Diabetes and Renal Disease in Veterans

BESSIE A. YOUNG, MD, MPH[1,2,3,4]
JACQUELINE A. PUGH, MD[5,6]
CHARLES MAYNARD, PHD[1,2,7]
GAYLE REIBER, PHD, MPH[1,2,7,8]

OBJECTIVE — To describe the frequency and sequelae of diabetic renal disease in veterans who receive health care from the Veterans Administration (VA).

RESEARCH DESIGN AND METHODS — Veterans with a diagnosis of diabetes, diabetic nephropathy, other kidney diseases, and end-stage renal disease (ESRD) were identified by diagnosis codes from national VA databases for FY1998. Data were obtained and analyzed for prevalence of renal disease, comorbid conditions, and 1-year mortality.

RESULTS — A total of 44,671 (10.7%) of the 415,910 veterans with diabetes had a concomitant diagnosis of any renal disease. The average age was 67 years; 98% were male and 60% were white. The prevalence of diabetic nephropathy was 6.0% (n = 25,263). ESRD secondary to diabetes was present in 4.2% (17,636) of subjects. The age-standardized prevalence of diabetes and any renal disease was 72.6/1,000 persons and differed by race (white 76.1/1,000, black 103.4/1,000 persons). Diabetes-associated ESRD prevalence was higher among black versus white veterans and male versus female veterans. One-year age-standardized mortality was 10.7%.

CONCLUSIONS — Nephropathy is prevalent in veterans with diabetes. Greater mortality is observed among those with renal disease compared with those without renal disease. Additional surveillance is needed to identify persons likely to progress to diabetic nephropathy and to plan for appropriate and timely health care for these individuals.

Diabetes Care **27 (Suppl. 2):B45–B49, 2004**

Diabetes is a prevalent disease in the U.S. Approximately 17 million Americans are estimated to have diabetes, but only 11.1 million are aware that they have the disease (1). Approximately 5–10% of persons with diabetes will have type 1 diabetes and 90–95% will have type 2 diabetes (1,2). Among those with diabetes, the prevalence of kidney disease ranges from 20 to 40% and varies depending on the type and duration of diabetes (3–11).

Diabetic nephropathy is now the leading cause of end-stage renal disease (ESRD) in the U.S. and accounts for 40.3% of all new cases of dialysis (12). Because the prevalence of type 2 diabetes is substantially higher than type 1 diabetes, most persons diagnosed with diabetic ESRD will have type 2 diabetes (12–14). Limited population-based data and no national registry data describe the incidence or prevalence of diabetic renal disease before the onset of ESRD (5,9–11,15–17). Most studies have evaluated the incidence and/or prevalence of microalbuminuria or "incipient diabetic nephropathy" in confined geographic areas or for a specific homogeneous population; however, few studies describe the prevalence of diagnosed diabetic nephropathy or associated renal disease before initiation of dialysis.

Determining the number of individuals diagnosed with diabetic nephropathy in a population-based setting before ESRD is difficult—yet necessary to project for future resource utilization—because not every person with diabetes progresses to diabetic nephropathy or ESRD. The Veterans Administration (VA) routinely collects national data from which these questions can be answered. The purpose of this article is to describe the characteristics, morbidity, and mortality for veterans with diabetic renal disease receiving VA care.

RESEARCH DESIGN AND METHODS

— Veterans with diabetes were identified through national VA databases at the Austin Automation Center, Austin, Texas. Inpatient and outpatient data were extracted from the Patient Treatment Files (PTFs) and Outpatient Care Files (OPCs) using ICD-9 and CPT codes as outlined in Table 1 (18,19).

