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Incidence, Risk Factors, and Treatment of Achilles Tendon Rupture in Patients with End-Stage Renal Disease

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Abstract

Background—Dialysis-dependent patients and kidney transplant recipients may be at increased risk for Achilles tendon rupture (ATR).

Methods—We studied Medicare patients with ESRD from 1999 through 2013. Patients were categorized as waitlisted for a transplant, not waitlisted, or received a transplant. We performed multivariate negative binomial regression using demographic characteristics, comorbidities, and year of study entry to estimate adjusted incidence rate ratios (aIRRs), identify ATR risk factors, and determine treatment patterns and outcomes.

Results—We identified 1091 ATRs (incidence, 3.80/10,000 person-years; 95% confidence interval [CI], 3.58–4.03). Compared with transplant recipients, non-waitlisted patients had lower incidence (aIRR, 0.44; 95% CI, 0.37–0.53), and waitlisted patients had similar incidence (aIRR, 0.94; 95% CI, 0.78–1.12) of ATR. ATR incidence was higher among patients taking fluoroquinolones (aIRR 1.65; 95% CI, 1.32–1.84) and corticosteroids (aIRR 1.72; 95% CI, 1.44–2.05) compared with those who did not. Patients with ATR were younger, had higher mean body mass index, and had fewer comorbidities than patients without ATR. Seventeen percent of patients received operative treatment within 14 days of ATR diagnosis. The 30-day cumulative incidence of operative site infections was 6.5%.

Conclusion—The incidence of ATR was higher among transplant recipients and waitlisted patients compared with non-waitlisted patients. Younger age, higher body mass index, fewer comorbidities, fluoroquinolone use, and corticosteroid use were risk factors for ATR. Patients were more likely to receive nonoperative than operative treatment for ATR. Those who underwent operative treatment had a low incidence of operative site infection.

Level of Evidence—Prognostic level III Comparative Study

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Keywords

Achilles tendon rupture; dialysis; end-stage renal disease; kidney transplant

INTRODUCTION

The incidence of Achilles tendon rupture (ATR) in the general population is 7–13 per 100,000 person-years^{19,20,34}. ATRs typically occur in young or middle-aged sporadic athletes or “weekend warriors”^{8,28}. There is evidence that the incidence of ATR is increasing as individuals maintain their athletic pursuits later in life^{13,18}. There is also evidence of decreasing rates of operative treatment, likely related to high-quality trials showing the equivalence of operative and nonoperative treatments for acute ATR^{13,23,32}.

It has been suggested that patients with end-stage renal disease (ESRD) are at greater risk of ATR. An association between kidney disease and spontaneous ATR has been documented in many case reports^{3,4,11,17,33}. Corticosteroid and fluoroquinolone use are known risk factors for tendon rupture, and both of these medications are commonly prescribed for patients with kidney disease or after a kidney transplant^{5,31}. Additionally, chronic kidney disease and maintenance dialysis create multiple metabolic abnormalities, particularly hyperparathyroidism, that appear to increase the risk for tendon rupture¹⁵.

The epidemiology of ATR in the ESRD population has not been fully characterized. There are potential differences in causes of, risk factors for, and treatment of ATR in the general population versus the ESRD population. The lifetime risk of advanced chronic kidney disease and ESRD is high and expected to rise with the aging population⁹; therefore, an understanding of ATR in this population is important. We speculate that these conditions may influence the orthopaedic surgeon’s choice of treatment of ATR in ESRD patients. Per American Academy of Orthopaedic Surgeons Clinical Practice Guidelines, both operative and nonoperative treatments are options for acute ATR; however, clinicians may hesitate to perform surgery, particularly for ESRD patients. It is unclear whether ESRD is a valid contraindication for surgery.

We conducted an epidemiological study using a comprehensive national registry database of ESRD patients. Our goals were to: 1) estimate the incidence of ATR in the ESRD population, 2) identify associated risk factors (i.e., age, sex, race, body mass index, cause of ESRD, and comorbidities), and 3) describe treatment type and incidence of operative site infection (SSI) among patients with ESRD. We hypothesized that patients waitlisted for transplant would be less likely to undergo operative repair of ATR than non-waitlisted patients because surgery could harm their chances for a transplant. We also hypothesized that the rates of surgery would decrease during the study period, according to documented trends of decreasing rates of operative intervention after publication of randomized controlled trials demonstrating the effectiveness of nonoperative treatment²³.

