# Functional dependencies among the elderly on hemodialysis

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**As the dialysis population ages, their limitations in performing daily activities affect the well-being of the patients as well as increase the burden on caregivers and the use of health services. In this cross-sectional study, we measured the proportion of patients 65 years and older undergoing chronic outpatient hemodialysis who needed help with day-to-day activities and identified the clinical characteristics of this population at most risk. Their dependence in performance of basic self-care tasks and instrumental activities such as driving were measured by the Barthel and Lawton Scales. Associations between disability in four basic activities to age, gender, education, multiple prescription drug needs, diabetes, cognition, depressive symptoms, and physical performance were examined using logistic regression. Of the 162 mostly male participants averaging 75 years old, eight had no disability, 69 had only instrumental dependence, and 85 had combined disability. Multiple prescription drug needs, poor timing in 'up-and-go' mobility performance, and education level were associated with basic dependency. Our study shows that the disability in self-care is common among older patients on hemodialysis. Strategies are needed to routinely identify those older dialysis patients at risk of functional impairment and to limit their disabilities.**

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In most regions of the world, an increasing number of adults aged 65 years or more are started on renal replacement therapy each year. Those aged 75 years or more represent the fastest growing segment of the population starting dialysis.[1,2] The median survival of those aged 65–79 years is estimated between 25 and 44 months.[2,3] What remains unclear is whether this increased quantity of life is accompanied by the ability to look after oneself in daily self-care tasks. Such activities are commonly described as basic or instrumental activities of daily living (ADL and IADL, respectively): IADLs involve household management tasks such as shopping, housecleaning, laundry, meal preparation, transportation, telephone use, and management of medications and finances, whereas ADLs are self-care tasks comprising bathing, grooming, dressing, toileting, eating, transferring, and ambulation.[4,5] A smaller set of four core ADLs has been proposed for evaluating community-dwelling adults that excludes eating, toileting, and grooming, as these activities are usually preserved in this population.[6] Disability is defined as difficulty or dependency in carrying out activities essential to independent living, such as ADLs and IADLs.[7]

Disability, or functional dependence, is a well-recognized predictor of hospitalization and of poor outcomes in older non-dialysis populations but has not been well studied in the renal population.[8,9] Previous research has suggested that renal patients are vulnerable and often cannot function fully within society;[10–17] however, few have characterized, in detail, the nature and type of disabilities seen, particularly among older patients. We hypothesized that disability in daily activities was common, and that factors associated with functional dependence in the general geriatric population such as cognitive impairment, depressive symptoms, polypharmacy, and performance measures of mobility impairment[9,18–20] would be more predictive of disability among older dialysis patients than age, gender, education, and diabetes. These latter factors have been associated with disability in the non-elderly renal population.[10–15,21]

The objectives of this study were to measure the specific pattern of ADL and IADL functional deficits in older dialysis patients, to characterize the proportion of patients with one or more disabilities in the four core ADL self-care tasks[22] (bathing, dressing, transfers from bed to chair, and walking

within the home) and to identify clinical variables that are associated with functional dependence.

## RESULTS

### Study population

All but three patients, aged 65 years or more and on chronic in-center hemodialysis, were approached to participate in the study. The three patients who were not approached were deemed ineligible based on our inability to find an interpreter who could communicate in their language and to obtain informed consent. Participant characteristics are presented in Table 1. Of 182 eligible participants, 168 (92%) agreed to take part in the study. Study assessments were incomplete in six patients because of death ($n=4$), withdrawn consent ($n=1$), and prolonged hospitalization ($>3$ months; $n=1$). These six patients were excluded from further analysis. Patients not recruited were similar in age and gender to study participants.[23]

Fifty-seven percent of patients were male, with a mean age of 74.8 ± 5.9 years (Table 1). Diabetes and renovascular disease were the most common causes for end-stage renal disease (ESRD). Although only a minority of patients (22%) lived alone, most (94%) resided in their own apartments or homes. Subjects had an average of 10 comorbid conditions (mean Charlson comorbidity index score 8.7 ± 1.8) and were taking multiple medications (mean 11.3 ± 3.5). The median duration on renal replacement therapy was 35.5 months (quartiles 14, 75). A sizeable proportion of patients were found to have depressive symptoms (30%) and cognitive impairment measured using adjusted Mini-Mental Status Examination (MMSE) scores (27%), and they reported having fallen in the past year (33%). The majority demonstrated deficits in physical performance measures: 75% were unable to rise from a chair without the use of their arms or an aid and 68% were unable to attempt a tandem stance, whereas 75% could not successfully perform the task

