

# Lower-Extremity Amputation Trends Among People With Diabetes in a Large Urban Environment

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Nontraumatic lower-extremity amputations (NLEAs) are a disabling and costly complication of uncontrolled diabetes (1). Factors influencing NLEAs include glycemic control, vascular disease, foot ulcer, and diabetes prevention practices (2,3). Texas has high rates of underinsured individuals, high prevalence of diabetes, a growing Hispanic population, and high rates of NLEAs (4). We examine trends of lower-extremity amputation rates among adults with diabetes in Dallas County between 2015 and 2019.

Using data from the Dallas-Fort Worth Hospital Council Educational and Research Foundation (DFWHC) and the Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System (BRFSS), we calculated age-adjusted rates for major, minor, and overall NLEAs between 1 October 2015 and 30 September 2019. We followed the methodology used by Geiss et al. (3) and calculated age-adjusted NLEA rates per 1,000 adults with diabetes, using four adult age categories, with denominator data (numbers of adults with diabetes) estimated using BRFSS Dallas County diabetes prevalence data. Because of the transition of the ICD-9 to ICD-10 coding system on 1 October 2015, the 2015 quarter 4 data were annualized to account for quarters 1–3 that were coded using the prior ICD-9 system and therefore not used. The 2019 data were annualized to account for the unavailable 4th quarter data. The

incomplete years were annualized and calculated using the available-quarter ICD-10 data and the diabetes prevalence data. We filtered the DFWHC adult (aged  $\geq 18$  years) inpatient database by quarter and year, choosing patients with a diabetes diagnosis code (ICD-10-Clinical Modification codes E10, E11, and E13) in any position and at least one lower-extremity amputation procedure code (ICD-10-Procedural Classification System [PCS] codes OY620ZZ to OY6Y0Z3). NLEAs were further separated into major (above the foot) and minor (foot and toes) categories. We analyzed all available inpatient encounters ( $N = 5,182$ ) (73% men, 27% women, 30% White, 31% Black, 33% Hispanic, 1% Asian). Thus, patients may contribute more than one hospitalization to analyses. Rates reflect the total inpatient diabetes encounters per year for NLEAs per Dallas County population with a diagnosis of diabetes. Encounters with both a major and minor ICD-10-PCS code were categorized as a major NLEA. We did not eliminate any cases because of a previous history of NLEAs.

We calculated age-adjusted (ages 18–44, 45–64, 65–74, and  $\geq 75$  years) rates of NLEAs per 1,000 adults with diabetes in the population. We used Stata 14.0 software (StataCorp LP, College Station, TX) for statistical analysis.

The BRFSS prevalence of diabetes in Dallas County was 11.7%. Age-adjusted NLEA rates per 1,000 in this population of adults with diabetes increased 22%

between 2015 and 2019. Men experienced higher NLEA rates than women (Fig. 1).

We found an overall steady increase in NLEA rates in Dallas County between 2015 and 2019. Our findings were consistent across all age-groups except 65–74 years. Increased rates were most pronounced among those aged 75 and older. Geiss et al. (3) reported a 43% decrease in NLEA between 2000 and 2009 with a 50% rebound between 2009 and 2015. The increase in NLEAs in our sample was driven mostly by minor versus major amputations. NLEAs were more prevalent in men versus women and in ages 18–64 years. The NLEA rates in men steadily increased between 2015 and 2019, while they decreased for women in the last 2 years of observation. In 2019, there was a difference between NLEA rates for males and females ( $P < 0.0001$ ), as shown in Fig. 1.

