# Racial Disparities in Lower Extremity Amputations and Timing to Amputation following Diagnosis of Diabetic Complications

Richard Feng, Senthil Nathan Sambandam[1], Dane K Wukich
[1]VA Medical Center

INTRODUCTION: One of the most feared outcomes of diabetic mellitus complications is lower extremity amputation (LEA). Little is known about racial disparities in LEAs for diabetic complications such as angiopathy, foot ulcer, osteomyelitis, cellulitis, and abscess and what drives differences in frequency. Additionally, racial disparities in time to amputation from diagnosis of many diabetic complications have not previously been reported. The purpose of this study is to determine if there are racial disparities in lower extremity major and minor amputation rates due to diabetic-related complications. A secondary purpose is to determine if there are racial disparities in timing to major and minor amputations following diagnosis of diabetic complications. We hypothesize that African American and Hispanic patients more frequently undergo major LEAs compared to Caucasian patients, and that this difference is not due to demographic differences.

METHODS: This retrospective review utilized a large insurance patient records database, which was queried for International Statistical Classification of Disease codes for several diabetic complication diagnoses: angiopathy without gangrene, angiopathy with gangrene, foot ulcer, osteomyelitis, cellulitis, and abscess. It was also queried for current procedural terminology codes for LEAs. Minor amputations were defined as interphalangeal toe joint amputations, ray amputations, metatarsophalangeal amputations, transmetatarsal amputations, Chopart amputations, and syme amputations. Major amputations were defined as below-knee amputations (BKA), above-knee amputations (AKA), and knee disarticulation amputations. The mean time to amputation was compared between minority racial groups (African American, Hispanic, and Asian) and Caucasians for each diabetic complication. Patient demographic information on age, sex, tobacco use, Charleston Comorbidity Index (CCI), and obesity was also collected. Odds ratios (OR) with 95% confidence interval (CI) ($\alpha = 0.05$) were used to compare major and minor amputations in minority races to those in Caucasians at 30 days, 1 year, and 5 years after diagnosis of diabetic complication.

RESULTS:

The total sample contained 7,450,186 patients with a diabetes-related ICD-10 diagnosis in the 5-year follow-up analysis. A total of 1,813,404 active patients with a diabetes-related ICD-10 diagnosis were included in the 30-day and 1-year analysis. All minority racial groups had higher odds of minor LEA at 5-year follow-up for at least one diagnosis analyzed except diabetic abscess. Compared to Caucasians, African American patients had significantly higher odds of major amputations at 30 days, 1 year, and 5 years after diagnosis of diabetes-related complications except for diabetic angiopathy with and without gangrene at 30 days follow up, and diabetes with abscess at 30 days and 1 year follow up (Table 1). Hispanic patients also demonstrated significantly higher odds of major amputations compared to Caucasians in all diagnoses except diabetic abscess. Asian patients only had significantly higher odds of major amputations compared to Caucasians at 5 years after diagnosis of diabetes overall (p=0.0040) and diabetes without complications (p=0.0248). For all diabetes-related diagnoses, Caucasians had an average time to major amputation of 163 ± 124 days. African Americans had an average time to major amputation of 170 ± 125 days, Hispanic 165 ± 128 days, and Asian 220 ± 136 days. Among patients with major amputations, African American patients diagnosed with diabetes without any complications had significantly longer time to amputation compared to Caucasians with the same diagnoses (p=0.0428). However, African Americans who underwent major amputations for DFU had significantly shorter time to amputation compared to Caucasians (p=0.0341).

DISCUSSION AND CONCLUSION: African American and Hispanic patients with diabetes complications have higher odds of undergoing major LEA compared to Caucasian patients with the same diagnoses. For African Americans, this difference may be partly explained by higher CCI scores but no other demographic confounders. Additionally, the time between diagnosis of diabetic complications and major LEA was not significantly different between minority patients and Caucasians for most diabetic-related diagnoses. This suggests that other factors such as implicit biases from providers may be driving the higher occurrence of major amputations in minority patients with diabetic-related complications.

