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Correlates of ADL difficulty in a large hemodialysis cohort

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Abstract

Needing assistance with activities of daily living (ADL) is an early indicator of functional decline and has important implications for individuals' quality of life. However, correlates of need for ADL assistance have received limited attention among patients undergoing maintenance hemodialysis (HD). A multicenter cohort of 742 prevalent HD patients was assessed in 2009–2011 and classified as frail, prefrail and nonfrail by the Fried frailty index (recent unintentional weight loss, reported exhaustion, low grip strength, slow walk speed, low physical activity). Patients reported need for assistance with 4 ADL tasks and identified contributing symptoms/conditions (pain, balance, endurance, weakness, others). Nearly 1 in 5 patients needed assistance with 1 or more ADL. Multivariable analysis showed increased odds for needing ADL assistance among frail (odds ratio [OR] 11.35; 95% confidence interval [CI] 5.50–23.41; $P < 0.001$) and prefrail (OR 1.93; 95% CI 1.01–3.68; $P = 0.046$) compared with non-frail patients. In addition, the odds for needing ADL assistance were lower among blacks compared with whites and were higher among patients with diabetes, lung disease, and stroke. Balance, weakness, and "other" (frequently dialysis-related) symptoms/conditions were the most frequently named reasons for ADL difficulty. In addition to interventions such as increasing physical activity that might delay or reverse the process of frailty, the immediate symptoms/conditions to which individuals attribute their ADL difficulty may have clinical relevance for developing targeted management and/or treatment approaches.

Key words: Activities of daily living, frailty, hemodialysis, symptoms/conditions

INTRODUCTION

Needing assistance with activities of daily living (ADL), i.e., difficulty carrying out routine self-care activities that are essential for independent living, is an early indicator of functional decline, with important implications for individuals' quality of life. The need for ADL assistance has been shown to overlap with the presence of frailty, a syndrome that connotes heightened vulnerability to a number of adverse health outcomes.[1] The presence of a chronic health condition is associated with greater likelihood of need for ADL assistance and frailty, as evidenced in studies of individuals with chronic kidney disease (CKD).[2–5] Need for ADL assistance has received limited attention among patients undergoing maintenance hemodialysis (HD), however.

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A recent study of a single-center cohort of 146 patients undergoing HD reported that the prevalence of ADL difficulty was 26.2% among individuals classified as frail, compared with ca. 14% of individuals classified as prefrail or nonfrail.[6] However, those data were not adjusted for other patient characteristics, and no information was provided about other correlates of ADL difficulty. In a large multicenter cohort of HD patients, we investigated the association of reported ADL difficulty with frailty as well as with multiple demographic and clinical correlates. We also determined categories of major symptoms/conditions to which patients attributed their need for ADL assistance, which may provide critical information for developing more targeted approaches to reduce and manage ADL difficulty issues.[7]

MATERIALS AND METHODS

Participants

ACTIVE/ADIPOSE (A Cohort Study to Investigate the Value of Exercise in ESRD/Analyses Designed to Investigate the Paradox of Obesity and Survival in ESRD) is a multicenter study of prevalent patients on HD coordinated by the United States Renal Data System (USRDS).[8] The data collection sites are 7 outpatient dialysis clinics in the Atlanta, Georgia metropolitan area, and 7 outpatient dialysis clinics in the San Francisco Bay Area, California, at which 771 prevalent HD patients were enrolled and participated in baseline assessments during 2009–2011.

Study participants were adults (≥18 years old), English- or Spanish-speaking, on HD for at least 3 months, and capable of giving informed consent. Exclusion criteria were current treatment by peritoneal dialysis or home HD, evidence of active malignancy, and expected geographic relocation; vulnerable populations (pregnant women, prisoners, persons with significant mental illness) were also excluded. Potentially eligible patients receiving outpatient HD treatment at the study clinics during the 2-year enrollment period were given information about the study and invited to participate. Double amputees and patients with prior or pending transplantation were considered eligible. Among eligible patients undergoing HD at the study clinics during the 2-year enrollment period, 85% supplied informed consent and were enrolled. Reasons most frequently given by those who declined to participate were that they were "not interested," "too busy," or "enrolled in another study."

