

Ethnicity and Risk of Diabetes-Related Lower Extremity Amputation

A Population-Based, Case-Control Study of African Caribbeans and Europeans in the United Kingdom

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Background: In the United States, people of black African descent with diabetes have 2 to 3 times the amputation risk of whites. This may be due to differences in care or pathophysiological characteristics. We therefore determined diabetes-related amputation rates in African Caribbeans vs Europeans in the United Kingdom, where care delivery is more equitable.

Methods: We conducted an incidence and case-control study, based in London, England. All diabetes-related amputations performed between 1992 and 1997 were identified. Controls, those with diabetes but no amputation, were sampled from family practitioners. Risk factor data were abstracted from medical records.

Results: Incident diabetes-related amputation occurred in 67 Europeans and 19 African Caribbeans. Amputation rates, age standardized to the diabetic population, were 147 per 100 000 and 219 per 100 000 in African Caribbeans and Europeans, respectively (relative risk,

0.67; 95% confidence interval [CI], 0.32-1.40; $P=.2$). Case-control analyses were performed on 178 cases and 350 controls. The ethnic difference in amputation risk differed significantly by sex ($P=.009$ for interaction). The unadjusted odds ratio comparing African Caribbeans with Europeans in men was 0.31 (95% CI, 0.17-0.57; $P<.001$), and in women was 0.97 (95% CI, 0.49-1.85; $P=.9$). Adjustment for smoking attenuated the odds ratio in men to 0.45 (95% CI, 0.23-0.89, $P=.02$); adding neuropathy, peripheral vascular disease, and age attenuated the odds ratio further to 0.97 (95% CI, 0.34-2.73; $P=.9$).

Conclusions: In contrast to the United States, we find no ethnic difference in diabetes-related amputation in women in the United Kingdom, but in men, amputation risk in African Caribbeans is one third that of Europeans. This was wholly accounted for by low smoking, neuropathy, and peripheral vascular disease rates.

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PEOPLE OF BLACK African descent in the United States, Caribbean, and United Kingdom largely originate from West Africa, and share a predisposition to type 2 diabetes mellitus.¹ In the United Kingdom, 16% of African Caribbeans of middle age have type 2 diabetes compared with 5% of Europeans.² Complication rates may also differ by ethnicity.³⁻⁵ Diabetes-related lower extremity amputation (LEA) is one such complication, but has received far less attention than the others, although it is largely avoidable,^{6,7} and demands on the health care system as a consequence of amputation are high.⁸

African Americans in the United States have 2 to 3 times the risk of diabetes-related LEA compared with US whites, even when the different prevalence of diabetes is accounted for.⁹⁻¹¹ Reasons for this ethnic difference are not clear, but may reflect both variations in pathophysiological

processes and inequalities in access to health care.^{12,13} One finding that provides limited support for the latter hypothesis is that amputation rates were similar in African Americans and US whites when health insurance coverage was equivalent.¹⁴ If this hypothesis is true, such ethnic differences should not be observed in the United Kingdom, where access to health care is thought to be equitable. This question so far has not been examined.

We therefore compared incidence rates of diabetes-related LEA in African Caribbeans and Europeans in the United Kingdom, and, using a case-control approach, determined whether any ethnic differences in risk could be accounted for by major risk factors.

RESULTS

Overall, 215 cases of diabetes-related LEA were identified, of which 28 had type 1 diabetes mellitus, had an amputation due to

PARTICIPANTS AND METHODS

METHODS

A cohort study is the ideal design for this question, but as absolute amputation rates are low, even the largest UK cohort is underpowered to examine this question properly.¹⁵ Routinely available hospital and family practitioner data do not routinely identify ethnic group. We therefore performed a population-based, case-control study, which provided reliable answers more quickly than a cohort study would do.

All residents of Lambeth, Southwark, and Lewisham (LSL) boroughs in South East London, England, formed the study population. Between 10% and 20% of this population is African Caribbean and would provide sufficient cases for analysis.¹⁶ This area includes 4 diabetes centers—King's College, St Thomas', Guy's, and Lewisham—that are recognized for their excellence and, for some, interest in the diabetic foot. It is therefore unlikely that people with major foot problems would be sent elsewhere.