METHODS

This study was deemed exempt from formal review by our institutional review board. All data were retrieved from the United States Renal Data System, a national registry of all patients with ESRD in the United States. We included all patients with ESRD who used Medicare Part A and B as their primary health insurance between January 1, 1999, and December 31, 2013. Demographic and comorbidity data were ascertained through the End Stage Renal Disease Medical Evidence Report, Medicare Entitlement and/or Patient Registration (form CMS-2728-U3), which must be filed for all patients within 45 days of an ESRD diagnosis. All patients were studied from their development of ESRD until death, end of Medicare primary coverage, or end of the study. Death was ascertained via the Social Security Death Master File.

Dialysis vs. Transplantation

Patients were categorized into the following 3 groups: 1) non-waitlisted (not on the transplant waitlist, never received a transplant), 2) waitlisted (on the transplant waitlist), or 3) transplant recipient ("transplanted"). Patients contributed time-at-risk in a time-varying manner in regression models. Patients could contribute person-time to multiple groups. For example, a patient on the waitlist for 2 years who then lived for 5 years after a transplant would contribute 2 and 5 years to the waitlisted and transplanted categories, respectively.

Patients were categorized in this way to help distinguish whether group differences in outcomes were the result of having undergone a transplant as opposed to selection bias. Patients who are waitlisted for a transplant or receive a transplant are typically healthier than patients not yet waitlisted for a transplant. Additionally, many patients' comorbidities prevent them from being eligible for transplant consideration. These categories allowed comparisons between patients of similar health status, with transplant as an independent variable.

Incidence of and Risk Factors for Achilles Tendon Rupture

We used Medicare Institutional and Physician/Supplier claims data to ascertain ATR events. ESRD patients are eligible for Medicare regardless of age, and more than a half use Medicare as their primary health insurance³⁰. The Medicaid claims of ESRD patients are incorporated into the United States Renal Data System Standard Analysis Files. ATRs were ascertained using *International Classification of Diseases, Ninth Revision, Clinical Modification*²⁵ (ICD-9-CM) diagnosis code 727.67 (nontraumatic rupture of Achilles tendon) and *Current Procedural Terminology*¹ (CPT) codes 27650 (repair, primary, open or percutaneous, ruptured Achilles tendon) and 27652 (repair, primary, open or percutaneous, ruptured Achilles tendon; with graft). We estimated the crude incidence, defined as the number of ATRs divided by the total time-at-risk, and its 95% confidence interval, by using univariate negative binomial regression. We subsequently performed multivariate negative binomial regression to estimate the adjusted incidence rate ratio (aIRR) among non-waitlisted, waitlisted, and transplanted groups and to identify risk factors for ATR. We included all potential confounders available in the database in our model: age, race, sex, body mass index (BMI) value, cause of ESRD, comorbidities (hypertension, diabetes,

congestive heart failure, atherosclerosis, peripheral vascular disease, cerebrovascular accident, chronic obstructive pulmonary disease, cancer, smoking status, alcohol dependence, drug dependence, inability to ambulate, and inability to be transferred), and year of study entry.

Treatment Modality

Among those who sustained an ATR, the patients whose records indicated a code of CPT 27650 or 27652 within 14 days of ATR diagnosis were considered to have received operative treatment⁸. We performed multivariate logistic regression, including age, race, sex, BMI value, cause of ESRD, and year of study entry to estimate the adjusted odds ratio (aOR) for receiving operative vs. nonoperative treatment among non-waitlisted, waitlisted, and transplanted groups and to identify factors associated with receipt of operative treatment.

We also reviewed the Medicare inpatient claims of patients who sustained ATR to ascertain whether they were admitted to the hospital within 14 days of diagnosis. We conducted multivariate logistic regression using the same set of covariables as the previous model to compare the odds of hospital admission among groups.

