward and backward translation. The final translation was reviewed and compared by clinicians to assume both item and semantic equivalence. The translation was tested on a small group of patients regarding the understanding of the concept. The final translated scale was administered by two independent geriatricians at the same day at different rooms to all 211 participants to test the interrater reliability. One of these investigators also applied the tool again to 36 participants and the same caregivers in one week period for test-retest analysis. In order to test reliability of the Turkish version of Katz ADL; internal consistency and test-retest reliability analysis were performed. For testing the construct validity the Katz ADL was administered concurrently with BI and SF-36 PF. Spearman rank correlations were assessed between the Katz ADL and health outcomes such as number of comorbidities

and self reported health status. The study was approved by the local Clinical Research Ethics Committee. Written informed consent was obtained from all participants and it was further obtained from the caregivers of patients with dementia.

## 2.2. Statistical analysis

Descriptive statistics are shown as mean  $\pm$  SD for normally distributed variables and median (minimum–maximum) for skewed distributed variables. The reliability (internal consistency) was tested by Cronbach's alpha coefficient indicating the connectedness of items within a scale. A Cronbach's alpha coefficient of  $>0.70$  was taken as criterion to indicate the extent to which items may be measuring the same underlying trait. Test–retest reliability and interrater reliability were assessed by the interclass correlation coefficient (ICC), using correlation coefficient of  $>0.70$  as criterion. In order to examine the construct validity which means whether the instrument measures the characteristic it purports to measure, Spearman correlation analyses were performed between the Katz ADL and the other functional status indices such as the BI and SF-36 PF. Analyses were performed by IBM SPSS Statistics version 21. The  $p$  value of  $<0.05$  was accepted as statistically significant.

## 3. Results

The mean age of participants was  $75.5 \pm 7.1$  (65–96) years. In all, 39.8% (84 patients) were male, 60.2% (127 patients) were female. The majority of participants were primary school graduates (41.2%), 8.5% were secondary school graduates, 12.8% were high school graduates, 10.2% were university graduates and 26.5% were illiterate. Dementia diagnosis was present in 15.6% (33 patients). At the time of enrollment 25.1% of patients were living at nursing homes. In all, 83.4% (176 patients) had a retirement salary. The mean Katz ADL score was  $4.7 \pm 1.6$ . Table 1 shows the comparisons of patient characteristics, comorbidities, distribution of scores of BADLs, IADLs and other tests used for comprehensive geriatric

**Table 1**  
Distribution of patient characteristics stratified by age.

	65–74 years <i>n</i> = 101	$\geq 75$ years <i>n</i> = 110	Total <i>n</i> = 211
Age, mean $\pm$ SD	69.5 $\pm$ 3.1	81 $\pm$ 4.8	75.5 $\pm$ 7.1
Gender (male), <i>n</i> (%)	43 (42.6%)	41 (37.3%)	84 (39.8%)
Illiterate, <i>n</i> (%)	26 (25.7%)	30 (27.3%)	56 (26.5%)
Nursing home residents, <i>n</i> (%)	16 (15.8%)	37 (33.6%)**	53 (25.1%)
Comorbidities $\geq 2$ , <i>n</i> (%)	44 (43.6%)	68 (61.8%)**	112 (53.1%)
Comorbidities $\geq 3$ , <i>n</i> (%)	18 (17.8%)	28 (25.8%)	46 (21.8%)
Diabetes, <i>n</i> (%)	42 (41.6%)	42 (38.2)	84 (39.8%),
Hypertension, <i>n</i> (%)	73 (72.3%)	88 (80%)	161 (76.3%)
Dementia, <i>n</i> (%)	4 (4%)	29 (26.4%)*	33 (15.6%)
Depression, <i>n</i> (%)	11 (10.9%)	34 (30.9%)*	45 (21.3%)
CHD, <i>n</i> (%)	27 (26.7%)	27 (24.5%)	54 (25.6%)
CHF, <i>n</i> (%)	4 (4%)	7 (6.4%)*	11 (5.2%)
Katz index, mean $\pm$ SD	5.1 $\pm$ 1.3	4.3 $\pm$ 1.8*	4.7 $\pm$ 1.6
Barthel index, mean $\pm$ SD	92.4 $\pm$ 18.7	80 $\pm$ 29.6*	86 $\pm$ 25.5
SF-36 PF, mean $\pm$ SD	79.7 $\pm$ 24.9	62.1 $\pm$ 32.4*	70.5 $\pm$ 30.3
LB-IADLs, mean $\pm$ SD	6.6 $\pm$ 2.3	4.8 $\pm$ 3.2*	5.7 $\pm$ 2.9
MMSE, mean $\pm$ SD	25.4 $\pm$ 5	21.5 $\pm$ 7.9*	23.3 $\pm$ 6.9
YGDS, median (IQR)	0 (0–3.5)	2 (0–6)**	2 (0–5)
MNA-sf, mean $\pm$ SD	12.6 $\pm$ 1.8	11.2 $\pm$ 2.3*	11.9 $\pm$ 2.2