Cases were all male and female African Caribbeans and Europeans residing in the study area who had undergone a diabetes-related LEA between 1992 and 1997. The definition of LEA was that which was used for the Global LEA Study, ie, the complete loss in a transverse anatomical plane of any part of the lower limb.¹⁷ Patients whose diabetes was secondary to another condition, or whose amputation was the direct result of major trauma, were excluded. There are indications that diabetes may be diagnosed at a younger age in people of black African descent.¹⁸ To ensure that all possible cases were identified, type 2 diabetes mellitus was defined as a diagnosis between 30 and 39 years of age inclusively, without immediate treatment with insulin, or a diagnosis at 40 years or older regardless of initial treatment. Cases were identified from the following sources: theater and theater recovery logs; diabetes registers; the Patient Activity Systems, which logs all discharges and deaths for each individual hospital; and the Hospital Episode System data set held at LSL health authority. This latter source includes all amputations performed on residents, regardless of hospital location. For these latter 2 sources, the Office of National Statistics operation codes for lower limb amputation (X09,

X10, and X11) were used. All amputations were identified from these sources, and case records then checked to determine which of these had diabetes. The Hospital Episode System data set identified 35 residents who had had an LEA at 13 hospitals outside the authority. Seventeen were performed at St George's Hospital, of whom 4 had diabetes. Further data were therefore abstracted from this source. Another 3 LEAs were performed at University College Hospital, but none of these patients had diabetes. As 3 or fewer cases were performed at each remaining hospitals, we performed a sensitivity analysis with the remaining 20 cases, assuming that 6 would have had type 2 diabetes (an overestimate, based on the proportion observed at St George's Hospital). We also assumed that all 6 cases were incident, again an overestimate. These 6 cases were all assigned European or all assigned African Caribbean ethnicity in 2 separate analyses, to assess the impact that these missing cases may have had on the relative risk of diabetes-related amputation.

The second level of analysis, a comparison of risk factors for amputation, required the selection of controls, ie, people with type 2 diabetes mellitus who had not had a diabetes-related LEA at the time of the case operation, and who were residents in the study area. Family practitioner lists were used as the sampling frame, as more than 95% of residents, even from inner cities, will be registered with a family practitioner, and this proportion is higher for people from minority ethnic groups and for older adults.¹⁹ It was not practicable to approach all 163 practices in the area to provide controls, so a limited number of practices, which would still be representative of the population and also of the care provided, would need to be identified. Each practice in this area had been allocated a band, from A (lowest, few services provided) to E (highest), determined by provision of services such as health promotion, a practice nurse, participation in audit and teaching, and achievement of health promotion targets. The number of patients registered with practices in each band was calculated and used to inform the number of controls that would need to be selected from each band. We then estimated the number of practices in each band that would yield sufficient controls and wrote to 28 practices. Of these, 22 agreed to participate. The proportion of all LSL residents registered with a band D or E practice was 66%; 68% of our controls came from this band, indicating that our selection process for controls had been

trauma, or had diabetes secondary to another condition. Of the remainder, 178 were European or African Caribbean, 8 were from other ethnic groups, and for 1 ethnicity could not be determined.

First diabetes-related amputation occurred in 67 Europeans and 19 African Caribbeans. Four of these (3 European and 1 African Caribbean) were younger than 50 years at the time of amputation and were therefore excluded as the age-standardized rates would have been unstable. Amputation rates, age standardized to the general population, were 47 per 100 000 in African Caribbeans and 14 per 100 000 in Europeans (relative risk for African Caribbeans vs Europeans, 3.4; 95% confidence interval [CI], 2.0-5.7; $P=.002$). These rates do not take account of the 4-fold elevation in risk of diabetes in African Caribbeans. Thus, incidence rates for the diabetic population (aged

50-64 years) were 147 per 100 000 in African Caribbeans ($n=11$) and 219 per 100 000 in Europeans ($n=20$) (relative risk for African Caribbeans vs Europeans, 0.7; 95% CI, 0.3-1.4; $P=.2$). There were not sufficient incident cases to perform a sex-stratified analysis. A sensitivity analysis was performed assuming that we had missed 6 incident cases. If all these were European, the relative risk in diabetes (African Caribbean vs European) was 0.6 (95% CI, 0.3-1.3); if all these were African Caribbean, the relative risk was 1.0 (95% CI, 0.5-1.9).