**Table 1 | Baseline characteristics**

| | Study population (*N*=162) | Neither IADL nor ADL disability (*N*=8) | IADL disability, no ADL disability (*N*=69) | IADL and ADL disability (*N*=85) |
|---|---|---|---|---|
| Age (years) | 74.8 ± 5.9 | 74.6 ± 9.3 | 73.7 ± 5.7 | 75.7 ± 5.6 |
| *Cause of ESRD* | | | | |
| Diabetes | 43 (27%) | 1 (12%) | 14 (20%) | 29 (34%) |
| Renovascular disease | 41 (25%) | 2 (25%) | 9 (13%) | 24 (28%) |
| Glomerulonephritis | 31 (19%) | 2 (25%) | 19 (28%) | 8 (9%) |
| Other | 47 (29%) | 3 (38%) | 27 (39%) | 24 (28%) |
| Median (range) duration of RRT (months) | 36 (1–309) | 51 (6–309) | 31 (1–239) | 41 (1–288) |
| Years of education (median, range) | 8.0 (0–20) | 6.5 (3–16) | 12 (0–20) | 6 (0–20) |
| Number of medications | 11.3 ± 3.5 | 12 ± 3.2 | 10 ± 3.3 | 12.3 ± 3.5 |
| *Comorbid conditions* | | | | |
| Diabetes | 73 (45%) | 5 (62%) | 25 (36%) | 43 (51%) |
| Hypertension | 141 (87%) | 6 (75%) | 58 (84%) | 77 (91%) |
| Stroke | 48 (30%) | 1 (12%) | 21 (30%) | 26 (31%) |
| Peripheral vascular disease | 49 (30%) | 1 (12%) | 15 (22%) | 33 (39%) |
| Coronary artery disease | 92 (57%) | 2 (25%) | 33 (48%) | 57 (67%) |
| Congestive heart failure | 67 (41%) | 2 (25%) | 28 (41%) | 37 (44%) |
| Arthritis | 80 (49%) | 3 (38%) | 30 (43%) | 47 (55%) |
| Documented depression | 37 (23%) | 3 (38%) | 14 (20%) | 20 (24%) |
| Peripheral neuropathy | 39 (24%) | 0 | 8 (12%) | 31 (36%) |
| Cataract | 81 (50%) | 2 (25%) | 29 (42%) | 50 (59%) |
| *Domicile* | | | | |
| Apartment | 86 (53%) | 4 (50%) | 35 (51%) | 47 (55%) |
| House | 67 (41%) | 4 (50) | 30 (43%) | 33 (39%) |
| Senior's housing | 4 (2.5%) | 0 | 2 (3%) | 2 (2%) |
| Nursing home | 3 (1.9%) | 0 | 0 | 2 (2%) |
| Percent reduction in urea | 75 ± 6.6% | 76 ± 6% | 75.6 ± 6.3% | 74.6 ± 7.0% |
| Hemoglobin (g per 100 ml) | 11.8 ± 1.2 | 11.6 ± 1.1 | 11.6 ± 1.2 | 11.8 ± 1.2 |
| Albumin ($g\,l^{-1}$) | 37.4 ± 3.1 | 37.5 ± 2.8 | 37.4 ± 3.4 | 37.4 ± 2.9 |
| Depressive symptoms | 49 (30%) | 3 (38%) | 21 (30%) | 25 (29%) |
| MMSE/30 | 24.5 ± 4.0 | 25.4 ± 4.0 | 25.7 ± 3.1 | 23.4 ± 4.4 |
| Cognitive impairment | 44 (27%) | 1 (12%) | 13 (19%) | 30 (35%) |
| TUG >10 s or unable to perform test | 130 (80%) | 5 (62%) | 45 (65%) | 80 (94%) |
| Balance impairment (tandem stance) | 110 (68%) | 6 (75%) | 39 (57%) | 76 (89%) |
| Unable to stand from a chair without arm or aid use | 121 (75%) | 5 (62%) | 42 (61%) | 74 (87%) |

ESRD, end-stage renal disease; MMSE/30, Folstein Mini-Mental Status Examination score (maximum 30/30); RRT, renal replacement therapy; TUG, timed 'up-and-go' test. Data shown are for the total study population and for those with no disability and differing levels of disability.

for 10 s. Seven percent were unable to perform a timed 'up-and-go' (TUG) mobility test, whereas 73% took longer than 10 s to complete the task.

