Variation in the Incidence and Proportion of Diabetes-Related Amputations in Minorities

LAWRENCE A. LAVERY, DPM, MPH
HISHAM R. ASHRY, DPM, MS
WILLIAM VAN HOUTUM, MS
JACQUALINE A. PUGH, MD
LAWRENCE B. HARKLESS, DPM
SRABASHI BASU, PHD

OBJECTIVE — To identify the age-adjusted and level-specific incidence of amputations associated with diabetes in Hispanics, African-Americans, and non-Hispanic whites.

RESEARCH DESIGN AND METHODS — We used a database from the Office of Statewide Planning and Development in California that identified all hospitalizations for lower-extremity amputations in the state in 1991. Amputation level was defined by ICD-9-CM codes 84.11–84.18 and were categorized as toe, foot, leg, and thigh amputations.

RESULTS — The age-adjusted incidence of diabetes-related amputation per 10,000 persons with diabetes in 1991 was 95.25 in African-Americans, 55.98 in non-Hispanic whites, and 44.43 in Hispanics. Hispanics had a higher proportion of amputations (82.7%) associated with diabetes than did African-Americans (61.6%) or non-Hispanic whites (56.8%) ($P < 0.001$). African-Americans had the highest age-adjusted incidence rate for each level in people with and without diabetes. African-Americans underwent more proximal amputations compared with non-Hispanic whites and Hispanics ($P < 0.001$). Diabetes-related amputations were 1.72 and 2.17 times more likely in African-Americans compared with non-Hispanic whites and Hispanics, respectively.

CONCLUSIONS — Hispanics had proportionally more amputations associated with diabetes than did African-Americans or non-Hispanic whites. A significant excess incidence of both diabetes- and non-diabetes-related amputations and proportionally more proximal amputations were identified in African-Americans compared with Hispanics and non-Hispanic whites. A possible explanation could be the higher prevalence of peripheral vascular disease in African-Americans. Public health initiatives, which have been demonstrated to reduce the incidence of diabetes-related lower-extremity amputations, should be implemented, and additional work should focus on minority groups.

In the U.S., approximately half of all amputations involve patients with diabetes (1,2). It has been estimated that as many as 15% of diabetic subjects will experience a lower-extremity amputation in their lifetime (3). In the U.S., there are ~60,000 diabetes-related lower-extremity amputations each year (4,5), with the cost of amputations averaging ~$25,000 per case (6).

The prevalence of diabetes is as much as two to four times greater in Hispanics and African-Americans compared with non-Hispanic whites (7,8). Likewise, diabetes-related complications such as retinopathy and kidney disease have been shown to disproportionately affect both of these minority groups (8–11). Amputation of the foot or leg is one of the most feared complications associated with diabetes, and while there have been several reports that have identified the incidence and risk of diabetes-related lower-extremity amputations (1,12–15), little or no specific information exists regarding the impact of diabetes-related amputations in Hispanics and African-Americans.

Although diabetes-related amputations are a common and costly complication, it has been estimated that half of the amputations in people with diabetes can be prevented when patients participate in a multispecialty team approach to foot complications associated with diabetes (16–18). Identification of high-risk groups is important to help administrators and health care providers plan intervention programs and raise awareness of the problem within targeted communities. The purpose of this project was to identify the incidence and risk of lower-extremity amputation in Hispanics, African-Americans, and non-Hispanic whites with diabetes.

RESEARCH DESIGN AND METHODS

— Data analyzed in this project were obtained from the Office of Statewide Planning and Development in California for 1991 and included all hospitals in the state of California with the exception of Veteran Administration and military facilities. Lower-extremity amputations were identified from ICD-9-CM codes 84.11–84.18. Amputations were categorized as toe (84.11), foot (84.12), leg (84.13–84.16), or thigh (84.17–84.18). A diagnosis of diabetes was identified by the presence of any 250-related ICD-9-CM code. Amputations with a trauma-related code were eliminated from analysis. These included ICD-9-CM codes 895–897, 905.9, 928–929, and 959 (19).

Estimates of the number of people with diabetes were obtained by applying age- and sex-specific prevalence of diagnosed cases of diabetes from the National Health and Nutrition Examination Survey II and the Hispanic Health and Nutrition Examination Survey to California population estimates from the 1990 U.S. Census for Hispanics, African-Americans, and non-Hispanic whites (7,20). No unique patient identifiers were available. There-

From the Departments of Orthopaedics (L.A.L., H.R.A., W.V.H., L.B.H.) and Medicine (J.A.P., S.B.), The Mexican American Medical Treatment Effectiveness Research Center, The University of Texas Health Science Center, San Antonio, Texas.

Address correspondence and reprint requests to Lawrence A. Lavery, DPM, MPH, The University of Texas Health Science Center, Department of Orthopaedics, 7703 Floyd Curl Dr., San Antonio, TX 78284-7776.

