

# **Mortality, re-amputation and post operative complication rates following 28,000 below knee amputations in diabetic patients in England: a national population study 2002-2022.**

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## **INTRODUCTION:**

Diabetes mellitus remains a major pandemic affecting 415 million people globally (9% of adults), of which 4 million are in the UK. Urgent below knee amputation (BKA) remains a last resort treatment for intractable diabetic foot disease. UK National Audit data suggests that despite reported improvements in ulcer healing rates following widespread investment in national guidelines for diabetic foot care, the BKA rate has not improved.

The overall mortality rate associated with BKA for diabetic foot disease remains unclear. Globally reported data is dominated by US Veterans population studies, while smaller single-centre UK cohorts observe a wide range of 1 year mortality rates from 13.8% to 61.1%. There is no consensus on mortality rates, risks of perioperative complications and which risk factors predispose patients with diabetic foot disease to poorer outcomes post BKA in England.

## **METHODS:**

Hospital Episodes Statistics (HES) data for England was obtained from NHS digital and combined with Office of National Statistics (ONS) mortality data from 2000 to 2022. The HES database holds information on all patients admitted to NHS hospitals in England. Each record in the database relates to one finished Consultant episode, describing the time an individual spends under the care of one NHS Consultant. The database includes detailed demographic data, co-morbidities, date and cause of death, peri-operative complications and any further operative intervention.

We included data on all patients over 18 years of age who underwent a major lower limb amputation from 2000-2022 in England. The data was cleaned using HES data dictionaries in STATA 18; operations and complications were identified according to the OPCS-4 and ICD-10 codes. The primary outcome was the rate of all cause mortality. Secondary outcome measures were causes of death, re-amputation rates, temporal variation in post BKA mortality and rate of 90 day peri-operative complications.

Analysis was performed using STATA 18 (STATAcorp, college station, Texas). Mortality and amputation free survival was calculated with Kaplan-Meier curve analysis. Multivariate logistic regression was used to stratify patient variables associated with mortality and/or re-amputation rate.

## **RESULTS:**

We identified 28,045 BKAs undertaken for diabetes in the 20 year period. The rates of BKA decreased from 2002 (8.1/100,000) to 2012 (6.2/100,000) and plateaued between 2012-2022 (6.5/100,000 in 2022). The rates are significantly higher in males (9.4/100,000 in 2022) when compared to females (3.3/100,000 in 2022) and highest in males aged 60-79 years old (14/100,000 in 2023).

The 90-day reoperation rate for any cause was 20.7%. The ipsilateral re-amputation rate at any time was 10.4% (n=2909), and the contralateral amputation rate was 8.2% (n=2304). Additional 90-day complications included PE (0.75%, n=211), MI (3.6%, n=1019) and Stroke (1.1%, n=316).

The mortality rates following BKA for diabetic foot disease were 7.1% at 30 days, 12.7% at 90 days, 24.6% at 1 year, and 61.2% at 5 years. Only 17% of patients survived to 10 years post BKA.

Multi-regression analysis demonstrated that female sex, lower socio-economic status and British Asian males aged 60-70 years had significantly higher BKA associated mortality rates. Female sex was associated with higher mortality at all time points (OR 1.07, 1.12, 1.15, 1.16 at 30 days, 90 days, 1 year and 5 years respectively). Increasing age was associated with significantly worse mortality at all time-points. British-Asians had significantly higher mortality risk at all timepoints (OR 1.99, 1.86, 1.63, 1.05 at 30 days, 90 days, 1 year and 5 years respectively). Lower deprivation status (higher-socioeconomic status) was associated with better longer-term outcomes. Black British people had significantly lower odds of mortality post BKA (OR (0.59, 0.78, 0.84, 0.60 at 30 days, 90 days, 1 year and 5 years respectively)

## **DISCUSSION AND CONCLUSION:**

This landmark 20 year England population study has revealed that BKA is associated with high mortality rates, peri-operative morbidity, high rate of further amputation and high incidence of significant complications including pulmonary emboli. Asian Males in their 60s have the highest mortality rates and represent an at risk group, while Black British people have the lowest mortality rates. Overall, there has been little improvement in post BKA mortality over the last 20 years.

	n	%	95% CI
<b>Total BKA numbers</b>	<b>28045</b>		
<b>Complications</b>			
Any reoperation	5801	20.68	(20.2 – 21.2)
Infection	391	1.39	(1.26 – 1.54)
LRTI	647	2.30	(2.14 – 2.49)
UTI	2837	10.11	(9.76 – 10.47)
PE	211	0.75	(0.65 – 0.86)
MI	1019	3.63	(3.42 – 3.86)
90d mortality	3465	11.97	(11.97 – 12.74)
stroke	316	1.12	(1.00 – 1.26)
AKI	3809	13.58	(13.18 – 13.98)
fasciotomy	90	0.32	(0.25 – 0.39)
DVT	312	1.11	(0.99 – 1.24)