Effects of Ethnicity and Nephropathy on Lower-Extremity Amputation Risk Among Diabetic Veterans

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OBJECTIVE — To describe ethnic differences in the risk of amputation in diabetic patients with diabetic nephropathy.

RESEARCH DESIGN AND METHODS — A retrospective cohort study was conducted on a national cohort of diabetic patients who received primary care within the Veterans Affairs (VA) Health Care System. Hospitalizations for lower-limb amputations were established by ICD-9-CM procedure codes. Relative risk of amputation in diabetic patients with and without diabetic nephropathy was determined using Cox proportional hazard modeling for unadjusted and adjusted models.

RESULTS — Of the 429,918 subjects identified with diabetes (mean age 64 ± 11 years, 97.4% male), 3,289 individuals were determined to have had a lower-limb amputation during the study period. Compared with diabetic patients without amputations, amputees were on average older, more likely to belong to a minority group, and were more likely to have received treatment for more comorbid conditions. Asians were more likely to have toe amputations compared with whites or other ethnicities, while Native Americans were more likely to have below-the-knee amputations. Native Americans had the highest risk of amputation (RR 1.74, 95% CI 1.39–2.18), followed by African Americans (RR 1.41, 95% CI 1.34–1.48) and Hispanics (RR 1.28, 95% CI 1.20–1.38) compared with whites. The presence of diabetic nephropathy increased the risk of amputation threefold in all groups. Asian subjects with diabetes had the lowest adjusted relative risk of amputation (RR 0.31, 95% CI 0.19–0.50).

CONCLUSIONS — Among diabetic patients, certain ethnic minority individuals have an increased risk of lower-extremity amputation compared with whites. Presence of diabetic nephropathy further increases this risk.

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The diabetic foot syndrome resulting in lower-extremity amputation contributes to the enormous morbidity and mortality of diabetes and results in increased patient disability, decreased quality of life, and increased health care costs (1,2). Nationally, diabetes is associated with >65% of nontraumatic lower-extremity amputations performed, even though diabetic individuals account for <3% of the total U.S. population (1,2). Risk factors for amputations in individuals with diabetes include age (3–6), peripheral vascular disease (7–9), smoking (6,7,10,11), hypertension (6–8,10,11), glycemic control (7,8,10,12,13), renal disease (7,9,11,14,15), and race/ethnicity (3,4,6,9,11,12,15–20), although it remains controversial whether African Americans have an increased incidence of amputations (7,13,21). Conversely, most minority patients are at increased risk of lower-extremity amputations in the setting of end-stage renal disease (ESRD) (15); however, risk associated with renal disease before the initiation of dialysis has not been clearly established.

We hypothesized that diabetic ethnic minority patients with and without renal disease were at higher risk of lower-extremity amputations compared with whites in a setting where access to and financial barriers to health care were comparable. We conducted a retrospective cohort study to examine ethnic differences in the risk of lower-extremity amputations in a population of diabetic patients with and without renal disease who received treatment in a national comprehensive health care system.

RESEARCH DESIGN AND METHODS

Design
Subjects with diabetes who received primary care within the U.S. Veterans Affairs (VA) Health Care System during fiscal year 1998 (FY98) (1 October 1997 through 30 September 1998) were selected for a retrospective cohort study.

Subjects and setting
To identify patients with diabetes, we utilized national Veterans Health Administration (VHA) databases located at the Austin Automation Center (ACC) in Austin, Texas. The ACC is the repository for information on all hospitalizations and outpatient visits that occur within VA health care systems nationally. The Patient Treatment File (PTF) records up to 10 *International Classification of Diseases,*

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Abbreviations: AAC, Austin Automation Center; BIRLS, Beneficiary Identification and Record Locator System; COPD, chronic obstructive pulmonary disease; CPT, Common Procedural Terminology; ESRD, end-stage renal disease; HMO, health maintenance organization; HR, hazard ratio; OPC, Outpatient Care File; PTF, Patient Treatment File; VA, Veterans Affairs; VHA, Veterans Health Administration.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

9th revision, Clinical Modification (ICD-9-CM) (22) diagnosis codes per hospitalization. In addition, outpatient visits are recorded in the Outpatient Care File (OPC), where information on the type of clinic visit, the date of the visit, and any procedures (recorded as Common Procedural Terminology [CPT] codes) performed during the visit can be abstracted. Mortality was established utilizing the Beneficiary Identification and Record Locator System (BIRLS) death file, a database that contains name, social security number, and date of death. The BIRLS death file has been shown to have a 94.5% ascertainment of death, which compares favorably to that of the National Death Index (96.7%) (23,24).