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Table 1—*Age-adjusted incidence and relative risk of lower-extremity amputation per 10,000 persons at risk*

Amputation site	Diabetes (95% CI)	No diabetes (95% CI)	Relative risk (95% CI)
Toe			
Hispanic	21.16 (19.09–23.22)	0.41 (0.31–0.51)	51.55 (39.35–67.53)
Non-Hispanic white	24.88 (22.70–27.06)	0.39 (0.35–0.42)	64.36 (56.62–73.16)
African-American	36.16 (31.30–41.02)	1.07 (0.80–1.27)	34.08 (26.36–44.07)
Foot			
Hispanic	4.48 (3.58–5.37)	0.08 (0.04–0.14)	52.08 (28.06–96.67)
Non-Hispanic white	5.66 (4.66–6.66)	0.09 (0.07–0.11)	62.53 (48.12–81.24)
African-American	10.20 (7.48–12.91)	0.43 (0.28–0.59)	23.52 (15.14–36.53)
Leg			
Hispanic	13.66 (12.25–15.07)	0.62 (0.49–0.76)	22.00 (17.28–28.01)
Non-Hispanic white	18.79 (16.94–20.64)	0.64 (0.59–0.69)	29.37 (25.99–33.19)
African-American	32.81 (28.56–37.07)	2.19 (1.18–2.49)	15.15 (12.36–18.56)
Thigh			
Hispanic	5.13 (4.29–5.98)	0.62 (0.48–0.76)	8.26 (6.27–10.90)
Non-Hispanic white	6.64 (5.84–7.45)	0.89 (0.83–0.94)	7.47 (6.52–8.56)
African-American	16.09 (13.45–18.73)	3.10 (2.65–3.48)	5.29 (4.27–6.54)
All sites			
Hispanic	44.43 (41.64–47.21)	1.74 (1.51–1.96)	25.56 (22.13–29.51)
Non-Hispanic white	55.98 (52.85–59.10)	2.01 (1.92–2.09)	27.84 (25.35–30.33)
African-American	95.25 (87.79–102.71)	6.79 (6.08–7.29)	14.16 (12.57–15.95)

All associations were significant, $P < 0.001$.

fore, it was not possible to identify multiple amputations in an individual unless the subsequent amputation occurred during the same hospitalization period. When multiple amputations were performed on the same patient during the same hospitalization, only the highest level was used in the data analysis. Age-adjusted incidence rates per 10,000 people with and without diabetes were calculated for each group using a direct standardization method with the 1990 U.S. population as the standard population. We used a normal test (Z statistic) to compare incidence rates, a χ^2 test for trend stratified by age to determine significant differences in the proportion of diabetes-related amputations involving the toe, foot, leg, and thigh within and between groups, and a Mantel-Haenszel χ^2 test to compare differences in the proportion of amputations associated with diabetes between groups. To calculate a 95% CI for the relative risk, we used the formula described by Miettinen's (21).

RESULTS— In California during 1991, there were 8,169 hospitalizations for lower-extremity amputations in African-Americans, Hispanics, and non-Hispanic whites. There was a higher proportion of lower-extremity amputations due to diabetes in Hispanics compared with African-Americans ($X^2_{MH} = 122.4$, $P < 0.001$) and non-Hispanic whites ($X^2_{MH} = 265.4$, $P < 0.001$) after adjusting for age. Likewise, there were more amputations due to diabetes in African-Americans than in non-Hispanic whites ($X^2_{MH} = 6.7$, $P < 0.01$). Overall, 62.6% of amputations were in people with diabetes. Diabetes was associated with 82.7% of all amputations in Hispanics, 61.6% in African-Americans, and 56.8% in non-Hispanic whites.

The age-adjusted incidences of lower-extremity amputations (95% CI) per 10,000 people with diabetes were as follows: toe 24.11 (22.69–25.53), foot 5.60 (4.93–6.27), leg 17.46 (16.35–18.57), thigh 6.73 (6.18–7.28), and total 53.90 (51.90–55.90). The incidence of diabetes-related lower-extremity amputa-