Veterans with diabetes were identified by having at least one outpatient visit with an ICD-9 diagnosis code of 250.xx for FY1998 and a total of three or more visits for that year. Persons with diabetes and renal disease were defined by ICD-9 code 250.4 (diabetic nephropathy) or a code for diabetes (250.xx) coupled with additional secondary renal conditions, including nephropathy, glomerulonephritis, or glomerulonephropathy. Veterans with a diagnosis of diabetes and other renal diseases (interstitial nephritis, acute renal failure, cystic disease, secondary vasculitis, hypertensive disease, neoplasms, glomerulonephritis from another cause, or other renal diseases) were identified through additional codes. Veteran mortality was determined using the Ben-

From the [1]Seattle Epidemiologic Research and Information Center, Department of Veterans Affairs, Puget Sound Health Care System, Seattle, Washington; [2]Health Services Research and Development, Department of Veterans Affairs, Puget Sound Health Care System, Seattle, Washington; the [3]Department of Medicine, Division of General Internal Medicine, Department of Veterans Affairs, Puget Sound Health Care System, Seattle, Washington; [4]Northwest Kidney Centers, Seattle, Washington; [5]VERDICT Health Services Research and Development Center of Excellence, Department of Veterans Affairs, South Texas Veterans Health Care System, San Antonio, Texas; the [6]Department of Medicine, Division of General Internal Medicine, University of Texas Health Science Center, San Antonio, Texas; the [7]Department of Health Services, University of Washington, Seattle, Washington; and the [8]Department of Epidemiology, University of Washington, Seattle, Washington.

Address correspondence and reprint requests to Bessie A. Young, MD, MPH, VA Puget Sound Health Care System (152-E), 1660 S. Columbian Way, Seattle, WA 98108. E-mail: youngb@u.washington.edu.

Received for publication 1 July 2003 and accepted 25 July 2003.

Funding for this supplement was provided by The Seattle Epidemiologic Research and Information Center and the VA Cooperative Studies Program.

Abbreviations: ESRD, end-stage renal disease; VA, Veterans Administration.

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

Table 1—*Diabetes and renal disease ICD-9 and CPT codes*

Diagnosis/procedure	ICD-9	CPT
Diabetes	250.xx	
Diabetic renal disease	250.xx plus any codes listed below	
Diabetic nephropathy/ glomerulonephritis/ glomerulonephropathy	250.4, 250.xx plus 580, 581, 582, 583	
Other renal disease in diabetes		
Secondary vasculitis	446.0, 446.4, 447.8, 710.0	
Interstitial nephritis/pyelonephritis	274.10, 590.00, 592, 593.89, 753.20, 753.3	
Hypertensive/large vessel disease	403.00, 403.90, 403.90, 440.1, 593.81	
Neoplasms/tumors	189.0, 189.1, 233.9, 236.91, 239.5, 238.6, 203.0, 277.3	
Polycystic, acquired cystic disease	753.10–753.14, 753.19	
Other (hereditary, congenital, and other conditions)	588, 589, 593, 759.89, 996.85, 996, 8042, 866.00, 587	
Renal failure		
Acute renal failure	584	
ESRD or uremia	585, 586	
Dialysis		
Hemodialysis	39.95 (procedure code)	90935, 90937
Peritoneal dialysis	54.98 (procedure code)	90945, 90947
Transplantation	55.6 (procedure code)	

eficiary Identification and Records Locator System (BIRLS) death file.

Data were initially downloaded as SAS data files (20). Data analyses were performed using SPSS and STATA statistical software packages (21,22). Renal disease prevalence rates were calculated for veterans with diabetes, as diagnosed by ICD-9 code. Standardized prevalence rates were compiled using the direct method; rates were age adjusted to the 1990 U.S. population of individuals aged 18 years and older (23). One-year, age-standardized mortality was computed using the direct method (23). Among veterans with diabetes and renal disease, analyses of differences in comorbid characteristics were conducted using the independent Student's *t* test for continuous data and the χ^2 test for categorical data (24).