Fluoroquinolone and Corticosteroid Use

To characterize the associations of fluoroquinolone and corticosteroid use with ATR, we reviewed Medicare Part D Prescription Drug Coverage claims of the study cohort. Because Medicare Part D coverage started in January 2006, this analysis was restricted to 544,185 individuals (50%) with confirmed Medicare Part D enrollment until their last day of follow-up. We also reviewed the immunosuppression records of the transplanted group because corticosteroids are often used for maintenance immunosuppression, which is usually covered by Medicare Part A and B.

Use of fluoroquinolones and corticosteroids was treated as a time-varying exposure. That is, individuals were treated as unexposed until the first day of prescription and as exposed thereafter. Using the same method described above, we estimated the aIRR of ATR among non-waitlisted, waitlisted, and transplanted groups for those with Medicare Part D coverage. Then, we added fluoroquinolone/corticosteroid exposure as a covariable to examine whether exposure to the medications explains the differences in ATR incidence among non-waitlisted, waitlisted, and transplanted groups. Lastly, we stratified the population by fluoroquinolone/corticosteroid exposure to compare the aIRRs among those who were exposed to fluoroquinolones/corticosteroids versus those who were unexposed.

Operative Site Infection

Among patients who underwent operative treatment for ATR, we ascertained the incidence of SSI using ICD-9-CM code 998.59 (other postoperative infection). Patients whose records indicated this code within 30 days of the initial ATR diagnosis were considered to have developed a SSI.

Statistical Analyses

We compared baseline characteristics using Student *t* tests for continuous variables and chi-square tests for categorical variables. BMI values were missing for 8.7% of patients. These missing values were treated with a missingness indicator. Alpha level was set to 0.05. All analyses were conducted using Stata/MP for Unix, version 14.2, software (StataCorp LP, TX).

RESULTS

Study Population

We identified 1091 ATRs during 2,870,817 person-years of follow-up. Patients who sustained an ATR were significantly younger (61 vs. 68 years) and more likely to be white, to have a higher BMI (29 vs. 27 kg/m²), to have diabetes or glomerulonephritis as the cause of ESRD (53% vs. 45% and 10% vs. 7.8%, respectively), and to be ambulatory (5.7 vs. 2.6% nonambulatory) compared with uninjured patients (Table 1). Patients with ATR had fewer comorbidities than those without, with significantly lower prevalence of congestive heart failure, cancer, cerebrovascular accident, chronic obstructive pulmonary disease, hypertension, smoking, and atherosclerosis.

Incidence of Achilles Tendon Rupture

Overall, the crude incidence of ATR was 3.80 per 10,000 person-years (95% confidence interval [CI], 3.58–4.03). The non-waitlisted group had a lower crude incidence (2.91; 95% CI, 2.68–3.16) compared with that of the waitlisted (6.07; 95% CI, 5.35–6.90) and transplanted groups (5.22; 95% CI, 4.66–5.85) (Table 2). After adjusting for confounders, the incidence was significantly lower in the non-waitlisted group compared with the transplanted group (aIRR, 0.44; 95% CI, 0.37–0.53). The incidence was similar between the waitlisted and transplanted groups (aIRR, 0.94; 95% CI, 0.78–1.12).

Risk Factors for Achilles Tendon Rupture

Non-white race, male sex, osteoporosis, and current smoker status were factors associated with a lower risk of ATR. Compared with underweight/normal BMI (<25 kg/m²), higher BMI was associated with ATR in a dose-dependent manner. Patients with ESRD caused by diabetes mellitus were at higher risk for ATR compared with those with ESRD caused by glomerulonephritis. Peripheral vascular diseases and drug dependence were also risk factors for ATR (Table 3).