For fiscal year 1998, all veterans with a diagnosis of diabetes were identified by the presence of at least one outpatient or inpatient visit with an ICD-9-CM diagnosis code of diabetes (250.XX). We required a total of three or more visits for that year for inclusion into the study. ICD-9-CM diagnosis codes were used to extract hospitalizations from the PTF and the OPC.

Exposures and predictors of interest

Characteristics of interest included age, ethnicity, sex, region, hospitalizations, service-connected disabilities, and total number of visits. Although income and availability of other health insurance were not available, service-connected disability was utilized as an indicator of socioeconomic status. Criteria for VA health care eligibility include a service-connected disability or low financial resources. Thus, absence of a service-connected disability is an indicator for low socioecomomic status. Comorbid conditions, such as coronary artery disease (codes 410–414, 427, 428), hypertension (codes 401–405), stroke (codes 431–434, 436 437), cancer (codes 140. XX-199.XX), chronic obstructive pulmonary disease (COPD) (codes 491, 492, 496), and depression (codes 296, 311), were also identified. Since data on actual smoking history were not available, treatment for COPD was utilized as proxy for significant smoking history.

The presence of diabetic renal disease was considered as a potential exposure and was identified in the population at the beginning of the study period by the use of ICD-9-CM diagnosis codes. Diabetic nephropathy was defined by the code 250.4 or the code for diabetes (250.XX) coupled with diagnosis codes for additional secondary renal conditions, which included glomerulonephritis, glomerulonephropathy, or nephropathy (codes 580, 581, 582, 583); ESRD (code 585); or uremia (code 586). Hemodialysis, peritoneal dialysis, and transplantation were identified using ICD-9-CM diagnosis codes as well as CPT codes. Subjects with a diagnosis of diabetes and other renal diseases such as hypertension (codes 403.00, 403.90, 403.90, 440.1, 593.81), interstitial nephritis (codes 274.10, 590.00, 592, 593.89, 753.20, 753.3), acute renal failure (code 584), cystic disease (codes 753.10–753.14, 753.19), secondary vasculitis (codes 446.0, 446.4, 447.8, 710.00), tumor or neoplasm (codes 189.0, 189.1, 233.9, 236.91, 239.5, 238.6, 203.0, 277.3), and glomerulonephritis from other causes or diseases (codes 588, 589, 593, 759.89, 996.85, 996, 8,042, 866.00, 587) were identified separately.

Outcomes

All lower-extremity amputations were identified for fiscal year 1998 by ICD-9-CM procedure codes 84.11 through 84.19. Traumatic amputations were excluded. Multiple amputations that occurred on the same day were considered as one procedure. Amputations were further categorized into the following levels: toe, below the knee (BKA), and above the knee (AKA). Below-the-knee amputation included foot and ankle, while above-the-knee amputation included knee and hip disarticulation. Amputations identified by ICD-9-CM procedure codes before the study period (FY98) were excluded from the primary outcome. Death during the period 1 October 1997 through 30 September 1998 was ascertained utilizing the BIRLS death file and the PTF.

Statistical analyses

We conducted statistical analyses to determine frequencies of distribution of covariates and associations of exposures with amputations for the diabetic veteran population. Data analyses were performed using the STATA 7.0 (College Station, TX) (25) software statistical package. Statistical significance was determined by the independent Student's *t* test for continuous data and the χ^2 test for categorical data (26). Cox proportional hazard modeling was used to estimate the risk of amputation, as modeled for censored failure times. Individuals were censored for death and the end of the study period. The hazard, or the instantaneous probability of an event, was modeled as a function of the predictor covariates. Predictor covariates were determined a priori. The main predictors of interest were ethnicity and the presence of renal disease. We included subsequent variables into the multivariate models either as independent risk factors of amputation after adjustment for other covariates or as an attempt to control for confounding. The hazard ratio (HR), or relative risk (RR), was estimated as the proportionate change in the instantaneous probability of amputation. Survivors were censored as of the last day of the study, 30 September 1998