Institutional Review Boards at Emory University and the University of California-San Francisco approved the study, and all participants provided written informed consent. Among participants who gave consent, study coordinators conducted a brief interview, measured physical performance and body composition, and reviewed medical records. This report focuses on 742 participants who responded to an interview item that asked about current need for ADL assistance and for whom information about frailty was available. Characteristics of the remaining 29 study participants were not significantly different from characteristics of participants included in this analysis.

Measures

Activities of daily living

Study participants were asked: "At the present time, do you need help from another person (1) to bathe (wash and dry your whole body)?; (2) to dress (like putting on a shirt or shoes, buttoning, and zipping)?; (3) to get in and out of a chair?; (4) to walk around your home or apartment?" Need for ADL assistance was indicated by a response of "yes, need help" or "unable to do" to one or more items.[1,9]

Following a response of "yes, need help" or "unable to do" to any of the four ADL tasks, participants were asked, "If you need help or are unable to do, what is the main symptom or condition that causes you to have difficulty or prevents you from doing the activity?" Open-ended responses to this question were grouped into 5 categories as defined by Leveille et al.: pain, balance, endurance, weakness, and other symptoms. Consistent with the Leveille et al. methodology, responses for an individual ADL task could include multiple symptom/condition categories.[7]

Frailty

The Fried frailty index includes (1) shrinking, 10 pounds or greater unintentional weight loss in the past 12 months; (2) poor endurance and energy, based on self-reported exhaustion measured by 2 items from the Center for Epidemiologic Studies Depression scale; (3) weakness, defined as dynamometer-measured grip strength of participants scoring in the lowest quintile (adjusted for sex and body mass index [BMI]); (4) slowness, defined as timed walk speed of participants in the slowest quintile on a 15-foot walk (adjusted for sex and height); and (5) low physical activity, defined as the lowest quintile (for each sex) of a weighted score of kilocalories expended per week in physical activities "you have done in the past 2 weeks" as reported on the Minnesota Leisure Time Activity questionnaire. In the absence of established consensus on population cutpoints for weakness, slowness, and physical activity, Fried et al. defined the lowest quintile of these distributions on these indicators as being indicative of

frailty.[1] Consistent with other investigations of frailty, participants unable to walk were classified in the slowest quintile for that indicator.[10] The Fried methodology defines participants positive for 3 or more indicators of the 5 indicators as "frail" and defines participants positive for 1 or 2 indicators as being in "an intermediate, possibly prefrail, stage clinically."[1]

Demographic and clinical covariates

Demographic variables including race, gender, and age were ascertained from patient report and the USRDS Medical Evidence Standard Analysis Files. Race was patient-reported; for the small number of participants who declined to specify their race, race information was taken from the USRDS Medical Evidence file. Age was categorized as ≥65 vs. <65. Patients reported the highest education level that they had attained and their smoking history. Comorbidities abstracted from clinic medical records included diabetes, chronic obstructive pulmonary disease (COPD), and cardiovascular conditions, i.e., congestive heart failure (CHF), coronary artery disease (CAD)/myocardial infarction (MI), cerebrovascular accident (CVA)/transient ischemic attack (TIA), peripheral vascular disease (PVD), and other cardiac disease (cardiac dysrhythmia, atrial fibrillation, tachycardia, pericarditis, cardiac arrest).

Study coordinators measured patients' standing height and obtained weight values from the medical chart. BMI was categorized as <18.5, 18.5–24.9, 25.0–29.9, and ≥30 kg/m^2.

Statistical analysis

Sociodemographic and clinical characteristics of the study cohort, including frailty classification, were described using summary statistics (% and mean [SD]). The association of frailty classification, race, and covariates with need for ADL assistance was estimated in univariable and multivariable logistic regression models. Potential interactions between frailty and race, age, and race, and frailty and BMI were examined. Percentages of white and black participants who reported each symptom/condition cause of ADL difficulty were compared by chi-square analysis. Statistical analyses were conducted using SAS 9.3 (SAS Institute, Cary, NC, USA).