Treatment Modality

Of the 1091 patients who sustained ATR, 282 (26% of all ATRs) were admitted to the hospital within 14 days after ATR diagnosis. Of these, 217 patients (77% of admitted patients) had an ICD-9-CM or CPT code related to ATR, indicating that the reason for admission was related to the ATR as opposed to another cause. The non-waitlisted group was most likely to have ATR-related hospital admission (26%), followed by the waitlisted group (19%) and the transplanted group (9.4%). These differences were statistically significant after adjusting for potential confounders. Compared with the transplanted group,

the non-waitlisted group (aOR, 3.48; 95% CI, 2.13–5.69) and the waitlisted group (aOR, 1.98; 95% CI, 2.13–5.69) had higher odds of ATR-related hospital admission. There were no other significant predictors for ATR-related hospital admission for the variables studied, including age, race, BMI value, and cause of ESRD.

Only a small proportion of patients (17%, N = 184) received operative treatment within 14 days of ATR diagnosis. There were no significant differences in the probability of receiving operative treatment among the non-waitlisted (17%), waitlisted (19%), and transplanted (16%) groups. Receipt of operative treatment was not associated with age, race, sex, BMI value, or cause of ESRD (Table 4).

The rate of surgery did not change during the study period. The rate ranged from a low of 8.3% in 2000 to a high of 27% in 1999. In the most recent years of the study, the rate was 14% in 2010, 17% in 2011 and 2012, and 19% in 2013 (Figure 1).

Fluoroquinolone and Corticosteroid Use

In the subgroup of 544,185 individuals with Medicare Part D coverage, the overall crude incidence of ATR was 3.97 per 10,000 person-years (95% CI, 3.69–4.29). After adjusting for confounders, we observed a significantly lower incidence in the non-waitlisted group compared with the transplanted group (aIRR, 0.51; 95% CI, 0.40–0.65). The incidence was not significantly different in the waitlisted group compared with the transplanted group (aIRR, 0.88; 95% CI, 0.71–1.10). These findings were comparable to those from the entire study population described above.

Fluoroquinolone exposure was associated with a significantly higher incidence of ATR (aIRR, 1.56; 95% CI, 1.32–1.84). However, the IRRs of the non-waitlisted, waitlisted, and transplanted groups remained similar even after controlling for fluoroquinolone exposure (Supplementary Table), suggesting that the higher incidence of ATR in the waitlisted and transplanted groups was unlikely attributable to fluoroquinolone exposure. When stratified by fluoroquinolone exposure, the non-waitlisted group had a significantly lower incidence of ATR compared with the transplanted group among exposed patients (aIRR, 0.52; 95% CI, 0.37–0.71) and unexposed patients (aIRR, 0.52; 95% CI, 0.39–0.69). The incidence was not significantly different between the waitlisted and the transplanted groups among exposed patients (aIRR, 1.13; 95% CI, 0.82–1.56) and unexposed patients (aIRR, 0.77; 95% CI, 0.58–1.03).

Corticosteroid exposure was associated with significantly higher incidence of ATR (aIRR, 1.72; 95% CI, 1.44–2.05). Both of the IRRs (non-waitlisted versus transplanted and waitlisted versus transplanted) increased slightly after controlling for corticosteroid exposure (Supplementary Table). Moreover, when stratified by corticosteroid exposure, the non-waitlisted group had a significantly lower incidence of ATR compared with the transplanted group among exposed patients (aIRR, 0.60; 95% CI, 0.45–0.81) but not among unexposed patients (aIRR, 0.78; 95% CI, 0.45–1.35). The waitlisted group had a significantly higher incidence of ATR compared with the transplanted group among exposed patients (aIRR, 1.51; 95% CI, 1.14–2.00) but not among unexposed patients (aIRR, 1.04; 95% CI, 0.60–

1.81). That is, the differences in ATR incidence between ESRD treatment groups were observed only among those exposed to corticosteroids.

Operative Site Infections

The 30-day cumulative incidence of SSIs was low (6.5%). Seven non-waitlisted patients (7.5%), 2 waitlisted patients (4.5%), and 3 transplant recipients (6.4%) had an SSI. These numbers were too low to allow statistical comparison.

DISCUSSION

In this national registry study, we examined ATRs in ESRD patients during 2,870,817 person-years of follow-up and found an overall incidence of 3.80 per 10,000 person-years. We observed a higher incidence of ATR among waitlisted patients (6.07 per 10,000 person-years) and transplant recipients (5.22 per 10,000 person-years) compared with non-waitlisted patients (2.91 per 10,000 person-years). These differences persisted after adjustment for potential confounders.