Abbreviations: SD: standard deviation; CHD: coronary heart disease; CHF: congestive heart failure; SF-36 PF: SF-36 physical functioning subscale; LB-IADLs: Lawton–Brody IADLs; MMSE: mini-mental state examination; YGDS: yesavage geriatric depression scale; IQR: interquartile range; MNA-sf: mini nutritional assessment-short form.

\*  $P < 0.001$ .

\*\*  $P < 0.05$ .

assessment stratified by age. There were no difference concerning gender, diabetes, hypertension, and congestive heart failure between age groups. The most prevalent comorbidity was hypertension (76.3%), followed by diabetes (39.8%) and coronary heart disease (25.6%). The prevalence of depression was 21.3% in total group.

## 3.1. Factor analysis

In exploratory factor analysis high factor loading were obtained for items bathing, dressing, toileting and transferring to and from a chair (factor loadings  $\geq 0.5$ ). Maintaining continence and feeding correlated less with other items and the total scale. One factor extraction explains 61% of total variance.

## 3.2. Psychometric properties of Turkish version of the Katz ADL

### 3.2.1. Internal consistency

Internal consistency was tested by Cronbach's alpha ( $\alpha$ ) coefficient. Cronbach's  $\alpha$  was 0.838. The results showed good internal consistency for Katz ADL supporting the reliability. If the item continence was deleted, Cronbach's alpha would be 0.884, if the item feeding was deleted, Cronbach's alpha would be 0.845.

### 3.2.2. Test–retest and inter-rater reliability

Thirty-six patients were interviewed two times in one week period by the same interviewers. There was no difference between two assessments (interclass correlation coefficient (ICC) = 1.000, 95% CI 1.000–1.000). The test–retest stability of the Katz ADL was perfect.

The inter-rater reliability was also good, reflected by an ICC of 0.999 (95% CI 0.999–1.000).

### 3.2.3. Construct validity

The construct validity was tested by the association between the Katz ADL and the other functional status indices. The correlation analysis showed significant associations between Katz ADL, BI and SF-36 PF. The correlation with the BI was found to be strong ( $r_s = 0.988$ ,  $p < 0.001$ ) and with the SF-36 PF was found to be good ( $r_s = 0.674$ ,  $p < 0.001$ ). There was a lack of correlation between YGDS and the Katz ADL. We performed correlation analysis after excluding the subjects with dementia. We found a statistical significant negative but weak correlation ( $r_s = -0.158$ ,  $p = 0.03$ ) between YGDS and the Katz ADL after excluding the subjects with dementia. Table 2 shows the correlations between the Katz ADL and other indices.

