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Ethnic differences in lower limb revascularisation and amputation rates. Implications for the aetiopathology of atherosclerosis?☆,☆☆

Naseer Ahmad [a,*], G. Neil Thomas [b], Colin Chan [a], Paramjit Gill [b]

[a] Department of Vascular Surgery, Wirral University, Hospital NHS Foundation Trust, Wirral, England CH49, UK
[b] University of Birmingham, England B15, UK

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ABSTRACT

Objective: Peripheral arterial disease, as a result of atherosclerosis, is the commonest reason for lower limb revascularisation and amputation in England. We describe the prevalence rate of these procedures among the White, South Asian and Black populations living in England and describe the association of ethnicity to amputation, both with and without, revascularisation.
Method: We extracted data from 90 million English hospital admissions between 2003 and 2009 and calculated prevalence rates among 50–84 year olds using census data. Logistic regression demonstrated whether ethnicity was related to amputation, both with and without revascularisation, independent of demographic (age, sex, social class) and disease risk factors (diabetes, hypertension, hypercholesterolaemia, coronary and cerebral vascular disease, smoking).
Results: There were 25 308 amputations and 136 215 revascularisations. The age adjusted prevalence rate for amputation was 26/100 000 and revascularisation 142/100 000. The prevalence ratio (95% confidence intervals) (White British = 100) of amputation in the Asian and Black populations was; 60 (54–66) and 169 (155–183) respectively with revascularisation ratios; 89 (86–92) and 94 (89–98) respectively. South Asians had approximately half the risk of amputation both with and without a revascularisation than Whites despite much higher rates of known atherosclerotic risk factors. The odds of having an amputation without any revascularisation was 63% higher in Blacks but fully attenuated by demographic and disease risk factors.
Conclusion: South Asians experience the lowest rate of both major lower limb amputation and revascularisation in England. The association cannot be explained by demographic or cardiovascular risk factors. This may have implications in the aetiopathology of atherosclerosis.

1. Introduction

Peripheral arterial disease (PAD), as a result of atherosclerosis of the lower limbs, has a prevalence of 15–20% in people over 70 [1,2] with over 70% of the 5000 annual major leg amputations undertaken in England attributable to it [3]. There has been very little research into the prevalence of the disease among the 9 million ethnic minorities living in England [4]. One pilot study into the two main ethnic groups, South Asian (origins from India, Pakistan and Bangladesh) and Black (origins from Africa or the Caribbean) found it to be lower in both at 12% [5].

Internationally, most prevalence studies are from the United States with a recent review highlighting prevalence between 6 and 20% in African Americans, 3 and 13% in Non-Hispanic Whites and 2 and 14% in Hispanics [6]. The only study on people from the Indian Subcontinent determined the prevalence to be 3% [7].

Ethnic differences in coronary heart disease, however, are well recognised with the high rate in South Asians [8] leading to a national strategy in England [9]. Only one study has linked coronary and lower limb revascularisations and found the ratio of the two procedures in England to be 1:1.4 [10]. The ratio was similar rate in Blacks (1:1.1), but much lower in South Asians (1:0.3) [10].

In the absence of accurate epidemiological data describing ethnic differences in peripheral vascular disease, prevalence of procedures used to treat the disease, (analysed in light of coronary heart disease data), may have implications for both the aetiopathology of atherosclerosis and public health. We describe ethnic differences in the prevalence rate of both lower limb amputation and revascularisation among the White, South Asian and Black

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* Corresponding author. Tel.: +44 (0)1516 785111; fax: +44 (0)7974 301068.
E-mail address: naseer102@hotmail.com (N. Ahmad).

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populations aged 50–84 living in England and demonstrate differences that are independent of demographic and disease risk factors.

2. Methods

2.1. Calculation of prevalence rates

Prevalence rates for both amputation and revascularisation procedures used Hospital Episode Statistics (HES) [11] as the numerator with the denominator population derived from the Office National Statistics (ONS) mid year population estimates [12].

The HES database captures every hospital patient encounter in England with approximately 52 million in and outpatient episodes added each year [11]. Information regarding patient demography, risk factors, diagnosis and intervention is collected. A subset of this main database covering in-patient admissions between 1st April 2003 and 31 March 2009 (approximately 90 million episodes) was created.