RESULTS

Prevalence of diabetes and renal disease

The median age for veterans with diabetes and renal disease was 67 years; 98.4% were male (Table 2). White veterans with renal disease comprised 59.9% of the population, followed by black (22.3%) and Hispanic (6.2%) veterans. Race or ethnicity was unknown for 10.6%. Compared with diabetic individuals without renal disease, veterans with diabetes and

Table 2—*Characteristics of veterans with diabetes with and without renal disease*

Characteristic	Veterans with renal disease	Veterans without renal disease
n	44,671	374,253
Age (years)	67 ± 10	64 ± 12*
Males (%)	98.4	97.3†
Race (%)		
Hispanic	6.2	6.2‡
Native American	0.5	0.4
Black	22.3	14.5
Asian	0.6	0.5
White	59.9	55.8
Unknown	10.6	22.7
Region (%)		
Northeast	19.3	21.6‡
South	38.4	37.9
Midwest	22.7	21.3
West	19.6	19.3
Comorbid conditions (%)		
Cardiovascular	59.5	38.6†
Stroke	12.7	6.8†
High blood pressure	82.1	65.6†
Cancer	18.1	10.7†
Depression	12.6	11.9†
COPD	21.9	14.4†
Eye exam (%)	52.9	47.4†
Number of clinic visits in FY1998	26.7 ± 26.6	17.0 ± 19.2*
Hospitalized in FY1998 (%)	43.6	15.4†
Number of amputations	1.93 ± 1.23	1.72 ± 1.11*
One-year mortality (%)	10.7	2.9†

Data are means ± SD. *$P < 0.0001$ using the independent Student's *t* test; †$P < 0.0001$ using the Pearson's χ^2 test for categorical data; ‡$P < 0.0001$ using the χ^2 test. COPD, chronic obstructive pulmonary disease.

Table 3—*Age- and population-adjusted prevalence (per 1,000 persons) of renal disease in veterans with diabetes

Renal disease category	Number (%)	Prevalence/ 1,000 persons	Disease prevalence* By ethnicity/race: White (n = 26,679)	Black (n = 9,961)	Other race (n = 3,263)	Unknown race (n = 4,768)	By sex: Men (n = 43,952)	Women (n = 719)
All renal disease	44,671 (100)	72.6	76.1	103.4	79.4	38.4	73.4	55.6
Diabetic nephropathy								
All cases	25,263 (56.6)	13.6	16.0	16.4	14.1	7.3	13.9	9.4
ESRD only	17,636 (39.5)	27.2	26.5	44.9	33.6	13.1	28.2	13.4
Other renal disease								
Intersitial	4,677 (10.5)	10.2	12.0	8.0	13.6	7.3	10.2	9.4
ARF	1,941 (4.3)	3.2	2.7	6.3	3.4	0.8	3.2	2.1
Tumor	1,276 (2.9)	1.4	1.6	1.6	1.8	0.7	1.5	0.7
HTN	1,224 (2.9)	1.8	1.7	3.3	1.9	0.9	1.8	0.8
Cystic	863 (1.9)	2.2	2.0	3.1	2.2	1.5	1.6	10.2
Other	9,317 (20.9)	12.9	13.6	19.9	9.3	5.6	14.0	9.7

*Diabetic nephropathy group includes veterans with diabetes with ESRD (number of cases/1,000). Prevalences computed from inpatient and outpatient files; age adjusted to 1990 ≧18-year-old U.S. population. ESRD, end-stage renal disease; ARF, acute renal failure; HTN, hypertensive renal disease; cystic, cystic renal disease; other includes all categories of renal disease not identified above and "not otherwise specified."

renal disease were significantly older, more likely to be of black race, and more likely to have comorbid conditions. Cardiovascular disease, stroke, high blood pressure, and chronic obstructive pulmonary disease were all significantly more common in veterans with diabetes and renal disease than those without renal disease.

Of the 415,910 veterans identified with diabetes, 44,671 carried a diagnosis of any type of renal diseases; of those, 56.6% (25,263) had a diagnosis of diabetic nephropathy and 39.5% (17,636) had a diagnosis of diabetic ESRD (Table 3). ESRD among those with diabetic nephropathy was present in 70% of veterans. In veterans with diabetes and other renal diseases, interstitial disease (10.5%) was the most frequent diagnosis, and acute renal failure accounted for 4.3%. Less than 10% of the renal diagnoses were secondary to tumor, hypertension, or cystic disease. Renal diseases secondary to congenital abnormality, hereditary abnormality, sickle cell disease, or "not otherwise specified" were included in the "other" category (20.9%).