RESULTS

— Of the 429,918 veterans identified with diabetes for fiscal year 1998, 11,794 had one or more amputations between 1989 and 1999. Of those identified, 8,388 had amputations between 1989 and October 1997, while 3,289 veterans underwent incident nontraumatic lower-extremity amputations from 1 October 1997 to 30 September 1998. Veterans with amputations were in general older (66 vs. 64 years, $P < 0.001$), more likely to be male (99.3%), more likely to belong to an ethnic minority group, and less likely to have service connection for their care at the VA compared with veterans without amputations (Table 1). Furthermore, veterans with amputations were more likely to have had comorbid conditions such as hypertension, cardiovascular disease, stroke, or COPD. In addition, unadjusted 12-month mortality was significantly higher in veterans with amputations compared with those without amputations (18.5–21.8 vs. 5.9%, $P < 0.001$) (Table 1).

Diabetic veterans with prevalent amputations were more likely to have had a diagnosis of renal disease, while the prevalence of diabetic renal disease was increased in diabetic veterans with amputations compared with those without amputations (29.6 vs. 9.8%, $P < 0.001$). Among veterans with amputations, diabetic ESRD was the most frequent renal diagnosis, which was followed by diabetic nephropathy not yet on dialysis and acute renal failure (Table 2). Interstitial nephritis, renal cell cancer, and other renal diseases were rare overall, but similar in

Table 1—*Demographic characteristics in diabetic veterans with and without amputations*

Characteristics	Diabetes	Incident amputation	Prevalent amputation
n	426,629	3,289	9,527
Age (years)	64.1 ± 11.4	66.0 ± 10.2*	66.35 ± 9.64†
Age category			
<40 years	10,594 (2.5)	24 (1.7)*	38 (0.4)†
40–64 years	196,414 (46.1)	1,424 (43.3)	3,507 (36.8)
65–74 years	152,180 (35.7)	1,275 (38.8)	3,999 (42)
75+ years	67,309 (15.8)	565 (17.2)	1,982 (20.8)
Male (%)	97.4	99.3*	99.3†
Ethnicity			
White	239,422 (56.1)	2,126 (64.6)*	6,016 (63.1)†
African American	65,181 (15.3)	804 (24.4)	2,394 (25.1)
Hispanic	26,277 (6.2)	267 (8.1)	878 (9.2)
Asian	2,040 (0.5)	6 (0.2)	14 (0.1)
Native American	1,717 (0.4)	30 (0.9)	72 (0.8)
Unknown	91,992 (21.6)	56 (1.7)	153 (1.6)
Region			
Northeast	91,164 (21.4)	655 (19.9)*	1,932 (20.3)†
South	161,745 (37.9)	1,299 (39.5)	3,929 (41.2)
Midwest	91,392 (21.4)	742 (22.6)	2,007 (21.1)
West	82,328 (19.3)	593 (18.0)	1,659 (17.4)
Non–service connected, *n* (%)	250,795 (58.8)	2,151 (65.4)*	5,898 (61.9)†
Primary care provider visit	49,301 (70.5)	320 (65.8)	1,101 (71.2)†
Visit to a diabetes educator	24,802 (35.5)	186 (38.3)	541 (35)

Data are means ± SD or *n* (%). $^*P < 0.005$ significant for trend within categories as determined by tests or for the mean of continuous variables using independent *t*-test for veterans with incident amputations versus veterans without amputations. $†P < 0.005$, significant for trend within categories as determined by tests or for the mean of continuous variables using independent *t*-test for veterans with previous amputations versus veterans without amputations. Prevalent and incident categories of patients are not mutually exclusive.

veterans with and without amputations (Table 2).

Level of amputation differed significantly by ethnicity and prevalence of renal disease. Toe amputations accounted for the majority of amputations in all groups, followed by below the knee and above the knee (Fig. 1*A*). Asian patients were much more likely to have toe amputations and less likely to have below- or above-the-knee amputations. Furthermore, Native-American patients had a higher percentage of below-the-knee amputations than toe amputations when compared with other ethnicities. Veterans with prevalent renal disease were more likely to have below-the-knee amputations compared with veterans without renal disease, whom were more likely to have toe amputations (Fig. 1*B*).