The reason for a decrease in major NLEAs and simultaneous increase in minor NLEAs is unclear. An increase in NLEAs could be attributed to preventive and clinical practices and advancements in wound healing and limb salvage surgeries resulting in limb preservation. Additionally, there may recently be differences in clinical decision-making that relate to sex, and this may explain the structural break in the data for females. Early intervention with minor NLEAs can

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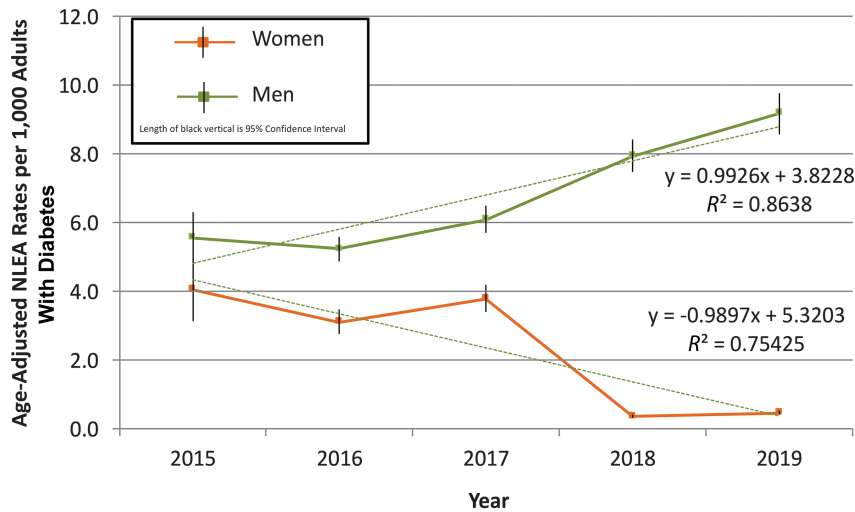
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**Figure 1**—All age-adjusted NLEA rates, males and females, with 95% CIs and trend line. The change in the number of NLEA cases per year between men and women is depicted by the trend lines showing a steady increase in men between 2015 and 2019, while the rates for women decreased from 2017 to 2018, similar to findings by Geiss et al. (3) at the national level.

reduce rates of major amputations and can improve morbidity, functionality and independence, quality of life, and mortality rate associated with them (5).

Our study is not without limitations. First, DFWHC data are at the encounter level and do not include unique identifiers. Thus, we were unable to estimate rates of NLEAs at the population level in Dallas County. Second, our analyses may be subject to residual confounding because we were unable to adjust for patient-level factors with the available data.

In conclusion, we observed a recent trend (2017–2019) toward a decrease in NLEAs in women and a shift from major to minor NLEAs, which may signal that more effective limb salvage surgeries may be leading to greater preservation of limb function in Dallas County.

**Duality of Interest.** L.M. reports advisory board and consulting activities for Sanofi, Novo Nordisk, and Applied Therapeutics. J.L.F. reports serving on an advisory board and speaker bureau for Integra. No other

potential conflicts of interest relevant to this article were reported.

**Author Contributions.** All authors contributed to the study design. All authors contributed to the writing, revisions, and final approval of the manuscript. K.K.C. and B.W. contributed to data collection and/or assembly of data, data analysis, and interpretation. K.K.C. and B.W. are the guarantors of this work and, as such, had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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## References

1. Agarwal S, Sud K, Shishehbor MH. Nationwide trends of hospital admission and outcomes among critical limb ischemia patients: from 2003–2011. *J Am Coll Cardiol* 2016;67:1901–1913
2. Crawford F, Cezard G, Chappell FM, et al. A systematic review and individual patient data meta-analysis of prognostic factors for foot ulceration in people with diabetes: the international research collaboration for the prediction of diabetic foot ulcerations (PODUS). *Health Technol Assess* 2015;19:1–210
3. Geiss LS, Li Y, Hora I, Albright A, Rolka D, Gregg EW. Resurgence of diabetes-related non-traumatic lower-extremity amputation in the young and middle-aged adult U.S. population. *Diabetes Care* 2019;42:50–54
4. Department of State Health Services. The health status of Texas 2014, October 2014. Accessed 7 July 2020. Available from <https://www.dshs.texas.gov/chs/HealthStatusTexas2014.pdf>
5. Ponticello MAC, Marmolejo V. Limb salvage versus amputation: a closer look at the evidence, costs and long-term outcomes. *PodiatryToday* 2016;29:30–39