Prevalence of renal disease

The age-standardized prevalence of diabetic renal disease was 72.6/1,000 persons. The prevalence of diabetic nephropathy excluding ESRD was 13.6/1,000 persons. The prevalence of diabetic nephropathy including ESRD was 27.2/1,000 persons. When evaluated by race/ethnicity, black veterans with diabetes had a higher age-adjusted prevalence of renal disease (103.4/1,000 persons) compared with white veterans (76.1/1,000 persons). In addition, the prevalence of diabetic nephropathy with ESRD was higher in black (44.9/1,000) compared with white (26.5/1,000) veterans. The frequency of acute renal failure was also higher in black (6.3/1,000) compared with white (2.7/1,000) veterans.

Sex differences

Sex differences in renal disease were evaluated and are shown in Table 3. Men had greater prevalence of all renal disease compared with women (28.2/1,000 vs. 13.4/1,000). In addition, the prevalence of other renal diseases was 1.4- to 2.0-fold greater in men than in women veterans, with the exception of cystic renal disease, the frequency of which was significantly greater in women (10.2/1,000) than in men (1.6/1,000).

Mortality

As shown in Table 4, annual age-adjusted mortality was calculated. Among veterans with renal disease, mortality increased with age as expected. Veterans younger than 45 years had the lowest annual mortality (4.1%), while veterans over age 75

Table 4—*One-year mortality risk for veterans with diabetes and renal disease*

Age-group	All veterans % (number of deaths): Total population	% deaths	Ethnicity/race % (number of events): Caucasian (n = 26,679)	African American (n = 9,961)	Other* (n = 8,036)	Sex % (number of events): Men (n = 43,952)	Women (n = 719)
<45	1,207	4.1	4.2	5.3	2.0	4.2	2.0
45–64	14,957	7.2	7.9	7.3	8.2	7.2	2.5
65–74	17,528	11.2	12.0	11.3	14.3	11.2	9.7
75+	10,979	15.6	16.8	16.7	18.0	15.6	18.1
Total	44,671	10.7	11.9	10.7	12.4	10.8	7.7

*Other includes those veterans identified as Asian, Hispanic, or Native American. Veterans of unknown ethnicity are not shown.

years had the highest (15.6%). The overall age-adjusted 1-year mortality among all veterans with diabetes and renal disease was 10.7%. In addition, overall age-adjusted mortality was higher in men (10.8%) than in women (7.7%).

CONCLUSIONS — Diabetes is a pervasive disease and affects 12.5% of veterans served in VA outpatient clinics (25). We found prevalent renal disease in 10.7% of veterans with diabetes, which occurred at a frequency of 72.6/1,000 patients. The prevalence of comorbid conditions was significantly greater in veterans with diabetes and renal disease than in veterans with diabetes without renal disease. Among those with diabetes and renal disease, the most common recorded renal diagnosis was diabetic nephropathy and ESRD. Black veterans were disproportionately affected with ESRD compared with white veterans, as were men compared with women.

Using ICD-9 diagnoses of renal disease to identify patients, we observed a greater prevalence of renal disease than reported previously. The prevalence of diabetic renal disease in population-based studies has varied widely. In a population of patients with diabetes, Klein and colleagues (9,10) reported a similar prevalence of microalbuminuria in younger patients (21%) and macroalbuminuria in older patients (18.4%) in Wisconsin. Prevalence varied by insulin usage and duration of diabetes. Since microalbuminuria and macroalbuminuria may represent an earlier end of the spectrum of diabetic nephropathy than that used in the current study, their results may not be comparable to those of the current study. In addition, Humphrey and Ballard (6), using a definition of chronic renal failure as a serum creatinine >4.0 mg/dl and/or proteinuria, reported a 3% prevalence of chronic renal failure among their diabetic patients. Age- and sex-adjusted incidence rates of diabetic nephropathy were 235/100,000 person-years for those with type 1 diabetes and 50/100,000 person-years for those with type 2 diabetes, values which are substantially lower than that observed in the current study. This difference may be due to differences in our case definition and patient population, or it may represent an increase in secular trends in the development of diabetic renal disease (12).