Control data were available on 350 individuals (the date of diabetes diagnosis occurred after the date of amputation of the case in 5 controls, and could not be used). The distribution of cases and controls by ethnicity indicates that African Caribbeans have approximately one half the risk of amputation compared with Europeans (OR,

successful in identifying representative controls. Practices were visited, and 2 controls per case were selected from their lists of all patients with type 2 diabetes. Ethnic minority groups in the United Kingdom are, on average, younger than the general population, due to migration patterns.^{20,21} Because amputation risk increases with age, it is likely that due to the age structure of the population alone, African Caribbeans would be underrepresented in the case population and overrepresented in the control population. We therefore ensured that the date of birth of the potential control was within 5 years of the case and then selected at random for each case from potential controls.

The Global LEA Study pro forma was used to collect data on amputation and risk factors from patient records as close to the date of amputation as possible.¹⁷ Retrospective data collection was a necessity because risk factors and complication status at the time of amputation were required; examining the patient at the time this study was conducted would be misleading. Furthermore, because mortality risk after amputation is high, and our cases spanned 5 years, excluding those who had died may have biased the results. Hospitals are expected to record ethnic group of all admissions, usually using self-identification, to a standardized format, and this allocation was used in our analysis. Where ethnic group was missing, care providers were asked to provide this information in both hospital and primary care settings. Occupation was recorded and classified.²² Occupational coding was used to define social class and was dichotomized to compare more affluent (social classes I, II, and III nonmanual) with more deprived groups (social classes III manual, IV, and V). Information on complication status had to be supported by the method of diagnosis, ie, symptoms or signs of disease. For example, for peripheral vascular disease (PVD), this could include any or all of symptoms of intermittent claudication, absent foot pulses, reduced transcutaneous oxygen pressure, abnormal ankle brachial index, or evidence of an abnormal lower limb arteriogram or arterial reconstruction.

Ethical approval was obtained from the participating hospitals, and the local medical committee.

STATISTICAL ANALYSES

Because type 2 diabetes is 3 times as common in African Caribbeans as it is in Europeans,² a conservative estimate

of the proportion of African Caribbeans with diabetes, using the lower estimate of population proportion of African Caribbeans, was 25%. With 150 cases and 300 controls, an odds ratio (OR) of amputation of at least 2.0 for African Caribbeans vs Europeans at a significance level of 5% with 90% power could be detected. A higher population proportion of African Caribbeans would yield a more powerful analysis.

Two levels of analysis were performed. The first was an incident analysis, based on new cases only, and the second was the case-control analysis on all cases identified. We wished to ensure that ethnic differences observed in a population including those who had had repeated amputations would also be observed in those with de novo amputation. The main risk factor for an amputation is a previous amputation. In analytical terms, a previous amputation is an integral of risk factors, such as smoking, PVD, neuropathy, and glycemic control. By exploring the role of individual risk factors, we could determine which of these in particular altered the ethnic difference in disease risk.

Incidence rates of amputation were first calculated. By definition, only cases with no history of a previous amputation could be included. Ethnicity, sex, and 5-year-age band-specific population denominators for LSL were obtained from the 1991 census.¹⁶ To calculate incidence for the diabetic population, existing population-based sex-specific prevalence figures for type 2 diabetes² were used to establish the number of people with diabetes for those aged between 40 and 65 years, as existing prevalence data only covers this age range. Age-standardized rates per 100 000 for the general and diabetic population were then calculated using the direct method. Analyses were repeated aging the census data by 5 years to reflect the calendar period of this study. Because the results did not differ, we present findings from the original analyses.

The second stage of the analysis focused on risk factors for amputation and used the case-control data. Cases and controls, and ethnic groups within controls, were compared by simple comparison of means and proportions. Odds ratios for amputation were estimated using logistic regression. The data set for logistic regression was restricted to those who had complete data on all risk factors included in the final model.

0.49; 95% CI, 0.32-0.76; $P=.001$) (**Table 1**). Rates of previous amputation were similar in Europeans (49%, 67/138) and African Caribbeans (42%, 17/40).

A sex interaction test was significant ($P=.009$). In men, African Caribbeans ($n=19$) had a lower risk of amputation than Europeans ($n=99$) (OR, 0.31; 95% CI, 0.17-0.57; $P<.001$), whereas in women the risk did not differ by ethnicity (African Caribbeans, $n=21$, Europeans $n=39$; OR, 0.97; 95% CI, 0.49-1.85; $P=.9$). The restriction of the protective effect to African Caribbean men only would explain why men are underrepresented in the case population. In Europeans, men were significantly more likely to have had an amputation than women (OR, 2.66; 95% CI, 1.70-4.16; $P=.001$). In African Caribbeans, there was no sex difference (OR, 0.86; 95% CI, 0.42-1.76; $P=.7$).