### Disability in daily functional activities

Overall, only eight subjects (5%) were fully independent and reported no functional impairment in any activity (Figures 1 and 2). Dependence (that is, requiring help from another person) in IADL tasks was most common. Ninety-five percent patients had at least one IADL dependency with a median of five dependent daily activities (Table 2). Sixty-nine (43%) subjects had only IADL dependence but remained independent in personal care ADL activities. The remaining 52% of subjects were dependent both in IADLs and in at least one of the core ADLs (bathing, walking, transferring from bed to chair, and dressing). As presented in Figures 1 and 2, the most common areas of dependence were home maintenance tasks (housework (83%), shopping (81%), laundry (80%), and cooking (68%)) followed by stair climbing (52%), bathing (48%), transportation (49%), financial management (37%), ambulation (29%), and medication management (24%).

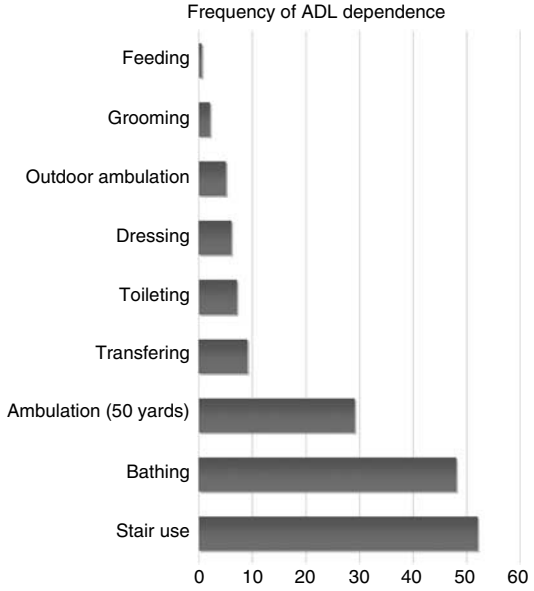


**Figure 1 | Figure showing ADL dependence in nine aspects of personal care measured using the Barthel Index**. The percentage of individuals who reported requiring help or supervision with this activity is shown in the dark bars.

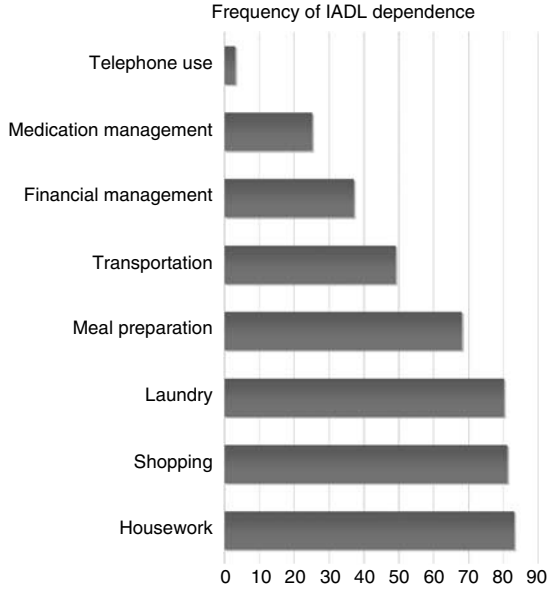


**Figure 2 | Figure showing IADL dependence in eight aspects of day-to-day living measured using the Lawton-Brody Scale**. The percentage of individuals who reported requiring help or supervision with this activity is show in the dark bars.