We also observed that the prevalence of diabetic nephropathy in a heterogeneous population differed from that reported by others in more homogeneous populations. Several authors (15–17) have evaluated the epidemiology of early diabetic nephropathy in population-based settings; however, data on more advanced disease are limited. Pima Indians, for whom the risk of diabetic ESRD is greatest (16), have elevated prevalence of incipient diabetic nephropathy, which varies widely by age (47–61%) (26,27). Population-based prevalence of diabetic nephropathy before the initiation of dialysis among Pima Indians has not been reported. In addition, compared with the current study, a similar prevalence of diabetic nephropathy (12.5%) was found in a population-based Norwegian cohort study; however, diabetic nephropathy or advanced renal disease prevalence was not reported.

The current study found that renal disease prevalence differed significantly by race. Our study confirms that of previous reports, most of which have shown that minority groups tended to have higher rates of ESRD than whites (13,16,28,31). Ethnic differences in the risk of renal disease were not evaluated in the current study.

In addition to the above findings, the current study found that women veterans treated in the VA were less affected by renal disease than men. In regard to whether this discrepancy represents differences in the biology of diabetic renal disease by sex among veterans, the small proportion of women veterans, or selection factors leading to noncomparability between male and female veterans with regard to risk of diabetic renal disease cannot be determined from this analysis.

Finally, we observed that the overall age-standardized mortality over 1 year was 10.7% for all veterans with diabetes and a diagnosis of renal disease. National race- and age-adjusted mortality rates are not available for persons with diabetes and renal disease before the onset of ESRD. The age-, race-, and sex-adjusted standardized mortality rate reported by the U.S. Renal Data System (USRDS) (23.2/100 patient-years) is greater than that reported by our study. It is likely that the USRDS population includes more type 1 diabetic patients, who may have greater disease severity and higher mortality than a population eligible for military service (12).

This study has a number of strengths, one of which includes evaluation of a large cohort of veterans who received primary health care in a national setting. However, a number of limitations exist. Because the current study used administrative data to identify persons with diabetes, selection bias may have occurred. In addition, the potential for misclassification of diabetic renal disease and ESRD was also possible since the diagnosis of diabetic nephropathy relied exclusively on ICD-9 codes and access to clinical, pharmacy, or histologic data was not available for disease confirmation. Further, the lack of clinical data, such as microalbuminuria, proteinuria, or creatinine levels, may have led to an underestimation of the true number of veterans with diabetic renal disease.

An additional limitation was the inability to distinguish between persons with type 1 and type 2 diabetes. Veterans with type 1 diabetes might have different renal disease outcomes compared with those with type 2 diabetes, although no data that directly compare the course of renal disease between type 1 and type 2 diabetic patients currently exist. However, the prevalence of type 1 diabetes is thought to be low in veterans, as type 1 diabetes is an exclusion criterion for military service.

Finally, this study was limited in its ability to determine significant differences based on sex. Because women only represented 2% of the diabetic veteran population, the study lacked power to evaluate sex differences in diabetic renal disease rates stratified by race or ethnicity. Sex differences in type 1 diabetes renal disease prevalence have been described in a population of type 1 diabetic patients, results of which varied as function of duration of diabetes (7). Duration of diabetes was not available in our database.