Table 1. Odds of Major Amputation by Race at 30 Days, 1 Year, and 5 Years after Diagnosis of Diabetic-related Complications

| Major Amputation | 30 days | | 1 year | | 5 years | |
|---|---|---|---|---|---|---|
| | OR (95% CI) | P-value | OR (95% CI) | P-value | OR (95% CI) | P-value |
| **Diabetes Overall** | | | | | | |
| White | Reference value | - | Reference value | - | Reference value | - |
| African American | 2.86 (2.45, 3.34) | **<0.0001** | 2.81 (2.41, 3.28) | **<0.0001** | 2.51 (2.24, 2.81) | **<0.0001** |
| Hispanic | 1.92 (1.36, 2.71) | **0.0002** | 1.89 (1.35, 2.65) | **0.0002** | 10.68 (9.51, 12.00) | **<0.0001** |
| Asian | 0.80 (0.40, 1.61) | 0.5310 | 0.79 (0.38, 1.54) | 0.4521 | 0.40 (0.22, 0.75) | **0.0040** |
| **Diabetes Without Complications** | | | | | | |
| White | Reference value | - | Reference value | - | Reference value | - |
| African American | 2.81 (2.36, 3.34) | **<0.0001** | 2.81 (2.38, 3.31) | **<0.0001** | 2.48 (2.18, 2.81) | **<0.0001** |
| Hispanic | 2.18 (1.53, 3.12) | **<0.0001** | 2.12 (1.50, 3.00) | **<0.0001** | 1.86 (1.42, 2.43) | **<0.0001** |
| Asian | 0.72 (0.32, 1.61) | 0.4221 | 0.88 (0.44, 1.77) | 0.7169 | 0.49 (0.26, 0.91) | **0.0248** |
| **Diabetic Foot Ulcer** | | | | | | |
| White | Reference value | - | Reference value | - | Reference value | - |
| African American | 2.05 (1.57, 2.67) | **<0.0001** | 2.13 (1.68, 2.69) | **<0.0001** | 2.65 (2.33, 3.02) | **<0.0001** |
| Hispanic | 1.46 (0.79, 2.68) | 0.2278 | 1.40 (0.80, 2.44) | 0.2437 | 1.67 (1.23, 2.26) | **0.0010** |
| Asian | 1.14 (0.29, 4.58) | 0.8588 | 1.38 (0.44, 4.34) | 0.5775 | 0.93 (0.44, 1.97) | 0.8572 |
| **Diabetic Angiopathy without Gangrene** | | | | | | |
| White | Reference value | - | Reference value | - | Reference value | - |
| African American | 1.65 (0.81, 3.39) | 0.1711 | 1.81 (1.15, 2.84) | **0.0102** | 2.15 (1.72, 2.69) | **<0.0001** |
| Hispanic | 1.31 (0.31, 5.52) | 0.7088 | 1.38 (0.56, 3.43) | 0.4857 | 1.87 (1.23, 2.85) | **0.0036** |
| Asian | 0.99 (0.06, 16.21) | 0.9936 | 0.85 (0.12, 6.12) | 0.8695 | 1.17 (0.48, 2.84) | 0.7285 |
| **Diabetic Angiopathy with Gangrene** | | | | | | |
| White | Reference value | - | Reference value | - | Reference value | - |
| African American | 2.13 (1.37, 3.33) | **0.0008** | 2.12 (1.49, 3.02) | **<0.0001** | 2.28 (1.93, 2.69) | **<0.0001** |
| Hispanic | 2.64 (1.31, 5.33) | **0.0068** | 1.65 (0.83, 3.27) | 0.1539 | 1.61 (1.14, 2.27) | **0.0064** |
| Asian | 0.47 (0.03, 7.65) | 0.5976 | 0.60 (0.08, 4.29) | 0.6078 | 1.10 (0.54, 2.21) | 0.7985 |
| **Diabetes with Cellulitis** | | | | | | |
| White | Reference value | - | Reference value | - | Reference value | - |
| African American | 3.05 (1.93, 4.84) | **<0.0001** | 3.31 (2.29, 4.78) | **<0.0001** | 3.90 (3.31, 4.59) | **<0.0001** |
| Hispanic | 3.15 (1.37, 7.21) | **0.0068** | 3.18 (1.61, 6.26) | **0.0008** | 2.36 (1.64, 3.39) | **<0.0001** |
| Asian | 3.26 (0.80, 13.30) | 0.0993 | 3.29 (1.04, 10.39) | **0.0421** | 1.61 (0.80, 3.24) | 0.1810 |
| **Diabetes with Osteomyelitis** | | | | | | |
| White | Reference value | - | Reference value | - | Reference value | - |
| African American | 4.59 (1.90, 11.09) | **0.0007** | 3.07 (1.55, 6.08) | **0.0013** | 2.14 (1.62, 2.84) | **<0.0001** |
| Hispanic | 2.35 (0.30, 18.52) | 0.4182 | 1.11 (0.15, 8.35) | 0.9176 | 1.31 (0.67, 2.57) | 0.4376 |
| Asian | 4.47 (0.26, 78.46) | 0.3055 | 2.17 (0.13, 36.90) | 0.591 | 0.65 (0.09, 4.66) | 0.6676 |
| **Diabetes with Abscess** | | | | | | |
| White | Reference value | - | Reference value | - | Reference value | - |
| African American | 0.91 (0.05, 17.57) | 0.9478 | 1.06 (0.24, 4.75) | 0.9398 | 3.57 (2.40, 5.33) | **<0.0001** |
| Hispanic | 12.09 (1.24, 117.85) | **0.0319** | 3.01 (0.39, 23.51) | 0.2933 | 1.47 (0.53, 4.03) | 0.4577 |
| Asian | 13.89 (0.70, 276.56) | 0.0846 | 3.88 (0.22, 67.38) | 0.3526 | 0.71 (0.04, 11.55) | 0.8118 |
| **Bold indicates statistical significance, p<0.05** | | | | | | |