We then explored reasons for the low risk of amputation in African Caribbean men. These analyses were not performed in women as there was no ethnic difference to explore. Major risk factors for amputation were the presence of other complications secondary to diabetes, especially PVD, neuropathy, and foot ulcer, and a history of smoking (Table 1). Cases were more likely to be from the lower social classes, and to have attended a lower band general practice, but the latter was not statistically significant. We explored risk factor status in the control population to assess possible reasons for ethnic differences in amputation risk (**Table 2**). African Caribbeans were less likely to be ever smokers and less likely to have neuropathy, foot ulcers, and PVD (although the latter was not statistically significant). For all men, the unadjusted risk (OR) of amputation was barely altered

Table 1. Comparison of Diabetes-Related Characteristics Between Cases (Diabetes and Amputation) and Controls (Diabetes and No Amputation)*

Characteristic	Cases (n = 178)	Controls (n = 350)	P Value
African Caribbean, %	22 ± 3 (178)	37 ± 3 (350)	.001
Male, %	34 ± 4 (178)	50 ± 3 (350)	.001
Age at diagnosis, y	57 ± 0.9 (162)	59 ± 0.6 (341)	.08
Diabetes duration, y	10 ± 0.5 (162)	7 ± 0.4 (341)	<.001
Age at amputation, y	68 ± 0.7 (178)	66 ± 0.5 (350)	.08
Random glucose, mg/dL [mmol/L]	232 ± 14 [12.9 ± 0.8] (113)	209 ± 14 [11.6 ± 0.8] (113)	.3
Systolic blood pressure, mm Hg	147 ± 1.8 (158)	149 ± 1.2 (346)	.5
Diastolic blood pressure, mm Hg	81 ± 0.9 (158)	83 ± 0.6 (346)	.09
Body mass index, kg/m ²	28 ± 0.9 (111)	29.5 ± 0.5 (279)	.1
Ever smoked, %	71 ± 4 (165)	56 ± 3 (309)	.002
Myocardial infarction, %	16 ± 3 (149)	10 ± 2 (335)	.06
Angina, %	18 ± 3 (149)	16 ± 2 (335)	.6
Nephropathy, %	34 ± 4 (122)	12 ± 2 (278)	.001
Neuropathy, %	74 ± 4 (147)	30 ± 3 (300)	.001
Peripheral vascular disease, %	83 ± 3 (151)	14 ± 2 (287)	.001
Leg ulcer, %	82 ± 3 (160)	7 ± 1 (335)	.001
Retinopathy, %	63 ± 4 (127)	21 ± 2 (316)	.001
Social class III manual, IV, and V, † %	75 ± 4 (114)	64 ± 4 (154)	.04
General practice band A, B, and C, † %	39 ± 4 (152)	32 ± 2 (239)	.1

*Data are given as mean or percentage ± SE (n).

†See the "Participants and Methods" section for description.

Table 2. Diabetes-Related Characteristics of Controls*

Characteristic	European (n = 221)	African Caribbean (n = 129)	P Value
Male, %	49 ± 3 (221)	51 ± 4 (129)	.7
Age at diagnosis, y	62 ± 0.7 (215)	56 ± 0.9 (126)	<.001
Age at time of case amputation, y	69 ± 0.6 (221)	63 ± 0.8 (129)	<.001
Diabetes duration, y	7 ± 0.4 (215)	7 ± 0.5 (126)	.8
Blood glucose, mg/dL [mmol/L]	205 ± 11 [11.4 ± 0.6] (73)	216 ± 14 [12.0 ± 0.8] (40)	.5
Systolic blood pressure, mm Hg	150 ± 2 (219)	146 ± 2 (126)	.1
Diastolic blood pressure, mm Hg	82 ± 1 (219)	84 ± 1 (126)	.2
Body mass index, kg/m ²	30.2 ± 0.8 (170)	28.2 ± 1.0 (108)	.1
Ever smoked, %	64 ± 3 (201)	42 ± 5 (108)	.001
Myocardial infarction, %	13 ± 2 (209)	5 ± 2 (126)	.01
Angina, %	19 ± 3 (210)	12 ± 3 (126)	.1
Nephropathy, %	11 ± 2 (168)	14 ± 3 (110)	.6
Neuropathy, %	35 ± 3 (186)	23 ± 4 (114)	.03
Peripheral vascular disease, %	16 ± 3 (174)	12 ± 3 (113)	.5
Leg ulcer, %	10 ± 2 (209)	4 ± 2 (126)	.06
Retinopathy, %	20 ± 3 (199)	24 ± 4 (117)	.4
Social class III manual, IV, and V, † %	49 ± 5 (89)	83 ± 5 (65)	.001
General practice band A, B, and C, † %	23 ± 3 (221)	47 ± 4 (129)	.001

*Data are given as mean or percentage ± SE (n).