There were no significant differences in ATR rates between waitlisted patients and transplant recipients. This suggests that the steroids and immunosuppressive medications taken by patients after transplant do not substantially increase the risk of ATR. A second possibility is that the transplant medications and metabolic abnormalities of dialysis are equally deleterious to the Achilles tendon, leading to similar rupture rates in similarly active patients.

The risk factors for ATR identified in our study differ from those in the general population. The risk of ATR was higher in women than men. This is in contrast to studies of the general population, which reported a higher risk in men^{12,16,19,20,22,24,28,34} or no difference between the sexes⁸. ATR incidence was also higher in white patients than black patients. Studies of military personnel have shown a greater risk of ATR in black patients than in those of other races^{6,35}. This discordance may suggest that the cause of ATR in patients with ESRD is different from the cause in the general population. ATR typically occurs in “weekend warriors” playing recreational sports. We speculate that ATR in the ESRD population is less attributable to sports and more attributable to other factors such as metabolic abnormality^{21,27}, use of fluoroquinolones and steroids^{5,31}, lower levels of regular physical activity², or preinjury tendinosis^{14,36}.

Although there is evidence supporting both operative and nonoperative treatment, less than 20% of the patients in our study were treated operatively. In another study of Medicare patients with ATR, nearly 30% of patients older than 65 years were treated operatively⁸. Our findings suggest that surgeons may favor nonoperative treatment for patients with ESRD. However, whether ESRD is a true contraindication for surgery is unknown.

We hypothesized that waitlisted patients would be less likely to receive surgery because surgery could harm their chances for a transplant. For example, patients who undergo surgery and develop SSI may be prevented from receiving a transplant because of active

infection²⁶. Our results do not support this hypothesis. The rates of surgery for the waitlisted and transplanted groups were similar.

The rates of surgery did not change significantly during the study period. This is in contrast to our hypothesis that operative rates would decrease in response to studies showing equivalence between nonoperative and operative treatment. Such a decrease has been documented in the general population²³. It is difficult to determine why operative rates did not decrease over time for patients with ESRD. It is possible that the rates were already so low that the new evidence of the equivalence of nonoperative treatment had little effect.

Other studies have found an association of ATR with fluoroquinolone use and corticosteroid use^{5,31}. The use of fluoroquinolones and corticosteroids in the ESRD population explains, at least in part, the higher incidence of ATR in this population. However, fluoroquinolone use did not seem to be responsible for the higher ATR rates in the waitlisted and transplant patients relative to the non-waitlisted patients.

Approximately 70% of transplant recipients take corticosteroids for maintenance immunosuppression¹⁰, and this is likely one reason for the higher ATR incidence observed among transplanted patients compared with non-waitlisted patients. It is unclear why the waitlisted patients exposed to corticosteroids had an even higher incidence of ATR compared with transplanted patients. This is the only covariable that was significantly different between these 2 populations. It is possible that the combination of higher activity (compared with non-waitlisted patients), dialysis, and corticosteroid use compounds risk.

A recent study showed that medical comorbidities were associated with significantly higher risk of infection after ATR repair, with an SSI incidence of 18% for those with a comorbidity compared with 6% for those without⁷. In our study, the risk of SSI for ESRD patients was low, with a 30-day cumulative incidence of 6.5%. It is possible that the patients in our cohort who underwent surgery were the healthiest patients of the cohort, which may account for their lower complication rate.

The biggest strength of our study is that we drew from a large, representative sample of the target population using a mandatory national registry. Patients with ESRD are eligible for Medicare regardless of their age, and approximately 60% use Medicare as their primary payer²⁹. Using a data linkage between ESRD registrations and Medicare claims, we were able to study all Medicare patients with ESRD from 1999 through 2013. This study also has several limitations. First, we used administrative codes to ascertain outcomes. The validity of these administrative codes has not been established. However, because our methods are similar to those of a previous study of the general population⁸, it is unlikely that the use of administrative codes would have biased our findings. Second, data on some covariables such as physical function and routine physical activity were unavailable in our data source. Third, in an effort to limit our analysis to acute injuries, we limited our analysis of surgical intervention to the first 14 days after ATR diagnosis. It is possible that this approach resulted in an underestimation of surgical repairs of ATR. Finally, we ascertained the incidence of SSI using ICD-9-CM code 998.59 (other postoperative infection), which is the only code specific for postoperative infection. It is possible that postoperative infections were coded

using different ICD-9-CM codes, and our use of a code specific for SSI underestimates the true infection rate.