Table 2. Time Between Diagnosis of Diabetic Complication and Major Amputation by Race

| Condition | Average Time to Amputation ±SD (days) | 95% CI | p-value |
|---|---|---|---|
| **Diabetes Overall** | | | |
| White | 163 ± 124 | | |
| African American | 170 ± 125 | (-7.05, 21.05) | 0.3286 |
| Hispanic | 165 ± 128 | (-29.70, 33.70) | 0.9015 |
| Asian | 220 ± 136 | (-20.42, 134,42) | 0.1488 |
| **Diabetes without Complications** | | | |
| White | 172 ± 122 | | |
| African American | 188 ± 122 | (0.52, 31.48) | **0.0428** |
| Hispanic | 169 ± 128 | (-36.01, 30.01) | 0.8585 |
| Asian | 219 ± 137 | (-29.35, 123.35) | 0.2273 |
| **Diabetic Foot Ulcer** | | | |
| White | 118 ± 107 | | |
| African American | 103 ± 104 | (-28.87, -1.13) | **0.0341** |
| Hispanic | 110 ± 92 | (-40.41, 24.41) | 0.6281 |
| Asian | 155 ± 83 | (-42.67, 116.67) | 0.3622 |
| **Diabetic Angiopathy** | | | |
| White | 121 ± 107 | | |
| African American | 99 ± 95 | (-45.13, 1.13) | 0.0622 |
| Hispanic | 115 ± 107 | (-51.17, 39.17) | 0.7939 |
| Asian | 133 ± 72 | (-82.83, 106.83) | 0.8034 |
| **Diabetic Angiopathy with Gangrene** | | | |
| White | 105 ± 103 | | |
| African American | 90 ± 95 | (-31.68, 1.68) | 0.0778 |
| Hispanic | 116 ± 101 | (-24.23, 46.23) | 0.5397 |
| Asian | 112 ± 74 | (-65.02, 79.02) | 0.8486 |
| **Cellulitis** | | | |
| White | 96 ± 98 | | |
| African American | 87 ± 89 | (-24.62, 6.62) | 0.2584 |
| Hispanic | 101 ± 98 | (-30.53, 40.53) | 0.7823 |
| Asian | 134 ± 89 | (-30.47, 106.47) | 0.2761 |
| **Abscess** | | | |
| White | 77 ± 80 | | |
| African American | 90 ± 100 | (-22.33, 48.33) | 0.4671 |
| Hispanic | 68 ± 71 | (-90.77, 7277) | 0.8268 |
| Asian | | | |
| **Osteomyelitis** | | | |
| White | 94 ± 97 | | |
| African American | 101 ± 109 | (-21.43, 35.43) | 0.6280 |
| Hispanic | 68 ± 79 | (-91.11, 39.11) | 0.4315 |
| Asian | 1.5 ± 0.7 | | |
| **Bold indicates statistical significance, p<0.05** | | | |