To determine risk factors for incident lower-extremity amputations, Cox proportional hazard models were generated (Table 3). Native-American veterans, who comprised the smallest minority population nationally, had the highest risk of lower-extremity amputation compared with white veterans (RR 1.74, 95% CI 1.39–2.18). African Americans had a 1.4-fold higher risk (1.31–1.48), while Hispanic veterans had a 1.2-fold higher risk of amputation (1.20–1.38) when compared with white veterans. We further found that Asian veterans had a 69% lower risk of amputation when compared with whites (0.31, 0.19–0.50) in models adjusted for age, region, service-connected disability, cardiovascular disease, hypertension, and COPD.

Although women veterans comprised only 2.6% of the total population and only 1% of veterans with amputations, their risk of amputation was 69% lower than that of diabetic men (RR 0.31, 95% CI 0.25 −0.39). Adjustment for region, service connection, age, comorbid conditions, and the presence of renal disease did not substantially alter that risk.

Significant differences were found when the risk of amputation was evaluated for those with prevalent renal disease. Diabetic nephropathy increased the risk of amputation 3.4-fold while diabetic ESRD increased the risk 3.8-fold after adjustment for age, sex, region, comorbid conditions, and service connection (Table 3). Risk for amputation was similar when veterans with prevalent amputations were excluded from the models (data not shown).

When the risk of amputation was evaluated within categories of renal disease (diabetic nephropathy and diabetic ESRD), outcomes varied by ethnic subgroup affiliation significantly (Table 3). Native-American veterans with diabetic nephropathy or diabetic ESRD had a 2.7-fold higher risk of amputation when compared with whites with diabetes and similar diagnoses of renal disease. African Americans with diabetic nephropathy or diabetic ESRD had a 1.4-fold higher risk of amputation, while Hispanic veterans maintained a 1.2-fold higher risk of amputation when compared with whites with similar diagnoses of renal disease. Interaction terms between ethnicity and renal disease, ethnicity and hypertension, ethnicity and cardiovascular disease, and ethnicity and COPD were not significant when added to individual multivariate models. The statistically significant protective association of Asian ethnicity for amputation risk was also apparent when

Table 2—*Comorbid conditions in diabetic veterans with and without amputations*

Characteristics	Diabetes	Incident amputation	Prevalent amputation
Comorbid conditions			
Hypertension	286,862 (67.2)	2,472 (75.2)*	6,942 (72.9)†
Cardiovascular disease	172,968 (40.5)	1,966 (59.8)*	5,056 (53.1)†
Stroke	31,227 (7.3)	570 (17.3)*	1,360 (4.3)†
Cancer	49,214 (11.5)	350 (10.6)	1,059 (11.1)
COPD	64,542 (15.1)	659 (20.0)*	1,624 (17.0)†
Depression	50,971 (11.9)	417 (12.7)	1,035 (10.9)†
Renal disease			
ESRD	17,117 (4.0)	519 (15.8)*	1,498 (52.9)†
Diabetic nephropathy	7421 (1.7)	206 (6.3)	575 (20.3)
HTN renal disease	1,286 (0.3)	48 (1.5)	73 (2.6)
Interstitial nephritis	4,656 (1.1)	21 (0.6)	65 (2.3)
Acute renal failure	1,849 (0.4)	92 (2.8)	129 (4.6)
Renal cell carcinoma	1,264 (0.3)	12 (0.4)	19 (0.7)
Other	9,078 (1.1)	165 (5.1)	473 (16.7)
Background retinopathy	40,194 (9.4)	659 (20.0)*	2,198 (23.1)†
Blindness	11,403 (2.7)	164 (5.0)*	600 (6.3)†
Hospitalizations	1.58 ± 1.09	2.38 ± 1.55*	1.93 ± 1.41†
Number of visits	18.9 ± 20.2	31.0 ± 25.4*	26.95 ± 26.79†
Mortality	25,292 (5.9)	718 (21.8)*	1,761 (18.5)†

Data are *n* (%) or means ± SD. $^*P < 0.005$, significant for trend within categories as determined by χ^2 tests or for the mean of continuous variables using independent *t* test for veterans with incident amputations versus veterans without amputations. $^\dagger P < 0.005$ significant for trend within categories as determined by χ^2 tests or for the mean of continuous variables using independent *t* test for veterans with previous amputations versus veterans without amputations. HTN, hypertensive.

models were adjusted for the presence of renal disease.