### 3.2.4. Known groups validity

Nursing home residents had lower Katz ADL scores compared to patients residing at home ( $3.1 \pm 2.2$  vs.  $5.3 \pm 0.88$ ,  $p < 0.001$ ). Patient with dementia also had lower Katz ADL scores compared to nondemented patients ( $2.6 \pm 1.9$  vs.  $5.1 \pm 1.2$ ,  $p < 0.001$ ). Having

**Table 2**  
Spearman rank correlations between Katz ADL and other indices.

	Spearman's rho (95% CI)	<i>p</i>
BI	0.988 (0.985–0.990)	$<0.001$
SF-36 PF	0.674 (0.593–0.741)	$<0.001$
LB-IADL	0.669 (0.587–0.737)	$<0.001$
MMSE	0.421 (0.304–0.526)	$<0.001$
YGDS	-0.103 (-0.234–0.032)	0.137
MNA-sf	0.514 (0.408–0.606)	$<0.001$

BI: Barthel index; SF-36 PF: SF-36 physical functioning subscale; LB-IADLs: Lawton–Brody IADLs; MMSE: mini-mental state examination; YGDS: Yesavage geriatric depression scale; MNA-sf: mini nutritional assessment-short form.

dementia and being a resident of a nursing home were closely associated with impairments in ADLs. Therefore, these patients had lower ADLs scores. Having three or more chronic conditions was associated with lower scores of Katz ADL ( $4.2 \pm 0.25$  vs.  $4.8 \pm 0.12$ ,  $p=0.002$ ). These findings also indicate the construct validity of the Katz index. Interestingly, we found no association between the presence of some chronic conditions and Katz ADL scores, such as diabetes and coronary heart disease. Having hypertension was associated with higher Katz ADL scores compared to patients without hypertension ( $4.9 \pm 1.3$  vs.  $4 \pm 2.2$ ,  $p=0.005$ ). Patients with depression had lower Katz ADL scores compared to patients without depression ( $3.9 \pm 2.1$  vs.  $4.9 \pm 1.4$ ,  $p=0.003$ ). Regarding self-rated health status, 39.8% ( $n=84$ ) of patients reported self-rated health as fair or poor and these patients had significantly lower scores of Katz ADL ( $4.11 \pm 0.21$  vs.  $5.16 \pm 0.11$ ,  $p < 0.001$ ). The distribution of the Katz ADL scores according to age and gender are seen in Table 3.

#### 4. Discussion

This study determined the reliability and validity of the Turkish version of Katz ADL in measuring the independence of Turkish geriatric patients in daily life activities. In this study, we demonstrated internal consistency of the Turkish version of the six item Katz ADL by finding a high Cronbach's  $\alpha$  coefficient in a large sample of geriatric patients. To the best of our knowledge, this is the first attempt to translate and validate the 6 item Katz ADL in Turkish older adults.

Previously Reijneveld et al. demonstrated good internal consistencies of ten item Katz ADL with four response categories (Cronbach's alphas: 0.84–0.94) for Dutch, Turkish, and Moroccan immigrants living in the Netherlands in 2007 (Reijneveld et al., 2007). However, they included relatively healthy and younger patients (55–74 years) and did not perform inter-rater and test-retest analyses. The internal consistency of Katz ADL was shown to be high (Cronbach- $\alpha=0.86$ ) by Alvarez Solar et al. (1992). In their study interrater reliability was 0.84 (nurses vs. doctors) test-retest reliability was 0.94 but retest was administered after two weeks which is a long interval to assess the scale's stability in geriatric population who are prone to sudden changes (Alvarez Solar et al., 1992). Spector et al. demonstrated sufficient Cronbach's  $\alpha$  ranging from 0.73 to 0.78 for a hierarchical scale including ADL (bathing, dressing, transferring, and feeding) and IADL (shopping and transportation), resembling to the Katz index of ADL as structure (Spector, Katz, Murphy, & Fulton, 1987). Brorsson B. et al. demonstrated construct validity (coefficient of scalability=0.74–0.88) and they found a low interobserver variability, also they showed predictive validity of the index as patients independent in ADL had shorter hospitalization. One year later, most dependent

patients were either dead or living in institutions (Brorsson & Asberg, 1984).

