

# Amputation Rates High in American-Indians

Data from the Strong Heart Study showed that amputation risk varies widely according to gender, level of education, renal function and glycemic control.

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The incidence of lower limb amputation among diabetic American-Indians was 4.4% over 8 years, according to findings from the Strong Heart Study. Investigators reported in *Diabetes Care* that many predictors are at work regarding this outcome.<sup>1</sup>

In 1988 the Strong Heart Study (SHS) was initiated to evaluate cardiovascular disease and its risk factors in American-Indians.<sup>2</sup> The cohort included 4,549 patients aged 45 to 74 years from 13 American-Indian communities in Oklahoma, North Dakota, South Dakota and Arizona.

## INCIDENCE OF LEA

Data from the baseline study found that lower-extremity amputation (LEA) due to diabetes was present in 3% of the total cohort and 6.3% of those with diabetes. These rates are generally similar to those reported for other American-Indian tribes. Previous studies have revealed that hyperglycemia, duration of

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diabetes, being male and prevalent microvascular disease all contribute to LEA. The current study sought to define the incidence of first LEA, due to diabetes, in a diverse population-based cohort of diabetic American-Indians, according to lead investigator Helaine E. Resnick, PhD, MPH.

Patients in SHS were examined at three intervals and missing extremities were noted. The participants were asked to attribute their missing extremities to diabetes (LEA), trauma, congenital, other or unknown. Diabetes was defined as fasting glucose  $\geq 126$  mg/dL, use of hypoglycemic medications or being told by a health care professional that the patient had diabetes.

Other studies have listed potential LEA risk factors as age, diabetes, smoking, hypertension, loss of protective sensation and being male. These factors were measured for participants in this study. Of the main cohort, 1,974 or 43.4% were diabetic and had no LEA at baseline; this group was used for the present analysis. Of this group, 87 or 4.4%, had LEA during 8 years of follow-up.

## TOE AMPUTATION MOST COMMON

Among both men and women, amputation of toes was most common, followed by below-the-knee and above-the-knee amputations.

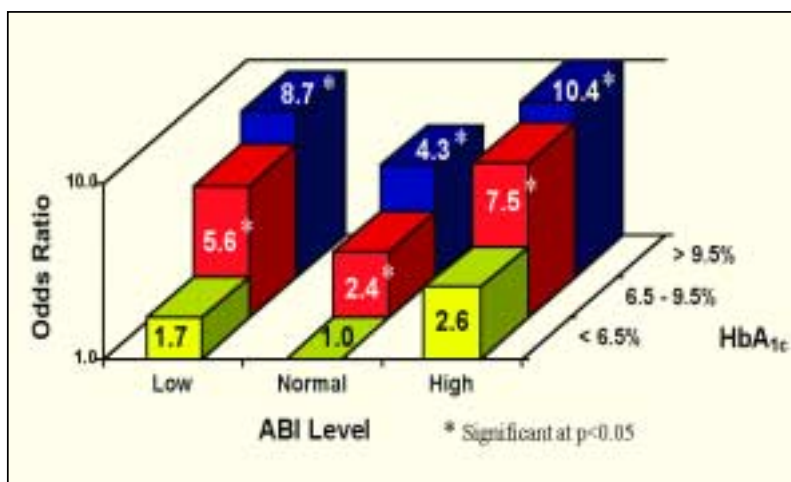


Figure 1. Odds ratio of incident LEA by categories of HbA1c and ABI from the SHS. Comparisons between the vertical bars and the reference group is indicated by an OR of 1.0

Researchers reported that the age-adjusted chance of LEA was higher among patients who had unfavorable combinations of risk factors, including albuminuria and elevated HbA1c.

### MODELED RISK FACTORS

When risk factors were modeled using a multivariable formula, those that predicted LEA risk were being male, renal dysfunction, high ankle-brachial index (ABI) longer duration of diabetes, less than a high school edu-

Women may have lower rates of LEA compared with men because women are often more involved in caring for themselves.

cation, increasing systolic blood pressure and HbA1c (Figure 1).

Men had double the risk of LEA when compared with

## DIABETES-RELATED AMPUTATION RATES MAY NOT BE ACCURATE

### Operating theater records are unreliable when calculating lower-extremity amputations.

Prospective data collection as a means of determining the incidence of lower-extremity amputations among patients with diabetes is more accurate than retrospective data collection methods.

Current reporting of amputation rates worldwide likely underestimate the true burden, investigators said in *Diabetes Care*. "We recommend that a prospective audit be incorporated into the activities of the specialist foot care team as a means of assessing and improving clinical care," wrote Gerry Rayman, MD, FRCP, and colleagues from the Ipswich Diabetic Foot Unit, Diabetes Centre, Ipswich Hospital, Suffolk, UK.