CONCLUSIONS — In this national cohort of veterans with diabetes, we found that certain ethnicities were associated with an increased lower-extremity amputation risk. In addition, the presence of diabetic nephropathy increased the amputation risk threefold, when individuals with renal disease were compared with those without renal disease.

Diabetic individuals have a 10- to 15-fold greater risk of lower-extremity amputations than nondiabetic individuals (4,10). In addition, the risk for amputation is higher in males (4,10–12,16) and increases with age (3,4,6,10). Various population-based studies, such as those conducted in Wisconsin natives (10,27), Native-American tribes (11,12,28,29), managed care populations (13), Medicare enrollees (3,18), and veteran populations (7–9,19,20,30,31) have identified consistent risk factors for lower-extremity amputations. These risk factors include glycemic control (7,8,10,12,13), duration of diabetes (7,8,10–13), blood pressure control (7,8,10–13), and history of foot ulcers (7,8,10,12). Even though ethnicity has not been found to be a consistent risk factor for amputations (3,6,13), analyses of association of ethnicity with amputation may be confounded by differing degrees of access to care (13) or the presence of hypertension. In this cohort study where access to care was comparable, ethnicity was found to be an independent predictor of amputation.

The effect of ethnicity on the risk of amputation remains controversial. Most and Sinnock (4) found that diabetic African Americans had an approximate twofold higher risk of amputation, the risk of which increased with age. However, their study was unable to compare amputation rates nationally between different ethnicities. Resnick et al. (6) evaluated long-term follow-up data from the National Health and Nutrition Examination Survey (NHANES) and determined that African Americans with diabetes had a higher risk of lower-extremity amputation than whites, the risk for which diminished after adjustment for education, hypertension, and smoking. Lavery et al. (3) also found that diabetic African Americans had a higher risk of amputation compared with whites; however, they were unable to control for socioeconomic status or access to care. Finally, in a case control study conducted at a large health maintenance organization (HMO), Selby and Zhang (13) found that diabetic African Americans did not have an increased risk of lower-extremity amputation after 13 years of follow-up. They concluded that comparable access to medical care abrogated the risk of diabetes-related amputations thought to be secondary to ethnicity. This question was recently reevaluated at the same HMO with similar results (21). Our results, which are based on a large study in a comprehensive health care system where access to care is comparable, suggest that nationally, African Americans may have an increased risk for lower-extremity amputation.

In addition to African Americans, Hispanic and Native-American veterans were also found to have higher risks of lower-extremity amputation. There are few studies that evaluate amputation risks in diabetic Hispanic Americans (3,9). In a population-based study conducted in the Southwest, Lavery et al. (3) found a higher incidence of lower-extremity amputation in Hispanics compared with whites. Collins et al. (9) arrived at a similar conclusion in a veteran population with prevalent peripheral vascular disease. Karter et al. (21), however, did not find an increased risk of lower-extremity amputations in the Kaiser Permanente population of Northern California.