We demonstrated an excellent inter-rater reliability and test-retest reliability for Katz ADL. Other studies validating Katz ADL in their language performed retest after 7–14 days (Alvarez Solar et al., 1992; Khoei et al., 2013; Lino, Pereira, Camacho, Ribeiro Filho, & Buksman, 2008; Wang, Hu, Chen, & Li, 2012). In our study, the interval for retest was chosen to be one week, so that a change in BADLs was not expected. In geriatric patients, who are vulnerable and prone to sudden changes in general status with interfering acute problems, two week period was considered to be long and retest was performed after one week. Test-retest was performed by the same interviewers to a sample of patients ( $n=36$ ). This number of patient is satisfactory to assess the stability of the six item Katz ADL.

We demonstrated convergent validity by finding strong correlations with other indices of functional status. There is not a gold standart test to measure the functional status, therefore we used the Turkish version of other indices used in Turkey, proved to be valid and reliable in Turkish population. Regarding validity, Reuben et al. (1995) demonstrated a weak correlation between Katz ADL and SF-36 PF ( $r=0.30$ ). In the present study, we found a good correlation with SF-36 PF, but BI showed a better correlation. The higher associations with BI and Katz ADL can be explained. The BI was improved for measurement of ADLs. SF-36 PF subscale is not specific to ADLs, it is a tool for measurement of physical functions and have some limitations in the assessment of physical activities of upper extremities. Lower extremity has superiority over upper extremity function in SF-36 PF (Brorsson & Asberg, 1984). Reijneveld et al. (2007) also showed strong associations between Katz ADL and SF-36 PF subscale. Cruz (1991) found a strong correlation between Spanish version of Katz ADL and Red cross functional scale ( $r=0.87$ ). Mystakidou et al. reported validity of Katz ADL by finding strong correlations between the Greek version of Katz ADL and Lawton IADLs scale ( $r=0.756$  for males,  $r=0.572$  for females) (Mystakidou et al., 2013). We also found a correlation coefficient of 0.669 for Katz ADL and LB-IADLs. However, these scales measures different concepts, therefore this finding supports divergent validity rather than construct validity.

Chronic diseases adversely affect functional independence. As number of diseases increases, the risk of difficulty with activities of daily living increases, as well (Mor et al., 1989; Verbrugge, Lepkowski, & Imanaka, 1989). Within chronic diseases, absence of hypertension and presence of depression were found to be associated with BADLs in our study. Especially type 2 diabetes mellitus is associated with a wide range of comorbidities and complications, leading to functional decline and physical disability (de Rekeneire & Volpato, 2015; Volpato, Maraldi, & Fellin, 2010).

**Table 3**

The distribution of the Katz index scores stratified for gender and age groups.

Katz index scores	Age 65–74 years <i>n</i> = 101		Age $\geq$ 75 years <i>n</i> = 110		Total <i>n</i> = 211
	Male <i>n</i> = 43	Female <i>n</i> = 58	Male <i>n</i> = 41	Female <i>n</i> = 69	
Total score (mean $\pm$ SD)	5.3 $\pm$ 1.1	5 $\pm$ 1.4	5.2 $\pm$ 0.8	3.8 $\pm$ 2*	4.7 $\pm$ 1.6
Item1: Bathing ( <i>n</i> , % dependent)	6 (14%)	7 (12.1%)	8 (19.5)	34 (49.3%)*	55 (26.1%)
Item2: Dressing ( <i>n</i> , % dependent)	4 (9.3%)	6 (10.3%)	2 (4.9%)	26 (37.7%)*	38 (18%)
Item3: Toileting ( <i>n</i> , % dependent)	3 (7%)	6 (10.3%)	1 (2.4%)	21 (30.4%)*	31 (14.7%)
Item4: Transferring ( <i>n</i> , % dependent)	2 (4.7%)	4 (6.9%)	1 (2.4%)	17 (24.6%)*	24 (11.4%)
Item5: Continence ( <i>n</i> , % dependent)	13 (30.2%)	32 (55.2%)*	19 (46.3%)	48 (69.6%)*	112 (53.1%)
Item6: Feeding ( <i>n</i> , % dependent)	2 (4.7%)	2 (3.4%)	0 (0%)	4 (5.8%)	8 (3.8%)

Abbreviations: SD: standart deviation.