RESULTS

Participants

Participant characteristics are summarized in Table 1. The study cohort was similar to the overall US population of in-center HD patients in gender composition (59% and 56% men, respectively, in the study cohort and in the overall population), and 72% and 74% of patients, respectively, had diabetes or hypertension as primary cause of end-stage renal disease (ESRD). Participants ranged in age from 20 to 92. Blacks and patients of other races had higher representation than in the overall population (62% black and 14.6% other in the study cohort vs. 38% black and 7.1% other in the overall population), reflecting the demographics of the selected study sites. Participants' median time since ESRD treatment start was 3 years.

Table 1 Characteristics of ACTIVE-ADIPOSE hemodialysis cohort (N = 742)

Frailty classification (%)	
Nonfrail (positive for 0 frailty indicators)	27.6
Prefrail (positive for 1–2 frailty indicators)	58.4
Frail (positive for 3 + frailty indicators)	14.0
Race (%)	
White	23.7
Black	61.7
Native American	0.4
Asian	11.3
Other (Native Hawaiian, other Pacific Islander, other)	2.8
Male (%)	59.4
Age, mean (SD)	57.2 (14.1)
Age ≥65 (%)	28.4
At least high school education (%)	76.1
Current smoker (%)	18.0
Diabetes (%)	50.7
COPD (%)	8.1
CHF (%)	28.8
CAD/MI (%)	27.2
CVA/TIA (%)	10.4
PVD (%)	9.6
Other cardiac disease (%)	25.9
BMI (%)	
<18.5	1.2
[18.5, 25]	31.4
[25, 30]	29.9
≥30	37.5
Reported need for ADL assistance (≥1 ADL task) (%)	18.5

ADL = activities of daily living; BMI = body mass index; CAD = coronary artery disease; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; MI = myocardial infarction; other cardiac disease = cardiac dysrhythmia, atrial fibrillation, tachycardia, pericarditis, cardiac arrest; PVD = peripheral vascular disease; TIA = transient ischemic attack.

Correlates of reported need for ADL assistance

Patients classified as frail or prefrail were more likely to report needing ADL assistance compared with patients who were not positive for any of the frailty indicators. For patients classified as frail compared with patients classified as nonfrail, unadjusted and multivariable-adjusted odds for needing ADL assistance were 18.11 (95% CI 9.15–35.86; P < 0.001) and 11.35 (95% CI 5.50–23.41; P < 0.001), respectively. For patients classified as prefrail compared with patients classified as nonfrail, unadjusted and multivariable-adjusted odds for needing ADL assistance were 2.69 (95% CI 1.45–5.00; P = 0.002) and 1.93 (95% CI 1.01–3.68; P = 0.046), respectively (Table 2). Interactions of frailty and age (P = 0.52), frailty and race (P = 0.36), and frailty and BMI (P = 0.37) were not significant.

In unadjusted analyses, black race was associated with lower odds for needing ADL assistance, and older age, diabetes, COPD, CHF, CAD/MI, CVA/TIA, PVD, and other cardiac disease were associated with higher odds for needing ADL assistance. There was a borderline association between higher educational level and decreased likelihood of needing ADL assistance.

In multivariable-adjusted analyses, black race (0.56 [95% CI 0.33–0.93; P = 0.03) remained associated with lower odds for ADL difficulty. Three clinical variables were

Table 2 Unadjusted and multivariable-adjusted associations of patient characteristics with reported need for ADL assistance: ACTIVE-ADIPOSE hemodialysis cohort