We found notably higher ATR rates in the ESRD population compared with previous studies of the general population and the Medicare population. The rate for dialysis-dependent patients not waitlisted for transplant was almost half the rates for dialysis-dependent patients waitlisted for transplant and patients after transplant. White, female patients and those with higher BMI were more likely to sustain ATR. Patients with diabetes mellitus as the cause of ESRD had higher rates of rupture than did patients with ESRD from other causes. Patients with hypertension, congestive heart failure, cerebrovascular accident, chronic obstructive pulmonary disease, cancer, atherosclerosis, current smoking, and inability to ambulate were less likely to sustain ATR. Similar to the general population, ESRD patients treated with fluoroquinolones and/or corticosteroids were more likely to sustain ATR than patients not treated with these medications.

Most ESRD patients with ATRs were treated nonoperatively, but those treated with surgery had SSI rates similar to those of the general population. However, the rates of operative treatment were quite low, making it likely that only the healthiest and most active patients underwent surgery. These results suggest that ESRD should be considered a risk factor when contemplating surgery but not an absolute contraindication.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Proportion of 1091 patients with end-stage renal disease treated operatively for Achilles tendon rupture, 1999–2013. Bars indicate 95% confidence intervals.

Table 1

Characteristics of Patients with ESRD, US Renal Data System and Centers for Medicare & Medicaid Services, 1999–2013

Characteristic	Patients with ATR, % (N = 1,091)	Patients without ATR, % (N = 1,086,710)	P Value
Age, y	61 (50–70) *	68 (57–77) *	<.001
Male sex	606 (55.5)	598,448 (55.1)	.75
Race			
White	772 (70.8)	732,790 (67.4)	.005
Black	279 (25.6)	291,873 (26.9)	
Other	40 (3.7)	62,047 (5.7)	
Body mass index, kg/m ²	28.8 (24.6–33.5) *	26.6 (22.9–31.5) *	<.001
Cause of ESRD			
Diabetes mellitus	580 (53.2)	484,009 (44.5)	<.001
Hypertension	111 (10.2)	84,317 (7.8)	
Glomerulonephritis	222 (20.3)	310,602 (28.6)	
Other/missing	178 (16.3)	207,782 (19.1)	
Comorbidities			
Hypertension	809 (75.0)	849,504 (79.3)	<.001
Diabetes	599 (55.5)	546,906 (51.0)	.003
Congestive heart failure	262 (24.3)	345,180 (32.2)	<.001
Atherosclerosis	230 (21.3)	265,927 (24.8)	.008
Peripheral vascular disease	154 (14.3)	154,510 (14.4)	.89
Cerebrovascular accident	69 (6.4)	102,931 (9.6)	<.001
COPD	57 (5.3)	93,805 (8.8)	<.001
Cancer	38 (3.5)	71,196 (6.6)	<.001
Current smoker	34 (3.2)	49,812 (4.6)	.020
Cannot ambulate	28 (2.6)	61,442 (5.7)	<.001
Cannot be transferred	13 (1.2)	28,554 (2.7)	.003
Alcohol dependence	11 (1.0)	10,662 (1.0)	.93
Drug dependence	10 (0.9)	5,812 (0.5)	.086

ATR, Achilles tendon rupture; COPD, chronic obstructive pulmonary disease; ESRD, end-stage renal disease.

* Data presented as mean (range).