From this anonymised database, patients aged 50–84 who underwent major lower limb amputation and revascularisation (endovascular and surgical), as defined by the Office of Population, Census and Surveys (OPCS) 4.5 classification [13] (Table 1) were identified. All 10 operative field codes were searched. Demographic and co-morbidity data were then extracted for these patients. Risk factor data based on ICD-10 classification were extracted from all 20 fields. The risk factors extracted were diabetes (E10–E14), hypertension (I10–I13), hypercholesterolaemia (E14), coronary heart disease (I20–I25), cerebrovascular disease and transient ischaemic attack (I63–I67 and G45), and smoking (F17, Z72).

Social class was defined using the Indices of Multiple Deprivation (IMD) score [14]. This scoring system is based on 37 indicators grouped into 7 domains (income, employment, health deprivation and disability, education skills and training, barriers to housing and services, crime, and living environment). Areas were then grouped into quintiles from 'most deprived' to least deprived'. The index is based on an area covering approximately 400 households and 1000 people.

Crude rates were calculated using the combined number of procedures over the six year period as the numerator with the denominator derived by combining the mid year population estimates between 2003 and 2008. 95% Confidence intervals were based on 5 year age bands with the overall rate age standardised to the England and Wales 2001 population using standard techniques [15]. Rates for each ethnic group were similarly calculated with minority rates expressed as a ratio (prevalence ratio) of the White British group.

Table 1
Procedure codes used to extract amputation and revascularisations procedures from National Hospital Data.

Procedure	Area	Code	Description
Amputation	Leg	X09	All leg amputations (above ankle)
Endovascular	Aorta	L26	Percutaneous angioplasty/ stent of aorta
	Iliac	L54	Percutaneous angioplasty/ stent of Iliac artery
	Femoral	L63	Percutaneous angioplasty/ stent of femoral/popliteal artery
	Other	L66	Other therapeutic transluminal operations/stent on artery
Surgery	Iliac	L51	Bypass of iliac artery (vein or prosthesis)
		L52	Reconstruction of iliac artery (endarterectomy)
	Femoral	L59	Bypass of femoral artery (vein or prosthesis)
		L60	Reconstruction of femoral artery (endarterectomy)

2.2. Ethnic group classification

Ethnicity coding in HES is self defined by patients on admission and is currently around 80% complete [16]. We analysed data from 2003 onwards because the change in ethnicity classification that accompanied the 2001 census (compared to the 1991 census) led, in the initial years, to classification inconsistency. We combined certain ethnic groups into their parent category to increase numbers e.g. 'Indian', 'Pakistani', 'Bangladeshi' and 'Asian Other' were combined into 'All Asian'. 'Black African', 'Black Caribbean' and 'Black Other' were combined into 'All Black'. Where numbers allowed, results for component ethnic groups have been presented.

2.3. Linkage of procedures and calculation of odds ratios

The amputation and revascularisation procedures (Table 1) were linked to determine exposure to vascular services. The outcome variables, 'amputation with revascularisation' was created if both procedures occurred within the same 6 year time frame in patients with the same unique HES identifier and ethnic group. Where linkage was not possible 'amputation without revascularisation' was assigned. To improve linkage we used 2 rather than 4 digit intervention codes although this potentially led to amputation procedures being linked to investigation rather than solely revascularisation procedures. However, as investigations for PAD are mainly performed as outpatients therefore not generating a hospital admission, we believe our linkage is more reflective of revascularisation.

Logistic regression was then used to identify predictors of these dichotomous outcomes using SPSS [17]. The odds of ethnicity demonstrating a relationship was performed unadjusted and repeated after controlling for demographic (age, sex, social class) and disease risk factors (diabetes, coronary heart disease, cerebrovascular disease, hypercholesterolaemia and smoking), by the forward stepwise selection method.

3. Results

There were 25 308 major lower limb amputations (males 17 341, females 7967) and 136 215 revascularisations (males 90 693, females 45 522) performed between April 2003 and March

Table 2
Number of major lower limb amputations and revascularisation; males and females; England: 2003–2009.

Ethnic group	Number procedures amputation		Number procedures revascularisation	
	Males	Females	Males	Females
All Asian[a]	225	77	1781	617
Indian	141	43	840	310
Pakistani	51	19	517	174
All Black[b]	258	172	817	508
African	178	126	545	329
Caribbean	38	29	144	98
Missing Ethnicity	2501 (14%)	1240 (16%)	15 100 (17%)	7702 (17%)
White British	13 496	6109	67 777	34 141
England	17 341	7967	90 693	45 522

[a] Includes Bangladeshi and 'Asian Other'.
[b] Includes 'Black Other'.