	Need for ADL assistance	
Characteristics	Unadjusted OR (95% CI); P value	Adjusted OR (95% CI); P value
Frailty classification		
Nonfrail (reference)	1.00	1.00
Prefrail	2.69 (1.45, 5.00); 0.002	1.93 (1.01, 3.68); 0.046
Frail	18.11 (9.15, 35.86); <0.001	11.32 (5.49, 23.32); <0.001
Race		
White (reference)	1.00	1.00
Black	0.48 (0.31, 0.73); <0.001	0.56 (0.34, 0.94); 0.03
Other	0.81 (0.46, 1.42); 0.45	0.84 (0.43, 1.65):0.61
Gender		
Male (reference)	1.00	1.00
Female	1.30 (0.89, 1.88); 0.18	1.29 (0.82, 2.04); 0.27
Age ≥65	1.91 (1.30, 2.81); 0.001	0.89 (0.54, 1.46); 0.65
At least high school education	0.66 (0.44, 0.998); 0.05	0.69 (0.42, 1.13); 0.14
Current smoker	0.81 (0.49, 1.35); 0.42	0.99 (0.54, 1.84); 0.98
Diabetes	2.39 (1.61, 3.54); <0.001	1.83 (1.12, 2.99); 0.02
COPD	3.62 (2.09, 6.29); <0.001	2.91 (1.49, 5.66); 0.002
CHF	1.75 (1.18, 2.58); 0.005	0.94 (0.58, 1.54); 0.82
CAD/MI	2.28 (1.54, 3.36); <0.001	1.29 (0.77, 2.15); 0.33
CVA/TIA	2.91 (1.75, 4.83); <0.001	2.12 (1.13, 3.99); 0.02
PVD	3.85 (2.30, 6.43); <0.001	1.63 (0.85, 3.15)..14
Other cardiac disease	2.73 (1.85, 4.04); <0.001	1.56 (0.93, 2.62); 0.09
BMI		
<18.5	1.29 (0.26, 6.45); 0.75	1.03 (0.18, 5.98); 0.97
[18.5, 25] (reference)	1.00	1.00
[25, 30]	0.80 (0.49, 1.32); 0.38	0.58 (0.32, 1.06); 0.08
≥30	1.29 (0.81, 1.95); 0.31	0.95 (0.56, 1.63); 0.86

N = 730 participants with information for all covariates.
ADL = activities of daily living; BMI = body mass index; CAD = coronary artery disease; CHF = congestive heart failure; CI = confidence interval; COPD = chronic obstructive pulmonary disease; CVA = cerebrovascular accident; MI = myocardial infarction; other cardiac disease = cardiac dysrhythmia, atrial fibrillation, tachycardia, pericarditis, cardiac arrest; OR = odds ratio; PVD = peripheral vascular disease; TIA = transient ischemic attack.

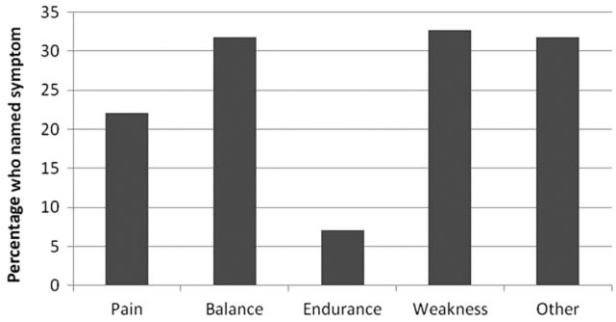

Figure 1 Symptoms/conditions named as causes of ADL difficulty by prevalent hemodialysis patients, ACTIVE-ADIPOSE study. ADL = activities of daily living. Examples of "Other" responses: "need to protect catheter," "graft in chest," "foot infection," "had surgery," "broken hip," "broken leg," "double amputee," "vision not good."

associated with higher odds for ADL difficulty: diabetes (OR 1.85 [95% CI 1.14–3.03]; P = 0.01), COPD (OR 2.99 [95% CI 1.54–5.83]; P = 0.001), and CVA/TIA (OR 2.13 [95% CI 1.13–4.00]; P = 0.02) (Table 2).

Symptoms/conditions named as reasons for needing ADL assistance

Figure 1 shows the proportion of patients who named each of the 5 specific symptoms/conditions as reasons for needing ADL assistance. Balance, weakness, and "other" conditions were most frequently cited. Among patients who named "other" conditions, amputations and dialysis access-related issues were most frequently named (Table 3). One fifth of participants who needed ADL assistance cited multiple symptom/condition categories as reasons.