†See the "Participants and Methods" section for description.

when the data set was restricted to those who had complete risk factor data for the final model (**Table 3**). Thus, the unadjusted OR in men was 0.32 ($P < .001$) for African Caribbeans compared with Europeans. Adjustment for smoking status alone attenuated this risk to 0.45 (95% CI, 0.23-0.89; $P = .02$). Further additional multivariate adjustment for PVD, neuropathy, and age at amputation attenuated the OR still further to 0.97 (95% CI, 0.34-2.73; $P = .9$). A stratified analysis by smoking status, adjusted for age at amputation, revealed ORs in men (African Caribbean vs European) of 0.38 (95% CI, 0.17-0.83; $P = .02$) in ever smokers and 0.54 (95% CI, 0.18-1.57; $P = .3$) in never smokers.

COMMENT

The higher rates of diabetes-related amputation in people of black African descent in the United States⁹⁻¹¹ are not confirmed in this UK study, which may support the hypothesis that high rates in the United States can be accounted for by inequalities in access to health care.¹⁴ Both the incident rates and the case-control analysis indicate that amputation risk is no higher in people of black African descent in the United Kingdom in people with diabetes, and may even be lower.

From the case-control analysis, we further show that the ethnic difference in amputation risk differs mark-

edly by sex. In the unadjusted analysis, while there appears to be no difference in risk in African Caribbean women compared with European women, men of black African descent have a risk of amputation that is one third that of European men. This is a completely novel finding, as previous US studies did not present sex-specific analyses, and had not been anticipated at the time we designed this study. This suggests that the risk factor profile for amputation is more favorable in African Caribbean men, at least in the United Kingdom. The multivariate analysis, designed to determine why African Caribbean men were protected from amputation, showed that adjustment for PVD, neuropathy, and smoking almost completely abolished the African Caribbean protection from amputation. The low smoking rates observed in African Caribbean men alone could not wholly account for the low amputation risk, as adjustment for smoking itself did not abolish the protective effect, and a stratified analysis by smoking status showed that the African Caribbean protection from amputation persisted in never smokers. Furthermore, we have previously shown that smoking rates in middle-aged African Caribbean men are not dissimilar (37% and 30% in Europeans and African Caribbeans, respectively) compared with women, where rates are very different (35% vs 8%).²³ If the protection was due to smoking rates alone, we would have expected to see far greater differences in women than in men.

While socioeconomic factors such as social class and indices of quality of primary care differed between cases and controls, these differences were not especially strong, and were overwhelmingly weaker than PVD and neuropathy.

In addressing our first objective, that of describing the incidence of amputation in the 2 ethnic groups, it was clearly important to identify all appropriate cases. We are confident that very few cases of amputation were missed, as, without exception, a case must have been admitted to the hospital for an operation, and we searched all available hospital sources for cases. Capture-recapture techniques to assess the completeness of coverage are invalid here, as they assume that sources of data are independent.²⁴ This cannot be true here as there is a clear link between, for example, inclusion on patient administration systems and data held by the health authority. However, we ensured that operations performed in hospitals outside the area were identified, and where feasible, collected risk factor data. Furthermore, our sensitivity analysis indicates that there would have to be a considerable number of amputations performed on African Caribbeans outside the district to approach the ethnic differences observed in the United States.

The second part of the study was to compare risk factors for amputation. For this, there was no necessity to identify all amputation cases as long as we ensured that these were representative of amputations performed on this study population. It is reassuring that our case-control findings, in terms of comparing overall ethnic differences in risk of amputation, reflected those from the analysis of incidence, and lend support to their validity. We also attempted to ensure that the control population reflected the general diabetic population and also reflected the quality of care that was provided in this area.