The study's objective was to accurately determine the incidence of diabetes-related LEA using prospective data collection methods, and then compare those results with data obtained retrospectively.

Over 3 years, investigators identified all diabetic inpatients with foot problems in a large district general hospital. Researchers said that the population was clearly defined and static, and patients were followed-up until discharge or death.

A specialist nurse and podiatrist collected demographic and admission details, medical history, investigations, procedures, history and etiology of foot lesions twice a week so that all patients undergoing amputation were identified. They compared this data with retrospective information from the hospital coding activities database, operating theater logbooks, anesthetic database and limb-fitting records.

The region had a population of 337,859 in 2000. Of these, 9,183 were known to have diabetes. During the survey period, Rayman and colleagues found that 79 amputations were performed (45 major and 34 minor).

"In our local population, the mean incidence during the survey period equates to 7.8 per 100,000 general population and 2.85 per 1,000 diabetic population for all amputations, 4.5/100,000 general population and 1.62/1,000 diabetic population for major amputations, and 3.3/100,000 general population and 1.23/1,000 diabetic population for minor amputations," Dr. Rayman wrote.

While the prospective survey detected all LEA identified by retrospective methods, the reverse was not true. All of the retrospective methods, including the most commonly used, did not account for all cases found in the prospective survey. The error rate, depending on the method used, was 4.2% to 90.6% and between 4.5% and 17.4% of amputations were misclassified.

In an interview, Dr. Rayman said that introducing prospective data collection and involving those providing foot care in the data collection process improved data accuracy and reduces amputation rates.

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Rayman G, Krishnan STM, Baker NR et al. Are we underestimating diabetes-related lower-extremity amputation rates? *Diabetes Care*. 2004;27:1892-1896.

women. The researchers noted that this was consistent with findings in at least two other studies; however, it is not a universal finding.

To explain the greater risk of LEA for men, the authors suggested the difference might be due to anatomical differences predisposing men to diabetic neuropathy. A twofold sex difference has been previously reported for insensate neuropathy, a known risk factor for LEA.

### EMPLOYMENT DIFFERENCES

Men may experience more minor trauma to the foot that can ultimately lead to LEA. This may be because of sex differences in employment type among American-Indians. Also, women may be more involved in self-care compared to men, who are more likely to seek attention only when problems become acute.

Rural areas and cultural differences add to the problem of adequate and preventive care.

“Rates of LEA in American-Indian populations are some of the highest in the nation,” said Dr. Resnick, director of the department of epidemiology and statistics, MedStar Research Institute, Hyattsville, Md. “A study of American-Indians living on the Gila River Indian Reservation found the incidence to be 24.1 per 1,000 person years. The rates in the general U.S. diabetic population are estimated to be about 6.5 per 1,000 person years.”

### INADEQUATE CARE

While a large part of the higher incidence of LEA in American-Indians is due to higher rates of diabetes in this population; however, American-Indians may not receive adequate preventive care and may be at higher risk than other groups. “The rural areas in which many Indians live contribute to the difficulty of receiving adequate care,” Dr Resnick said.

Clinicians who treat American-Indian patients are faced not only with the difficulty of achieving glucose control in their patients, but the additional challenge associated with cultural differences, she said.

An important observation the researchers noted is that medial arterial calcification is often present in diabetic patients who have neuropathy and poor renal function. Earlier data from the SHS showed that ABI is associated with albuminuria, and both independently

predict mortality. These two risk factors predicted LEA, independently, in the current study as well.

A particularly interesting finding was the predictive value of education in LEA risk. While 52% of the entire SHS cohort completed high school, only 46% of diabetic patients reached that level of education. High school education was associated with a more than 50% reduction in LEA risk. The researchers said that part of this association is age related because older patients were less likely to have completed high school, but the effect of education was still seen after adjustment for age and other risk factors.

The education association with LEA was also seen in a previous study of black and white Americans in the National Health and Nutrition Examination Survey Epidemiologic Follow-up Study.<sup>3</sup> In fact, the adjusted risk estimates for LEA associated with having a high school education were practically identical (0.47 for NHANES).

### APPROPRIATE INTERVENTIONS NEEDED

The risk of LEA increases the worse a patients’ glycemic control is after adjustment for diabetes duration. The reverse of this is also true, the researchers said, however interventions cannot be designed to target this risk factor. Nevertheless, having this data may help diagnose American-Indians at particularly high risk for amputation.

“Interventions such as screening for neuropathy and proper foot care education should target diabetic patients with the following risk factors: poor glycemic control, hypertension, renal disease or peripheral vascular disease,” Dr. Resnick said.

Many of the LEA risk factors are modifiable, suggesting that greater attention to risk factor modifications may reduce the burden of LEA in the future. “This is of particular importance for American-Indians who experience extremely high rates of diabetes and its large and small vessel complications,” Dr. Resnick said. ■

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