The current study found that Native

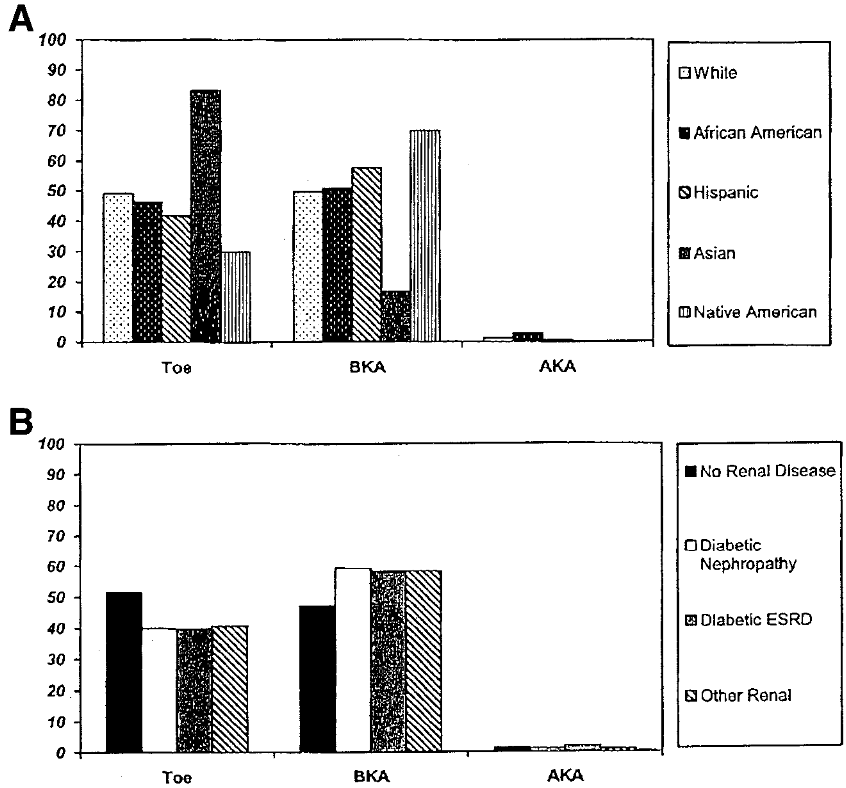

Figure 1—*Level of incident amputation by ethnicity and renal disease presence. Level of amputation is presented as stratified by ethnicity* (A) *and presence of diabetic renal disease* (B)*. Level of amputation was categorized as follows:* 1) *toe amputations;* 2) *BKA (below-the-knee amputation), which included foot, above the ankle, and below the knee; and* 3) *AKA (above-the-knee amputation), which included knee, above the knee, and hip disarticulation. Among groups, level of amputation was significantly different as determined by* χ^2 *test* (P < *0.001*).

Americans had the highest risk of amputation regardless of the presence of renal disease, which is consistent with the current literature. Diabetic Native Americans have the highest reported risk of amputations in the world, which varies by tribe (11,12,29); data that compares Native Americans with other ethnicities in a national setting are lacking. Although the current study was unable to evaluate risk of amputation by tribe specifically, it confirmed the excess relative risk of amputation for a heterogeneous group of Native Americans compared with whites and other ethnic groups where access to care for all individuals was similar.

Findings from our study suggest that diabetic Asian veterans with and without renal disease had the lowest risk of lower-extremity amputation when compared with whites and other minority patients. Asian patients had a different rate of prevalent amputation when compared with other ethnicities. Limited data exist on the risk of amputation in the diabetic Asian population. In a multicenter, multicountry prospective cohort study, Unwin et al. (32) collected data from Europe, North America, and East Asia and compared incidence rates of amputation among different populations. Asian patients from Japan had the lowest incidence of first amputation (0.2/100,000 population per year) while Native Americans from the Navajo Tribe in the U.S. had the highest incidence (25.1/100,000 per year). Unfortunately, incidence rates were not estimated for patients by diagnosis of diabetes. Gujral et al. (33) found that diabetic Asian patients in the U.K. had an approximate fourfold lower risk of lower-extremity amputation compared with whites. Recently, Karter et al. (21) found that Asian patients with diabetes had 60% lower risk of lower-extremity amputation compared with whites in a large HMO population. Similarly, Eggers et al. (15) found that Asian-American dialysis patients had the lowest amputation risk (OR = 0.58, $P < 0.0001$) when compared with whites. Those results compare with the current study, in which a 70% reduction in risk of amputation was found that persisted despite the presence of renal disease.

Patients with diabetes and ESRD are at much higher risk of amputation compared with the nondialysis population. Eggers et al. (15) reported that diabetic individuals with ESRD have a 10-fold higher incidence of amputations compared with the general diabetic population, the risk of which was increased for African Americans and Native Americans. In a clinic-based study, Griffiths et al. (34) found that impaired renal function was an independent risk factor for diabetic lower-extremity foot ulceration, but renal function increased neither the severity nor the duration of the lesion. Hill et al. (14) reported that ethnicity and ESRD were significant risk factors for lower-extremity complications such as amputations, foot ulcers, and infections. In the present study, we demonstrate an increased risk of lower-extremity amputation associated with diabetic nephropathy prior to the initiation of dialysis, and we confirm the increased risk of lower-extremity amputation in diabetic individuals with ESRD.