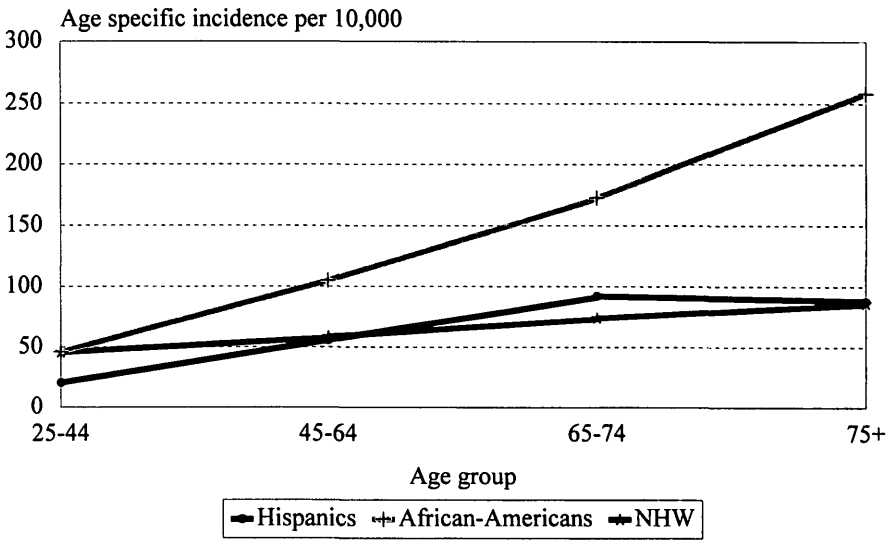

Figure 1—*Age-specific incidence of diabetes-related amputations in Hispanics, African-Americans, and non-Hispanic whites.*

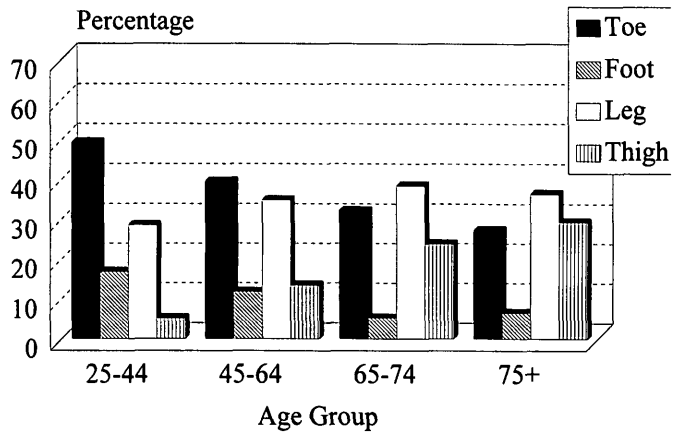

Figure 2—*Proportion of amputations for toe, foot, leg, and thigh levels in African-Americans with diabetes by age-group.*

tion was significantly greater in African-Americans compared with Hispanics and non-Hispanic whites. In both diabetic and nondiabetic subjects, African-Americans had the highest age-adjusted incidence of diabetes-related amputation for every level of amputation (Table 1). In people both with and without diabetes, there was an increase in the age-specific incidence of amputation in every group as age increased (Fig. 1).

Overall, toe amputations were the most common level of amputation and had the highest level-specific incidence of amputation in all three groups. The proportion of toe amputations decreased and thigh amputations increased as age increased in all three groups (Figs. 2–4). There were proportionally more proximal amputations in African-Americans compared with non-Hispanic whites ($P < 0.001$, $X^2 = 8.99$) and Hispanics ($P < 0.001$, $X^2 = 18.9$). Likewise, non-Hispanic whites had proportionally more proximal amputations than Hispanics ($P = 0.048$, $X^2 = 3.9$).

CONCLUSIONS— The total age-adjusted incidence of lower-extremity amputations associated with diabetes in African-Americans and non-Hispanic whites in the state of California in 1991 was similar to previous reports of diabetes-related lower-extremity amputations in the U.S. We have been unable to identify any reports in the medical literature of diabetes-related lower-extremity amputations that include Hispanics; identify level-specific incidence for African-Americans, Hispanics, and non-Hispanic whites; or compare the proportion of amputations for each level between groups. The age-adjusted incidence of diabetes-related amputations in the U.S. per 10,000 people with diabetes has been reported to be 51.0 in Washington state in 1988 (12) and 76.8 in New Jersey in 1979–1981 (13). The Centers for Disease Control compared amputations in African-Americans and non-Hispanic whites and found rates of 90.0 per 10,000 people with diabetes compared with 63.0, respectively, in 1987 (15). Previous reports relied on data sets that did not have specific identifiers for race. Minorities were often combined. Without addressing the significant differences in the prevalence of diabetes in minorities, the population of people with diabetes at risk for an amputation was probably underestimated and the incidence of diabetes-related lower-extremity amputations in the general population may have been overestimated, especially in areas with large African-American populations.

The reason for the higher proportion of amputations due to diabetes in minorities and the excess incidence in African-Americans with and without diabetes needs to be examined more thoroughly. The high proportion of amputations in diabetic subjects in California (82.7% in Hispanics and 61.6% in African-Americans) is in contrast to previous reports that have identified that 45% of amputations involved diabetic subjects (1). Ethnic differences in the prevalence of risk factors for amputation may explain the variations observed in the risk of amputation associated with diabetes in minority groups. Significant risk factors for lower-extremity amputation in people with diabetes include poor glycemic control, duration of diabetes >10 years, peripheral vascular disease, peripheral neuropathy, retinopathy, nephropathy (14, 22), and no regular health care (22).