\*  $P < 0.05$ .

We found no association between diabetes and functional disability in BADLs. The risk of disability associated with diabetes can not be totally explained by disease itself. Accompanying cardiovascular disease, retinopathy, neuropathy, peripheral vascular disease, renal failure and sarcopenia are potential contributors to functional disability. Elderly onset diabetes may have a better clinical course (Kirkman et al., 2012). The prevalence of retinopathy is less common in elderly onset diabetes, whereas the prevalence of chronic kidney disease, peripheral neuropathy, stroke, coronary heart disease are similar among middle-age onset and elderly onset diabetic subjects aged >65 years (Selvin, Coresh, & Brancati, 2006). Inadequate glycemic control adds on to the risk of disability. Our results are inconsistent with other studies partly because of paucity of accompanying chronic conditions and systemic complications of diabetes. We found a higher risk of disability in patients without hypertension. There are conflicting evidence regarding the association between hypertension and disability. Some studies found that mildly elevated blood pressure is associated with a better health status including activities of daily living (Szewieczek et al., 2015); and some studies found a lower blood pressure in frail elderly (Fattori, Santimaria, Alves, Guariento, & Neri, 2013). These studies may explain this result of our study. We found a negative correlation between the Katz ADL and having depression. Patients with depression had a high risk of disability. This is also consistent with the literature (Marventano et al., 2014). Although we found an association between depression and activities of daily living, YGDS scores were not associated with the Katz ADL. The YGDS has some limitations when screening depression in cognitively impaired subjects (Gilley & Wilson, 1997). Therefore we performed correlation analysis after excluding patients with dementia and found a significant but weak negative association between YGDS and the Katz ADL. The nursing home residents and patients with dementia had the lowest Katz ADL scores. These patients were expected to have high level of dependency. Older adults who receive nursing home care deteriorates faster in terms of ADLs compared with those who receive home care (Lee et al., 2015). Many studies have established a higher functional dependency in patients with dementia compared with those without (Orsitto et al., 2005; Samus et al., 2009). Therefore, the concordance of Katz ADL scores with the expected dependency level of patients with dementia and nursing home residents, contributes to the validity of the scale. Additionally, there are studies reporting a positive correlation between cognitive test scores and daily living abilities (Warren et al., 1989). In our study, we also found a moderate correlation between Katz ADL scores and MMSE scores ( $r = 0.421, p < 0.001$ ) that is consistent with the findings of other studies.

The frequencies of each item, except item feeding, were different between genders in older age groups. Females aged 75 years and older were more dependent than males at the same age group. However, in patients aged 65–74 years old, only dependency in item continence was more prevalent in females. The reason for this may be assumed as multiple parities and pelvic relaxation, also the increased frequency of overactive bladder at this age, although data was not shown here (Esin et al., 2015). The item continence is accepted as dependent if the participant is partially or totally incontinent of bowel or bladder. The activities in the Katz ADL are expected to be lost in a hierarchical ordering from bathing to feeding, the continence being fifth. However, some patients with no disability may have incontinence especially women with stress incontinence or overactive bladder. Therefore, the item continence had a low correlation with the total score. This finding has been previously observed in other studies (Mystakidou et al., 2013; Spector & Fleishman, 1998; Spector et al., 1987). Although it is believed that many older individuals deny incontinence or they do not disclose

because they assume incontinence as a part of normal aging, in our study we found a high prevalence of incontinence (53.1%). In our country, the relationship between doctor and patient is close, older patients tend to behave their doctor as close as a family member, so they are not ashamed of telling incontinence. Furthermore, in our outpatient clinic presence of incontinence is asked to every patient, therefore, it is not usually under-diagnosed. Due to high prevalence of incontinence, it could be offered to modify this item as using incontinence products (diapers-pads) or medications to increase the correlation of the item with total score. The Cronbach's alpha coefficient increased with the deletion of this item.