### Model development

As shown by the crude odds ratios (ORs) in Table 3, the factors associated with having disability in one or more ADLs included the inability to perform a TUG test within 10 s, abnormal cognition, polypharmacy, and having fewer years of education. No significant relationship with ADL disability was noted for diabetes, gender, or depressive symptoms, whereas the association of age with ADL functional impairment was of borderline significance. All variables were entered into a multivariable logistic regression model to obtain adjusted estimates. A total of 85 subjects had at least one core ADL disability, resulting in $\geqslant 10$ events per pre-specified variable, thus limiting model overfitting. The multivariable model revealed a significant association between the likelihood of at least one ADL disability and the

**Table 2 | Functional status**

| | Study population (*N*=162) | IADL and ADL disability (*N*=85) |
|---|---|---|
| ADL: mean Barthel score/100 | 93.1 ± 9.7 | 87.3 ± 10.2 |
| IADL: mean Lawton score/24 | 18.9 ± 3.1 | 18.5 ± 3.0 |
| Median (range) number of dependent IADLs | 5 (0–8) | 5 (1–8) |
| Median (range) number of dependent ADLs | 1 (0–6) | 2 (1–4) |

ADL, basic activities of daily living; IADL, instrumental activities of daily living.

**Table 3 | Univariate model results: association with dependency in one or more core ADLs (bathing, dressing, transferring, and ambulation)**

| Variable | $\beta$-Value | OR | 95% CI |
|---|---|---|---|
| Age (years) | 0.0549 | 1.06 | 1.00, 1.12 |
| Gender (F) | 0.4333 | 1.54 | 0.97, 2.46 |
| Diabetes | 0.4724 | 1.60 | 0.89, 2.90 |
| Education | −0.1304 | 0.88 | 0.82, 0.93 |
| Number of medications | 0.1833 | 1.20 | 1.10, 1.30 |
| Poor TUG performance | 2.1564 | 8.64 | 3.44, 21.67 |
| Abnormal cognition | 0.8979 | 2.45 | 1.18, 5.09 |
| Depressive symptoms | −0.0832 | 0.92 | 0.47, 1.80 |

ADL, basic activities of daily living; CI, confidence interval; F, female; OR, odds ratio; TUG, timed 'up-and-go.'

**Table 4 | Multivariable model results: association with dependency in one or more core ADLs (bathing, dressing, transferring, and ambulation)**

| Variable | β-Value | Adjusted OR | 95% CI |
|---|---|---|---|
| Age (years) | 0.0626 | 1.06 | 1.00, 1.14 |
| Gender (F) | −0.1802 | 0.84 | 0.37, 1.89 |
| Diabetes | 0.3688 | 1.45 | 0.70, 2.99 |
| Education | −0.1333 | 0.88 | 0.80, 0.95 |
| Total medications | 0.2248 | 1.25 | 1.11, 1.41 |
| Poor TUG performance | 1.8940 | 6.64 | 2.24, 19.71 |
| Abnormal cognition | 0.1262 | 1.13 | 0.42, 3.07 |
| Depressive symptoms | −0.2115 | 0.81 | 0.35, 1.84 |

ADL, basic activities of daily living; CI, confidence interval; F, female; OR, odds ratio; TUG, timed 'up-and-go.'

study variables (log likelihood ratio 57.05, $P<0.001$ for 8 d.f.), suggesting that at least one regression coefficient was different from zero. ADL dependency was positively associated with the total number of medications taken (OR = 1.25 (95% confidence interval (CI): 1.11, 1.41)) and poor mobility performance on the TUG (OR = 6.64 (95% CI: 2.24, 19.71)) and negatively associated with years of education (OR = 0.88 (95% CI: 0.80, 0.95)) as measured by Wald statistics (Table 4). The association for age, gender, diabetes, depressive symptoms, and cognitive impairment did not reach statistical significance. Tests for collinearity did not reveal any significant interactions, and the addition of an interaction term for education and impaired cognition was not significant (OR = 1.05 (95% CI: 0.86, 1.18)) and did not change the final model. Results of a secondary analysis, performed without inclusion of performance measurements, showed that the adjusted ORs and their 95% CIs were not appreciably different from the original model (log likelihood ratio 43.10, $P<0.001$ for 7 d.f.; data not shown).