Table 4 compares the percentage of whites and blacks who reported the five specific symptoms/conditions as reasons for needing ADL assistance. Balance was named more often by whites than by blacks (45.6% vs. 22.4%; P = 0.009), but no race differences were evident in frequency of naming pain, endurance, weakness, or other reasons for experiencing difficulty with ADL tasks.

DISCUSSION

Linkage of ADL difficulty with frailty has been shown in multiple studies of community dwelling adults, including both CKD and non-CKD samples.[1,2,5,11–16] A recent study of 146 HD patients suggested an association between need for ADL assistance and frailty (P = 0.19).[6] Among 742 HD patients in the ACTIVE-ADIPOSE cohort, we found that the odds of needing ADL assistance were 11.3- and 1.9-fold greater for participants classified as frail or prefrail, respectively, compared with those classified as nonfrail.

Black participants had lower odds for reporting difficulty carrying out ADL tasks, independent of frailty status. Blacks and whites did not differ significantly in mean (SD) serum albumin concentration, body mass index, or waist

Table 3 "Other" symptoms/conditions that were named by study participants as reasons for their ADL difficulty

Symptom/Condition	Number of mentions*
Amputation	13
Double amputee	
Single amputee	
Foot amputated	
Dialysis access issue	7
Need to protect catheter	
Can't get catheter wet	
Catheter in chest needs dressing	
Graft placement	
Vision problems	5
Blind	
Vision not good	
Fracture	2
Broken hip	
Broken leg	
Recent surgery	2
Had surgery (not specified)	
Surgery on arm	
Infection	2
Staph infection	
Foot infection	

*Some participants named more than one type of other symptom/condition.
ADL = activities of daily living.

Table 4 Percentage of white and black hemodialysis patients who reported each of five categories of symptoms/conditions as reasons for their ADL difficulty

Symptoms/conditions	Whites (n = 46) (%)	Blacks (n = 67) (%)	P value
Pain	17.4	25.4	0.32
Balance	45.7	22.4	0.009
Endurance	8.7	6.0	0.58
Weakness	28.3	35.8	0.40
Other	26.1	20.9	0.52

Examples of "Other" responses are "need to protect catheter," "graft in chest," "foot infection," "had surgery," "broken hip," "broken leg," "double amputee," "vision not good."
ADL = activities of daily living.

circumference, but blacks had higher mean (SD) serum creatinine concentration than whites (10.5 [3.6] vs. 8.6 [3.1]; $P < 0.0001$), whereas whites were more likely than blacks to be currently employed (13.7% vs. 7.6%; $P = 0.02$) [Correction added on 18 December 2013, after first online publication: patient category with (SD) serum creatinine concentration of 8.6 [3.1] was corrected to "whites"]. A race/sex difference was evident for the muscle weakness component of the Fried frailty index. Only 29.4% of black men, but 59.3% of white men, scored ≤30 kg on grip strength, and only 46.0% of black women, but 72.9% of white women, scored ≤20 kg on grip strength, sex-specific cutpoints that have been suggested as optimal to identify sarcopenia.[16] No consistent race-sex differences were evident for the remaining frailty components. The average age of participants was lower among blacks, but age was adjusted in the analysis. Our finding of a race difference in ADL difficulty is consistent with the black/white difference in reported ADL-mobility difficulty that we previously observed among dialysis patients aged 60 and older[17] and, more generally, with research that has indicated better health-related quality of life among blacks compared with whites on dialysis.[18,19]

Balance, weakness, and "other" symptoms/conditions, followed by pain, were the categories most often cited by patients as contributing to ADL difficulty. Endurance was least often named, which was also true among the Women's Health and Aging Study participants in the research reported by Leveille et al.[7] Balance and pain are not specifically addressed by criteria included in the Fried frailty index, and these symptoms/conditions may add important information for understanding contributors to ADL difficulty among HD patients. In addition, it is possible that participant mentions of "weakness" or being "weak" represent symptoms different from those captured by the muscle strength weakness component of the Fried index, e.g., weakness associated with stroke or with blood pressure and/or electrolyte changes that are common in dialysis patients. Symptoms/conditions classified as "other" included dialysis-related issues, especially limitations associated with the dialysis access (catheter, graft), acute conditions such as an infection or fracture, and longer standing conditions such as vision limitations and amputations.