Mexican-Americans and African-Americans have significantly higher serum glucose levels and develop diabetes at a younger age than do non-Hispanic whites (7,8,23). Consequently, both of these groups have diabetes of longer duration in comparison to non-Hispanic whites of the same age. Poor glycemic control, increased age, and duration of diabetes have also been associated with peripheral vascular disease (25–27) and peripheral neuropathy (28,29). Both peripheral vascular disease and neuropathy have been demonstrated to be two of the most important risk factors for amputation associated with diabetes (22).

African-Americans with diabetes have higher prevalence and incidence of peripheral vascular disease than do non-

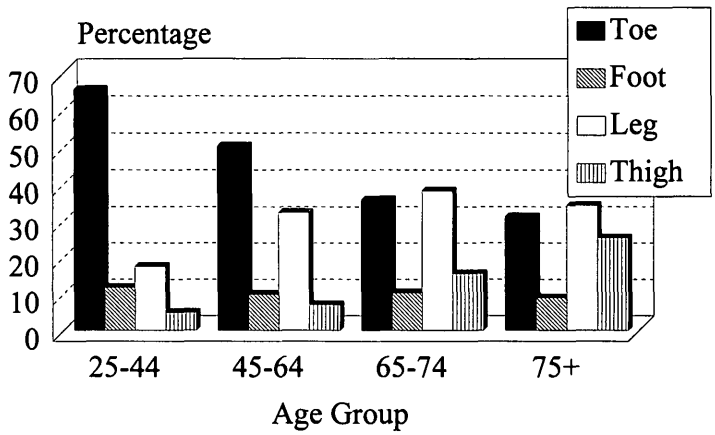

Figure 3—*Proportion of amputations for toe, foot, leg, and thigh levels in Hispanics with diabetes by age-group.*

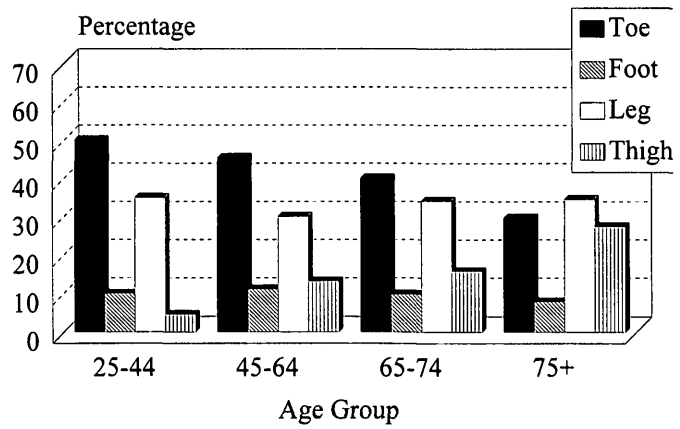

Figure 4—*Proportion of amputations for toe, foot, leg, and thigh levels in non-Hispanic whites with diabetes by age-group.*

Hispanic whites (8,30). However, neither African-Americans or Hispanics have a higher prevalence of diabetic peripheral neuropathy compared with non-Hispanic whites (28,32). African-Americans also have more infratrifurcation disease and more severe peripheral arterial occlusive disease compared with non-Hispanic whites (31). Although Hispanics have been shown to have an increased prevalence of peripheral vascular disease compared with non-Hispanic whites, this association was not statistically significant (24,30). Since peripheral vascular occlusion plays such a pivotal role in the etiology of lower-extremity amputations, especially proximal amputations, inequality in access to medical and surgical services to identify and treat vascular compromise in minorities may affect the choice of amputation over revascularization. In contrast to reports of cardiovascular disease and coronary artery bypass surgery that indicate African-Americans have fewer coronary bypass surgeries (33,34), African-Americans in Maryland were 39% more likely to have lower-extremity bypass surgery than were non-Hispanic whites for peripheral arterial occlusive disease; however, African-Americans still had considerably more amputations than did non-Hispanic whites (35). More severe vascular disease may decrease both the short-term and long-term success of lower-extremity vascular procedures. Many of these patients may eventually require an amputation, even though all other options have been exhausted.

Unfortunately, not much is known about the underlying cause or specific risk factors for diabetes-related amputations in African- or Hispanic-Americans or the availability of preventive medical care for foot complications and peripheral vascular disease. Public health initiatives to prevent amputations in high-risk populations should be implemented to reduce the incidence of diabetes-related lower-extremity amputations (16–18). One of the objectives of *Healthy People 2000*, a national strategy to improve the health of the American people, is to reduce amputations in people with diabetes by 40% (36). It is possible that efforts to screen and treat high-risk patients could prevent thousands of amputations and save hundreds of millions of dollars in direct costs alone.

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