## DISCUSSION

To our knowledge, this is one of the largest, detailed, population-based studies measuring the functional status of elderly patients undergoing chronic hemodialysis therapy. The data presented show a high prevalence of disability in activities required for independent living among older patients. This high prevalence of functional impairment may contribute to the high mortality and morbidity rates seen in dialysis patients. In a recent study of elderly dialysis patients, those who were non-ambulatory were shown to have a higher mortality rate than those who were able to ambulate.[2] Similarly in older non-renal populations, functional impairment was closely associated with more frequent and prolonged hospitalization, high morbidity, and high mortality.[8,9,24] These findings are made more significant by the fact that treatment strategies such as geriatric assessment and multidisciplinary team care have been shown, albeit in non-renal populations, to be effective in preventing functional decline.[25–28] Disability among older dialysis patients is a potentially underinvestigated problem that may have a substantial impact on nephrology health outcomes and care planning.

The functional status of dialysis patients has been measured previously; however, in many studies, patients of all ages were included, scores were condensed into summary values, and the primary focus was on the ability to return to work or to return to a full community life.[10–17,29] In contrast, our focus was on mobility and the ability for self-care. The prevalence of disability related to tasks important for independent living in our dialysis patients was higher than that we had expected. Objective measures of lower extremity function strongly predict poor health outcomes such as disability, hospitalization, and mortality in older adults.[30,31,9] We found a high prevalence of poor physical performance where only one-quarter of participants could stand up from a chair without using their arms for support, less than one-third had normal balance, and only 20% had normal timed functional mobility scores. Of particular interest, among the few subjects who reported no need for assistance in daily tasks required for independent living, the majority had deficits noted on performance measures of mobility (see Table 1). This has important implications as the inability to complete physical performance tasks such as the TUG test is associated with the onset of new functional dependence, poor health status, and increased risk of death in seniors without ESRD.[6,32] In other words, using these measures routinely may be helpful in identifying seniors on dialysis who are at high risk of subsequently developing disability and other adverse outcomes. Further prospective studies are needed to confirm this.

To our surprise, only 5% of the dialysis population studied had no functional impairment of any type. Although there are too few patients to draw clear conclusions, it appears that these patients had a lower burden of vascular comorbidity despite having been on renal replacement therapy for a longer period of time. Owing to the cross-sectional nature of our data, these observations must be interpreted with caution until longitudinal data are available. Our data show that the most common dependency was for basic household maintenance tasks; however, more than half of the study participants were dependent in at least one of the core ADLs, namely walking, transferring, bathing, and dressing. When compared to a population-based sample of 8900 Canadian seniors of similar age, the dialysis patients in our study had higher frequencies of dependency in all tasks except eating, grooming, using the telephone, and walking outside.[33] All of the subjects with ADL disability were also dependent in IADLs. Instrumental activities are often compromised more frequently and earlier in the disablement process than basic self-care functioning.[14,33] With the exception of a single subject who reported toileting dependence related to occasional bladder incontinence requiring the use of pads, all of our subjects followed known patterns of ADL dependence where bathing is the most commonly impaired basic ADL and independent feeding and grooming the least likely to be impaired.[6,34] In our study, more patients reported difficulty walking 50 yards either indoors or outdoors than those who reported difficulty

walking outdoors. This, while seeming paradoxical, likely relates to the fact that dialysis patients are often housebound and when they do leave their homes (for example, for dialysis), the distances walked are often much shorter than 50 yards. By recognizing these patterns of functional decline, clinicians may be able to quickly identify patients who have higher versus lower levels of disability and associated risk for poor health outcomes.

Predictors of ADL deficits included polypharmacy, poor mobility performance, and low education. Diabetes, age, depressive symptoms, and cognitive impairment did not have significant associations when adjusted for other variables. Performance measures of mobility were most strongly associated with ADL deficits. This appears logical as basic personal care often involves walking or moving around. The association between low education level and ADL dependence has been previously reported in renal and non-ESRD populations and may reflect social determinants of independence.[14,35] Age has been previously associated with functional dependence; however, these studies were not limited to older patients.[11,13,14,21] A screen for depressive symptoms was not associated with functional dependence. If a true relationship exists, the depressive symptoms identified in this sample may not have been sufficiently severe as to interfere with self-care activities.