Table 2

Crude Incidence of ATR from 2,870,817 Person-Years of Follow-up in Patients with End-Stage Renal Disease, US Renal Data System and Centers for Medicare & Medicaid Services, 1999–2013

Patient Group	No. of ATRs	Follow-up, Person-Years	ATRs per 10,000 Person-Years (95% Confidence Interval)
Non-waitlisted, dialysis-dependent	555	1,907,626	2.91 (2.68–3.16)
Waitlisted, dialysis-dependent	237	390,204	6.07 (5.35–6.90)
Transplanted	299	572,986	5.22 (4.66–5.85)
Overall	1091	2,870,817	3.80 (3.58–4.03)

ATR, Achilles tendon rupture

Table 3

Risk Factors for Achilles Tendon Rupture in Patients with ESRD, US Renal Data System and Centers for Medicare & Medicaid Services, 1999–2013

Parameters	Adjusted IRR (95% CI)	P Value
ESRD treatment		
Transplanted	Referent	
Nonwaitlisted	0.44 (0.37–0.53)	<.001
Waitlisted	0.94 (0.78–1.12)	.5
Age group, y		
0–49	0.93 (0.76–1.14)	.5
50–64	1.11 (0.93–1.33)	.3
65–69	Referent	
70–100	0.88 (0.73–1.07)	.2
Race		
White	Referent	
Black	0.65 (0.57–0.75)	<.001
Other	0.46 (0.33–0.63)	<.001
Sex		
Female	Referent	
Male	0.75 (0.66–0.85)	<.001
Body mass index, kg/m ²		
0–24.99	Referent	
25.00–29.99	1.25 (1.05–1.49)	.01
30.00–39.99	1.56 (1.31–1.85)	<.001
40	1.81 (1.41–2.31)	<.001
Cause of ESRD		
Glomerulonephritis	Referent	
Diabetes mellitus	1.43 (1.16–1.78)	.001
Hypertension	0.95 (0.75–1.20)	.6
Other/missing	0.95 (0.75–1.21)	.7
Comorbidities		
Drug dependence	2.04 (1.07–3.92)	.03
Peripheral vascular disease	1.34 (1.12–1.61)	.002
Alcohol dependence	1.27 (0.68–2.36)	.4
Atherosclerosis	1.09 (0.93–1.28)	.3
COPD	0.94 (0.71–1.24)	.7
Congestive heart failure	0.89 (0.76–1.04)	.1
Cancer	0.89 (0.64–1.23)	.5
Cerebrovascular accident	0.85 (0.66–1.09)	.2
Current smoker	0.68 (0.48–0.97)	.03

Parameters	Adjusted IRR (95% CI)	P Value
Osteoporosis	0.14 (0.12–0.17)	<.001

CI, confidence interval; COPD, chronic obstructive pulmonary disease; ESRD, end-stage renal disease IRR, incidence rate ratio

Table 4

Odds of ESRD Patients Receiving Operative Treatment for Achilles Tendon Ruptures within 14 Days of Injury, US Renal Data System and Centers for Medicare & Medicaid Services, 1999–2013

Parameters	Adjusted OR (95% CI)	P Value
ESRD treatment		
Transplanted	Referent	
Nonwaitlisted	1.52 (0.97–2.39)	.1
Waitlisted	1.35 (0.83–2.20)	.2
Age group, y		
0–49	1.53 (0.92–2.54)	.1
50–64	1.08 (0.66–1.76)	.8
65–69	Referent	
70–100	0.64 (0.37–1.11)	.1
Race		
White	Referent	
Black	1.04 (0.71–1.52)	.9
Other	0.36 (0.11–1.22)	.1
Sex		
Female	Referent	
Male	0.86 (0.62–1.20)	.4
Body mass index, kg/m ²		
0–24.99	Referent	
25.00–29.99	1.11 (0.70–1.75)	.7
30.00–39.99	0.79 (0.49–1.26)	.3
40	0.75 (0.38–1.50)	.4
Cause of ESRD		
Glomerulonephritis	Referent	
Diabetes mellitus	0.65 (0.37–1.13)	.1
Hypertension	0.55 (0.29–1.03)	.1
Other/missing	0.98 (0.53–1.80)	.9

CI, confidence interval; ESRD, end-stage renal disease; OR, odds ratio