Table 3. Multivariate Examination of Risk Factors Accounting for Lower Risk of Amputation in African Caribbean Compared With European Men*

Bivariate Adjustment	OR (95% CI)	P Value
Ethnic group	0.32 (0.17-0.61)	<.001
Ethnicity and diabetes duration	0.34 (0.17-0.66)	.002
Ethnicity and age at diagnosis	0.31 (0.16-0.61)	<.001
Ethnicity and age at amputation	0.35 (0.18-0.67)	.002
Ethnicity and ever smoked	0.45 (0.23-0.89)	.02
Ethnicity and nephropathy	0.26 (0.12-0.55)	<.001
Ethnicity and retinopathy	0.37 (0.17-0.80)	.01
Ethnicity and angina	0.38 (0.20-0.74)	.004
Ethnicity and myocardial infarction	0.36 (0.19-0.69)	.002
Ethnicity and peripheral vascular disease	0.46 (0.21-1.04)	.06
Ethnicity and neuropathy	0.37 (0.18-0.75)	.006
Ethnicity and leg ulcer	0.31 (0.11-0.87)	.03
Ethnicity and general practice band A, B, and C vs D and E (highest)†	0.34 (0.17-0.67)	.002
Ethnicity and social class III manual, IV, and V vs I, II, and III nonmanual†	0.21 (0.10-0.45)	<.001
Multivariate model		
Ethnicity, peripheral vascular disease, neuropathy, ever smoked, age at amputation	0.97 (0.34-2.73)	.9

*Included 78 of 99 European cases, 82 of 108 European controls, 16 of 19 African Caribbean cases, and 52 of 66 African Caribbean controls. OR indicates odds ratio; CI, confidence interval.

†See the "Participants and Methods" section for description.

To this end, we chose to stratify our sample of practices by banding so that the quality of care provided to these patients would reflect that provided to the whole study population, and then ensured that larger practices provided the greatest number of patients. Data collection relied on accurate assessment of complication status at the time of the amputation. There are limitations to the quality of data collected retrospectively. Despite this, due to the existence of guidelines recommending annual assessment of complication status, a fair proportion of required data was ascertainable. It is unlikely that reporting of complications should differ by ethnic group, so that any variability in ascertainment would mean that we have underestimated the impact of certain risk factors on the ethnic difference in amputation risk. We had planned to interview a subset of patients to collect risk factor information, but as the key risk factors were other diabetes complications, such as PVD and neuropathy, the reliability of responses to questions about complication status a few years previously would be questionable, and arguably the case notes would provide more accurate information. Our data on socioeconomic factors were relatively crude, especially assessment of social class, but these factors had a very weak effect on risk of amputation.

In the UK Prospective Diabetes Study (UKPDS), both neuropathy and PVD appeared to be less frequent in African Caribbeans than Europeans, although this was only true for neuropathy when biothesiometer readings were compared; no such differences were observed for absent reflexes.¹⁵ These low rates of PVD are congruent with the low risk of coronary heart disease found in African Caribbeans, both in the diabetic and general population, compared with Europeans,^{2,4,25} but are in marked contrast to the high rates of stroke and hypertensive heart dis-

ease.²⁶ These data may also provide clues to the explanation for the striking sex difference in the relationship between ethnic group and amputation risk. Mortality and morbidity from heart disease in African Caribbeans is strikingly low compared with that of Europeans, and this difference is greatest in men.²⁵ Because ischemic heart disease and PVD are closely related, it may not be surprising that African Caribbean men are at a particularly low risk of amputation.

Similarly, the proportion of never smokers was greater in African Caribbeans than Europeans in the UKPDS,¹⁵ and this may account for a large part of the low risk of amputation in the former group, as it is observed that smoking is a stronger risk factor for PVD than for cardiovascular disease.²⁷ In the United States though, PVD rates are found to be higher in people of black African descent compared with whites in the general population,²⁸ and more stringent assessments of neuropathy show no ethnic differences.²⁹ This disparate finding to UK data may in part be related to the higher smoking rates in African Americans compared with US whites for people with diabetes,³⁰ and may also reflect inequalities in access to health care.

We conclude that in the United Kingdom, unlike the United States, diabetes-related amputation rates are not higher in African Caribbeans compared with Europeans. Furthermore, there are important sex differences in risk, with women having equivalent rates in both ethnic groups, whereas African Caribbean men have a third of the risk of European men. This protection from amputation is due to a low prevalence of associated complications, such as neuropathy and PVD, and risk factors, such as smoking. The challenge now is to understand reasons for the low risk of complications resulting in amputation in African Caribbean men and assess the impact of changing smoking rates in this and other populations.

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