We found that patients were prescribed an average of $11 \pm 4$ medications. Nearly one-quarter reported that they needed assistance with taking their medications and 6% felt that they 'were completely unable' to do this task themselves. We did not anticipate that so many patients would feel that they could not manage medications themselves, and had unfortunately not included any data collection around actual adherence or the methods patients used to organize medication administration. We examined, *post hoc*, potential associated factors with self-reported difficulties in managing medications using a multivariable logistic regression model (data not shown). Variables examined included comorbidity, polypharmacy, depressive symptoms, cognitive impairment, arthritis, and having any vision diagnosis. Our results suggested a positive but nonsignificant association with the presence of depressive symptoms and vision problems (defined as at least one of diagnosed cataract, retinopathy, or macular degeneration), and a positive association with the number of comorbidities. Importantly, cognitive impairment, the number of medications, and a diagnosis of arthritis were not associated with self-reported difficulties in medication management.

We were particularly interested in the relationship between cognitive impairment and disability in self-care activities. Cognitive impairment is common in dialysis patients and we anticipated a relationship between impaired cognition and ADL disability.[36,37] In univariate comparisons, cognitive impairment was associated with functional dependency, but this association became nonsignificant when adjusted for other factors, including education. This aspect of function does require further evaluation, particularly as our study protocol used the MMSE to evaluate cognitive function. This measure is less sensitive than tests such as the modified mini mental state examination or psychometric tests, and thus we may have underestimated the degree of cognitive impairment present.

Our study has several limitations. We studied the prevalent dialysis patients and therefore, by excluding those who may have died early in the course of their dialysis history, introduced a survival bias into the study. This is likely to cause an underestimation of the severity of disability, as higher levels of disability are associated with increased mortality.[24] We are also unable, due to the cross-sectional study design, to comment on the dynamic nature of disability over time. Both improvement and deterioration in disability are known to occur.[38,39] Thus, our disability prevalence estimate includes both those who had transient disability (for example, due to a recent illness) and those with chronic, persistent disability. Although a limitation, transient disability has been shown to be highly predictive of recurrent or chronic, persistent disability and is therefore in itself of concern. In addition, it has been observed that single measures of prevalent disability tend to underestimate the true burden of disability when subjects are followed over time.[22] We are also unable to comment as to whether some of the disability measured may be directly related to the dialysis process. We minimized any potential measurement error by consistently collecting data on a dialysis day; however, in a study of 104 patients, Thomas-Hawkins[15] showed that functional status varied throughout the dialysis week, with increased disability just before dialysis. Lastly, functional impairment was based on self-report and not on observed function. In this regard, there are two points of importance: first, self-report has been shown to be valid in non-dialysis populations;[40] second, studies correlating functional impairment with clinical outcomes, such as need for nursing home care or increased mortality, have used self-report assessments.[9] We also believe that any bias, if present, is likely to be in the direction of underestimation of disabilities rather than overestimation, as patients, particularly those with multiple comorbidities or cognitive impairment, tend to underestimate the severity of their functional disabilities.[41] We did not measure caregiver burden. From the data presented, we found that many of the study participants were primarily living in their own homes or apartments and needed significant help. It is highly likely that these patients depend heavily on informal and community supports.[29] The caregiver burden among dialysis staff and families is high.[17,42]

In summary, our data suggest that the majority of older dialysis patients have disability in tasks necessary for independent living. Functional independence appears to be the exception rather than the rule. Most older dialysis patients had high levels of comorbidity, polypharmacy, and markers of frailty (for example, deficits in mobility and strength). Given the strong relationship between disability and outcomes such as hospitalization and mortality, routine assessment of functional status may identify vulnerable

seniors, alter patient and family expectations of how elderly individuals fare on dialysis, and also help with long-term care planning. The strong association between TUG performance and core ADL disability suggests that performance measures could be useful in identifying seniors at risk for disability and that interventions targeting basic impairments such as strength, balance, and mobility could be powerful mediators of the disablement process; however, further prospective studies will be necessary before clear guidelines can be established.