In summary, we found that renal disease was present in a large number of veterans with diabetes who received VA medical care during FY1998. Prevalence of renal disease varied by race and sex. The most frequently identified type of renal disease in this population was diabetic nephropathy. Veterans with diabetes and renal disease were older, more likely to have associated comorbid conditions, and less likely to survive for 1 year. This information may provide assistance to persons involved in health care planning who care for people with similar demo-

graphic features, as well as for identifying potential areas for further investigation.

Acknowledgments— The Department of Veterans Affairs, Veterans Health Administration, Epidemiologic Research and Information Center, and Health Services Research and Development, Seattle, Washington, supported the research reported and outlined in this article.

At the time of this research, B.A.Y. was a fellow in the Health Services Research and Development Program at VA Puget Sound. B.A.Y. is currently supported by an American Diabetes Association Career Development Award and a Robert Wood Johnson Minority Faculty Development Fellowship. G.R. is supported by a VA Health Services Research and Development Career Scientist Award.

References

1. American Diabetes Association [Web site]. Available at http://www.diabetes.org. Accessed 19 June 2003
2. Kenny S, Aubert R, Geiss L: Prevalence and incidence of non-insulin-dependent diabetes. In *Diabetes In America*. Harris M, Cowie C, Stern M, Boyko E, Reiber G, Bennett P, Eds. Washington, DC, US Government Printing Office (publication no. NIH 95-1468), 1995, p. 47–67
3. Nelson RG, Newman JM, Knowler WC, Sievers ML, Kunzelman CL, Pettitt DJ, Moffett CD, Teutsch SM, Bennett PH: Incidence of end-stage renal disease in type 2 (non-insulin-dependent) diabetes mellitus in Pima Indians. *Diabetologia* 31: 730–736, 1988
4. Hasslacher C, Ritz E, Wahl P, Michael C: Similar risks of nephropathy in patients with type I or type II diabetes mellitus. *Nephrol Dial Transplant* 4:859–863, 1989
5. Humphrey LL, Ballard DJ, Frohnert PP, Chu CP, O'Fallon WM, Palumbo PJ: Chronic renal failure in non-insulin-dependent diabetes mellitus: a population-based study in Rochester, Minnesota. *Ann Intern Med* 111:788–796, 1989
6. Humphrey LL, Ballard DJ: Renal complications in non-insulin-dependent diabetes mellitus. *Clin Geriat Med* 6:807–825, 1990
7. Orchard TJ, Dorman JS, Maser RE, Becker DJ, Drash AL, Ellis D, LaPorte RE, Kuller LH: Prevalence of complications in IDDM by sex and duration. *Diabetes* 39:1116–1124, 1990
8. Nelson RG, Knowler WC, Bennett PH: Natural history of diabetic nephropathy in non-insulin-dependent diabetes mellitus. *J Diabetes Complications* 5:76–78, 1991
9. Klein R, Klein BE, Linton KL, Moss SE: Microalbuminuria in a population-based study of diabetes. *Arch Int Med* 152:153–158, 1992
10. Klein R, Klein BE, Moss SE: Incidence of gross proteinuria in older-onset diabetes: a population-based perspective. *Diabetes* 42:381–389, 1993
11. Nelson RG, Knowler WC, Pettitt DJ, Hanson RL, Bennett PH: Incidence and determinants of elevated urinary albumin excretion in Pima Indians with NIDDM. *Diabetes Care* 18:182–187, 1995
12. U. S. Renal Data System: *USRDS 1999 Annual Data Report*. Bethesda, MD, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, 1999
13. Ibrahim HN, Hostetter TH: Diabetic nephropathy. *J Am Soc Nephrol* 8:487–493, 1997
14. Ritz E, Stefanski A: Diabetic nephropathy in type II diabetes. *Am J Kidney Dis* 27: 167–194, 1996