The item toileting is accepted as independent if the participant is able to go to toilet, get on and off, arrange clothes and clean genital area without help. In our country mostly alla turca toilets are preferred instead of European style toilets by older adults. However with aging, squatting becomes difficult due to joint disorders and osteoarthritis, so older individuals could not insist on squatting. We adapted this item by identifying the toilet type as 'European style toilet' because some patients could use these toilets even if they can not use alla turca toilets.

In our country western type bathtubs are not mostly preferred, older people generally use eastern type bathtubs, in which they stand up in the bath, instead of lying down, mostly they use showers or a bucket of water and a bowl. However, this cultural difference does not need a change in the item bathing. We accepted the item bathing as independent if the patient is able to bath self completely or needs help in bathing only a single part of the body such as the back, genital area, though a bucket of water previously prepared by someone else.

The item feeding is accepted as independent if the participant is able to get food from plate into mouth without help. The difficulty level of this item is low. Most patients with a high level of disability may be able to do this task resulting in discordance with the impairment level. The Cronbach's alpha coefficient increased with the deletion of this item.

Our study has some limitations. First, due to its cross-sectional nature predictive validity can not be assessed. The KI was previously demonstrated to be predictive of functional outcomes over time, useful to predict the length of stay in the hospital, morbidity and mortality (Lindmark & Hamrin, 1988). We could not test this, but our aim was to validate the index. Future studies can be conducted to test its predictivity. Second, our sample did not include hospitalized older adults. Further studies can be conducted to test its validity in hospitalized older adults. We used only self-reported limitations in activities for scoring Katz ADL. It is more reliable to use clinician rated, observed ability of patient to perform activities of daily living (Wajman et al., 2014). Due to loss of insight, some patients may be unaware of the existence of their disabilities. In these cases the opinion of caregivers is important but the caregivers could also have bias to their loved family members while reporting disabilities. Especially caregivers with burnout syndrome tend to give biased responses (Schulz et al., 2013). In case of suspicion of unreliable caregiver responses, performance-based scales can be preferred.

As a strength of the study, the study population was not homogenous, we included community dwelling relatively healthy older adults as well as bedridden persons and nursing home residents who were admitted to our clinic by their relatives or caregivers. We included these varieties of patients on purpose to assess known groups validity. Other strong points of our study are relatively large sample, relatively wide range of age including oldest old, lack of missing data, and incorporation of patients with different levels of dependency, such as patients with dementia and nursing home residents. Besides, assessment of multiple indicators of validity and reliability added more value to the study.

Assessment of functional dependency is an important component of comprehensive geriatric assessment. Measuring the level of functional dependency in daily activities of daily living is essential for clinical decision making, monitoring therapy and predicting outcome. Therefore, validity and reliability studies conducted in different cultures are extremely necessary. Most of all, such studies provide researchers a more accurate interpretation of results when working in different languages and cultures.

## 5. Conclusion

In the context of Turkish studies, to our knowledge, this is the only study to demonstrate reliability and validity of the six item Katz ADL in the geriatric population living in Turkey. This study will contribute in the gerontological and geriatrics discipline not only in Turkey but also in other areas where Turkish speaking communities live.

The results of this study suggest that the Katz ADL is an easy to perform, reliable, valid and cross-culturally acceptable scale for measurement of BADLs in our geriatric population. The Katz ADL measures functional status in a consistent and reproducible manner.

## Author's contributions

Study concept and design: Gunes Arik, Burcu Balam Yavuz.

Acquisition of data: Gunes Arik, Hacer Dogan Varan, Ozgur Kara, Mustafa Kemal Kilic, Muhammet Cemal Kizilarlanoglu, Fatih Sumer.

Analysis and interpretation of data: Burcu Balam Yavuz, Gunes Arik, Erdem Karabulut.

Drafting of the manuscript: Gunes Arik.

Critical revision of the manuscript for important intellectual content: Burcu Balam Yavuz.

Statistical analysis: Erdem Karabulut, Mehmet Emin Kuyumcu.

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Study supervision: Burcu Balam Yavuz.

Sponsor's role: None.

## Conflict of interest

None.

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