## MATERIALS AND METHODS

### Study population

This cross-sectional study was conducted as part of a longitudinal cohort study examining the burden of falls in elderly dialysis patients.[23] All incident and prevalent patients aged 65 years or more receiving chronic outpatient hemodialysis treatment at the University Health Network during the period 9 April 2002 to 9 April 2003 were eligible for participation. Patients were excluded if they were unable or unwilling to provide informed consent. Ethics approval was granted by the University Health Network Research Ethics Board.

### Baseline data collection

Baseline assessments were conducted by a research study nurse using standardized protocols. Tests of physical performance were measured immediately before dialysis, and interview-based information was collected during dialysis. The medical history, including cause of ESRD, comorbid conditions, and laboratory values, was abstracted from clinical and electronic chart records. A complete medication history was recorded for each subject. All patients were asked to participate in a full geriatric evaluation including structured interviews to ascertain: living status, years of education attained, and history of falls in the previous 12 months.[43] Depressive symptoms were assessed with the Mental Health Inventory using a cutoff score of $\geqslant 3/6$.[44] Cognitive assessment was performed using the Folstein MMSE.[45] Using a method validated in non-renal geriatric patients, MMSE scores were compared with predicted values after adjustment for age, gender, and education.[46] Patients were defined as having cognitive impairment if measured scores were $<85\%$ of the predicted value.[46]

Mobility impairment was measured using a test of functional mobility (the TUG test).[47] Further tests were used to characterize physical performance, including standing balance (the tandem stance) and lower extremity power (chair stands).[6,43] The TUG test requires the subject to stand from a chair, walk 10 feet (3 m), and return to the seated position. Completion of the task is timed and scores $<10$ s are considered normal.[47] In the tandem stance test, patients are asked to maintain a standing position with one foot directly in front of the other for 10 s without external support.[43] Chair stands were evaluated by asking the subject to rise independently from a chair of standard height and seat depth without the use of their arms or an aid within 3 s. For each of the three tasks, patients were given a total of three attempts and the best performance was used for analysis. Impairment was defined as the inability to complete the task appropriately. Patients who were unable to attempt the task were also deemed as impaired.

Information on self-reported functional status for basic and instrumental activities of daily living was obtained using structured interviews with the Barthel Index (ADL)[48] and the Lawton-Brody Instrumental Activities of Daily Living Scale (IADL).[5] For the latter, subjects were asked if they could perform each task (telephone use, transportation (that is, travel alone via bus, taxi, or drive a car), shopping, meal preparation, housework, laundry, medication, and money management) without any help, with help, or whether they were completely unable to perform the activity. Subjects were considered to be 'dependent' for a given function if they needed supervision or assistance with or were unable to complete the task. For the evaluation of associated factors, functional impairment was considered to be present in the case of dependency in transferring or dressing or bathing activities[22] and walking 50 yards. This definition of functional impairment was chosen because these particular activities are the most commonly impaired basic self-care activities in the elderly.[6]

### Analysis

Differences among baseline factors when grouped by disability status were measured using the two-sample *t*-test for continuous variables, the Wilcoxon rank-sum normal approximation for dichotomous variables, and the $\chi^2$ test for categorical variables. Predictor variables were chosen based upon previous non-renal geriatric literature and the renal literature. These included cognitive impairment, depressive symptoms, polypharmacy, and mobility impairment[18,19] and age, gender, education level, and diabetes, respectively.[10–15,21] Contingency tables and box plots were used to examine the distribution of ADL dependency with respect to the other measured clinical factors and to examine for collinearity among independent variables. Univariate associations between predictor variables and the presence of disability were measured with crude ORs. Logistic regression was used to examine the association between all eight predictor variables and the likelihood of dependency in at least one of the four core ADLs (bathing, dressing, transferring, and ambulating). By fitting this model, a regression coefficient was obtained for each variable. Regression estimates show a change in the odds of having at least one core ADL disability for every 1-unit increase in the continuous variables (age, education, and number of medications) and in the presence of the categorical variables (diabetes, mobility impairment, depressive symptoms, and impaired cognition). The log likelihood ratio was used to assess the significance of the association fitted by the model. Significance of the individual regression estimates was tested by Wald statistics. A secondary analysis excluding the TUG mobility test was also performed, as mobility performance is rarely measured in dialysis patients in clinical practice. Analyses were performed using SPLUS statistical software (2005, v 7.0; Insightful Corp., Seattle, WA, USA).

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