The likelihood of ADL difficulty was 2–3 times greater for ACTIVE-ADIPOSE participants with diabetes, COPD, and CVA/TIA. Diabetes may limit daily activities through a variety of pathways. COPD is likely to be associated with endurance-related ADL difficulty. Both diabetes and stroke may contribute to weakness, which was the symptom/condition cited most frequently by black patients. Balance difficulty, on the contrary, was named significantly more often by whites compared with blacks ($P = 0.009$), as Leveille et al. also found.[7]

The ACTIVE-ADIPOSE study has several strengths, including the successful enrollment and evaluation of over 700 patients at 14 dialysis clinics. Most of the patients who were approached agreed to participate. Study participants were receiving HD at outpatient dialysis clinics, which is true of the majority of treated ESRD patients in the United States.[20] Data collection included performance-based assessment of muscle strength and gait speed as specified by the Fried methodology, and a large number of treatment-related factors were assessed.

Gill and Gahbauer reported high reliability for the ADL measure and noted that difficulty in additional tasks, including eating, toileting, and grooming, would be uncommon in the absence of difficulty as assessed by the 4-item measure.[9] To our knowledge, the categories of symptoms/conditions contributing to need for ADL assistance that were identified by Leveille et al.[7] have not been previously applied in a study of patients undergoing dialysis, but we found the categories to be exhaustive in encompassing the reasons that ACTIVE-ADIPOSE participants named for needing assistance with ADL tasks. In applying the Fried index, we used the lowest quintiles of the muscle weakness, walk speed, and physical activity distributions in our study population to define frail status on these components rather than using the cutpoints for these components that corresponded to the lowest quintiles among older adults who participated in the Cardiovascular Health Study (CHS) as reported by Fried et al. in their appendix.[1] The approach we used, which has been applied in other studies as well,[10] defines frailty on these three dimensions relative to the range of performance measured in the study population of interest (in this case, prevalent HD patients) rather than relative to the range of performance measured among "relatively functional" community-dwelling adults (i.e., CHS participants).

A limitation of our study is that the data were reported by participants at one time point. Difficulty in functioning is likely to be a dynamic process, with transitions between episodes of difficulty and recovery. Among 357 community-dwelling older adults who participated in the UAB Study of Aging, more participants with measured estimated glomerular filtration rate (eGFR) = <60 mL/minute/1.73 m^2 had an increase over the subsequent 2 years in the number of ADL activities with which they had difficulty than did participants with higher eGFR at baseline (20% vs. 7%).[4] Among patients with kidney disease, longitudinal analyses could be especially important for

assessing the significance of body composition for ADL difficulty over time. An analysis of longitudinal data for 11,491 community dwellers aged 50+ who participated in the Health and Retirement Study indicated that some excess body weight in later life reduced the rate of ADL disability among prefrail and frail adults over an 8-year follow-up.[15]

Dependence in self-care activities has been shown to characterize elderly HD patients,[17,21] but data from ACTIVE-ADIPOSE show that need for ADL assistance/ADL difficulty is not uncommon among more middle-aged HD patients. There are different views about whether functional decline is inherently part of the concept of frailty or should be viewed as an outcome associated with frailty.[22] Fried et al. have argued that functional decline and frailty are distinct clinical entities, although interrelated, and that clinical management of each has its own unique content and challenges.[23] Progressive loss of muscle strength, a cardinal element of the frailty syndrome proposed by Fried et al., may predispose an individual to ADL difficulty. However, factors such as impaired balance and weakness that have an immediate and noticeable impact on daily functioning are more proximal to ADL difficulty end-points.[7] We found that "other" conditions, often dialysis-related, also were among the most frequently named reasons for ACTIVE-ADIPOSE participants' reported ADL difficulty. In addition to interventions such as increasing physical activity that might delay or reverse the process of frailty, the symptoms/conditions to which individuals attribute their ADL difficulty could have clinical relevance for developing targeted management and/or treatment approaches.

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