15. Martin TL, Selby JV, Zhang D: Physician and patient prevention practices in NIDDM in a large urban managed-care organization. *Diabetes Care* 18:1124–1132, 1995
16. Nelson RG, Bennett PH, Beck GJ, Tan M, Knowler WC, Mitch WE, Hirschman GH, Myers BD: Development and progression of renal disease in Pima Indians with non-insulin-dependent diabetes mellitus: Diabetic Renal Disease Study Group. *N Engl J Med* 335:1636–1642, 1996
17. Joner G, Brinchmann-Hansen O, Torres CG, Hanssen KF: A nationwide cross-sectional study of retinopathy and microalbuminuria in young Norwegian type 1 (insulin-dependent) diabetic patients. *Diabetologia* 35:1049–1054, 1992
18. Physician ICD-9-CM. In *Medicode Publications*. Speirs L, Ed. Salt Lake City, UT, 1999, p. 671
19. Staff CE, Ed.: *Current Procedural Terminology*. Chicago, IL, American Medical Association, 1999
20. SAS [computer program]. Version 6.12. Cary, NC, SAS, 1996
21. SPSS [computer program]. Version 8.0. Chicago, IL, SPSS, 1998
22. Stata [computer program]. Version 6.0. College Station, TX, Stata, 1999
23. Rothman K, Greenland S: *Modern Epidemiology*. Philadelphia, PA, Lippincott-Raven Publishers, 1998
24. Rosner B: *Fundamentals of Biostatistics*. 4th ed. Wadsworth Publishing Company, Belmont, CA, 1995
25. Krein SL, Hayward RA, Pogach L, Boots-Miller BJ: Department of Veterans Affairs' quality enhancement research initiative for diabetes mellitus. *Medical Care* 38 (Suppl. 1):138–148, 2000
26. Nelson RG, Kunzelman CL, Pettitt DJ, Saad MF, Bennett PH, Knowler WC: Albuminuria in type 2 (non-insulin-dependent) diabetes mellitus and impaired glucose tolerance in Pima Indians. *Diabetologia* 32:870–876, 1989
27. Nelson RG, Knowler WC, McCance DR, Sievers ML, Pettitt DJ, Charles MA, Hanson RL, Liu QZ, Bennett PH: Determinants of end-stage renal disease in Pima Indians with type 2 (non-insulin-dependent) diabetes mellitus and proteinuria. *Diabetologia* 36:1087–1093, 1993
28. Cowie CC, Port FK, Wolfe RA, Savage PJ, Moll PP, Hawthorne VM: Disparities in incidence of diabetic end-stage renal disease according to race and type of diabetes. *N Engl J Med* 321:1074–1079, 1989
29. Pugh JA TM, Basu S: Survival among Mexican-Americans, non-Hispanic whites, and African Americans with end-stage renal disease: the emergence of a minority pattern of increased incidence and prolonged survival. *Am J Kidney Dis* 23:803–807, 1994
30. Nelson RG, Hanson RL, Pettitt DJ, Knowler WC, Bennett PH: Survival during renal replacement therapy for diabetic end-stage renal disease in Pima Indians. *Diabetes Care* 19:1333–1337, 1996
31. Nelson RG, Meyer TW, Myers BD, Bennett PH: Clinical and pathological course of renal disease in non-insulin-dependent diabetes mellitus: the Pima Indian experience. *Sem Nephrol* 17:124–131, 1997
32. Nelson RG, Everhart JE, Knowler WC, Bennett PH: Incidence, prevalence and risk factors for non-insulin-dependent diabetes mellitus. *Primary Care Clin Office Pract* 15:227–250, 1988
33. Damsgaard EM, Froland A, Jorgensen OD, Mogensen CE: Eight to nine year mortality in known non-insulin dependent diabetics and controls. *Kidney Int* 41: 731–735, 1992
34. Rossing P, Hougaard P, Borch-Johnsen K, Parving HH: Predictors of mortality in insulin dependent diabetes: 10 year observational follow up study. *BMJ* 313:779–784, 1996
35. Valmadrid CT, Klein R, Moss SE, Klein BE: The risk of cardiovascular disease mortality associated with microalbuminuria and gross proteinuria in persons with older-onset diabetes mellitus. *Arch Int Med* 160:1093–1100, 2000