Our study has several limitations that must be addressed. First, results obtained were for the veteran population, and as such may not be applicable to the general U.S. population. However, given this limitation, the data illuminate differences in risk of amputation when access to care is not the primary issue. The VA system represents the largest integrated health care system in the U.S. and has the capacity to institute changes in health care policy rapidly. Although care received by patients in a non-VA setting may differ from that received within the VA, outcomes appear to be similar (35).

A second limitation is related to the use of administrative databases (36). The data available from these databases lacked pharmacy information, clinical laboratory data, smoking history, and other clinical parameters, all of which may be important variables. Smoking is a risk factor that has been shown to be associated with risk of amputation (6,7,10,11), for which we were not able to adjust. However, we were able to adjust our analysis for COPD, which is a proxy for substantial current and past cigarette use (37). In addition, ethnicity was unknown in a substantial

Table 3—*RR of amputation in veterans during fiscal year 1998*

Characteristic	Unadjusted RR (95% CI)	Adjusted RR* (95% CI)
White	1.0	1.0
African American	1.45 (1.39–1.52)	1.41 (1.34–1.48)
Hispanic	1.28 (1.20–1.37)	1.28 (1.20–1.38)
Native American	1.64 (1.31–2.05)	1.74 (1.39–2.18)
Asian	0.30 (0.18–0.48)	0.31 (0.19–0.50)
Diabetic nephropathy	4.30 (3.95–4.67)	3.41 (3.13–3.71)
Diabetic ESRD	4.97 (4.71–5.25)	3.77 (3.57–3.99)
Subgroup analysis by the presence of diabetic nephropathy		
White	1.0	1.0
African American	1.34 (1.28–1.42)	1.44 (1.37–1.52)
Hispanic American	1.26 (1.17–1.36)	1.25 (1.15–1.35)
Native American	1.59 (1.23–2.04)	2.79 (1.39–2.30)
Asian American	0.23 (0.12–0.42)	0.26 (0.14–0.48)
Subgroup analysis by the presence of ESRD		
White	1.0	1.0
African American	1.25 (1.15–1.37)	1.41 (1.34–1.48)
Hispanic	1.15 (1.00–1.32)	1.27 (1.18–1.37)
Native American	1.99 (1.36–2.91)	2.75 (1.37–2.22)
Asian	0.30 (0.13–0.73)	0.27 (0.16–0.47)

*Models adjusted for age, sex, cardiovascular disease, hypertension, COPD, service connection, region, and stroke.

proportion of veterans without amputations; however, the assessment of race for veterans who were hospitalized or who had procedures appeared to be much more complete. The accuracy of VA administrative databases has been evaluated by Kashner (38), who found that the correlation of data obtained from VA administrative files was excellent for demographic characteristics, but varied by underlying diagnosis (κ ranged from 0.39–1.00). He concluded that more than one variable should be used to abstract data for certain diagnoses, which was done in the current study.

Lastly, the diagnosis of renal disease was established by ICD-9-CM codes in our study, since laboratory data were not available. Patients identified with diabetic nephropathy may have chronic renal disease and may be more likely to obtain medical care later in the course of their disease. Thus, our identification of diabetic renal disease may have underestimated the actual prevalence. However, these data confirm the higher risk of lower-extremity amputations found in patients with a diagnosis of ESRD, although the risk found in this population was lower than that reported by Eggers et al. (15). In addition, duration of diabetes, type of diabetes, and adequacy of glycemic control, risk factors known to affect onset and progression of diabetic nephropathy and ESRD, were not available for this analysis. Despite these limitations, our study provides new information on racial differences in lower-extremity amputations that has not been reported previously.

In conclusion, our findings suggest that certain ethnic minority diabetic patients are at increased risk of lower-extremity amputation despite comparable access to medical care. The increased amputation risk found was independent of underlying renal disease, cardiovascular disease, COPD, or hypertension. Additional prospective research is needed to investigate which risk factors may contribute to the development of microvascular disease in these populations. From the clinical prospective, vigilant monitoring for the development of the diabetic foot syndrome in patients with diabetic nephropathy and those from certain ethnic minority groups may be warranted.

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