Diabetes-Related Nontraumatic Lower-Extremity Amputations, Connecticut

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Abstract

The report — *Diabetes-Related Nontraumatic Lower-Extremity Amputations, Connecticut* — provides statistics on hospital discharges for diabetes-related nontraumatic lower-extremity amputations (DNLEAs) among Connecticut residents. In Connecticut in 2022, 2.1% of diabetes-related inpatient hospitalizations had a diagnosis code for DNLEA. The Connecticut Hospital Discharge Dataset was used to produce the numbers, percentages, and odds ratios of DNLEA hospital discharges overall and for level of amputation (toe, foot, below knee, and above knee) by demographic and clinical characteristics. Multivariate logistic regression was used to analyze the strength of association between DNLEA and demographic and clinical characteristics in a single statistical model. A similar analysis was done for each level of amputation. The strongest associations were between DNLEA and peripheral artery disease (PAD) with and without gangrene and osteomyelitis; toe amputations and older age, foot ulcers, and osteomyelitis; foot amputations and male gender, PAD with gangrene, osteomyelitis, and foot ulcers; below knee amputations and non-Hispanic Black and Other Race residents, Medicare recipients, younger age, and PAD with gangrene; above knee amputations and female gender. Due to the strong associations between DNLEA and clinical conditions such as PAD and osteomyelitis, preventing diabetes-related nerve damage, reduced blood flow, and lower-extremity infections may reduce the risk of DNLEA. The risk for these diabetes-related complications may be reduced through access to and participation in diabetes self-management education services and access to regular foot care.

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About this report

The report — *Diabetes-Related Nontraumatic Lower-Extremity Amputations, Connecticut* — provides statistics on hospital discharges for diabetes-related nontraumatic lower-extremity amputations (DNLEAs) among Connecticut residents. The report presents the number, percent, and odds ratios of DNLEA hospital discharges by demographic and clinical characteristics. The statistical information presented in this report will be used by the Connecticut Department of Public Health (DPH) and its partners to implement evidence-based policies and programs that prevent or control type 2 diabetes and its risk factors. The DPH makes this report available to the public to provide the latest data on health trends in the state.

This report is organized into two parts. The first part is a narrative that describes the findings and includes figures. The second part of the report contains descriptions of the methodologies used and detailed data tables.

Notes to the reader

The data source is the 2022 Connecticut Hospital Discharge Dataset. DPH receives the dataset annually from Connecticut Hospital Association (CHA). CHA submits Connecticut Hospital Information Management Exchange (CHIME) data on behalf of its member hospitals to DPH. The dataset includes patient demographics, up to 15 diagnosis codes, and up to 10 procedure codes. For this analysis, the dataset was limited to inpatient discharges among Connecticut residents.

The Connecticut Hospital Discharge Dataset has limitations. One limitation is the data are collected for administrative purposes such as billing and not with public health goals in mind. Another limitation is the dataset contains the number of hospital discharges and not unduplicated patients. A third limitation is the data are cross-sectional. This means that data are collected from individuals at a single point in time. Therefore, the data cannot be used to establish causation because the individuals were not followed over time. Instead, the data may be used to establish associations between DNLEA and risk factors.

Throughout this report, all racial groupings (for example, Black or African American, White) exclude persons of Hispanic ethnicity. A Hispanic or Latino/a ethnicity category is included reflecting data separate from race categories. Therefore, the modifier “Non-Hispanic or Latino/a” is assumed. Asian, Pacific Islander, American Indian or Alaskan Native, other race, and multiracial adults are reported as “Non-Hispanic Other Race” due to small numbers.

In this report, the term “statistical significance” is used to describe statistics with p-values less than 0.05 or those that have confidence intervals that do not overlap. A lack of statistical significance does not mean the health events themselves are not significant; it simply reflects a high degree of statistical uncertainty about an estimate.

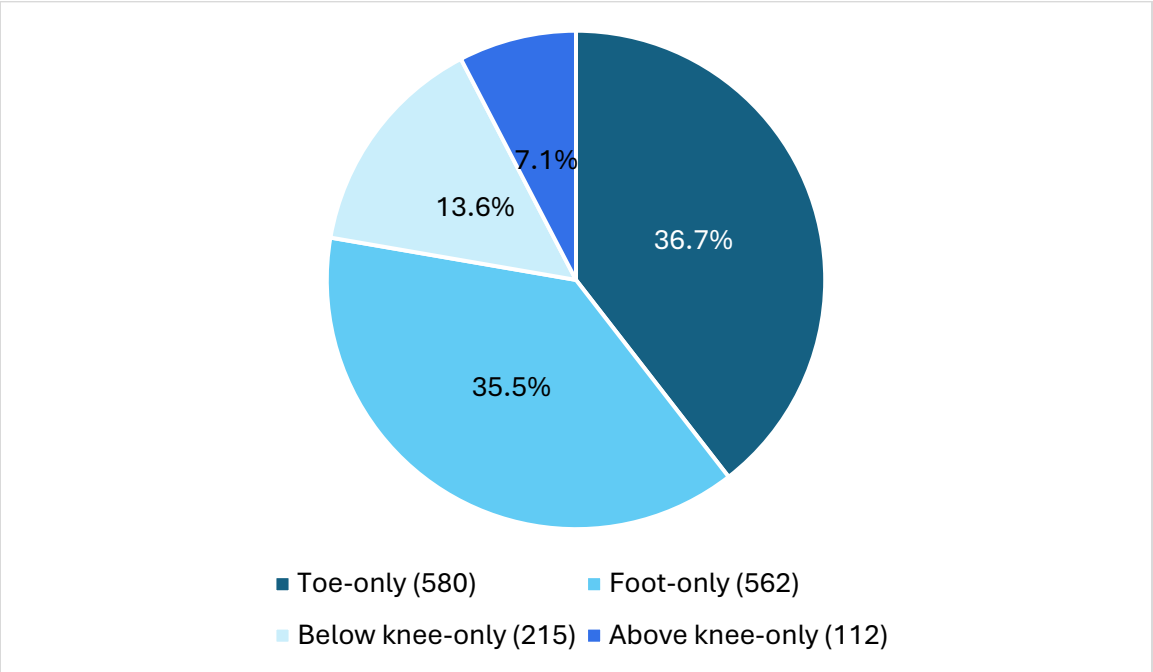
About DNLEAs

DNLEA is the surgical removal of a toe, foot, or leg because of complications from diabetes.[1] These complications include nerve damage and reduced blood circulation in the legs and feet. Reduced nerve damage and reduced circulation are associated with ulcers and infections that increase the risk of amputation.[2] Diabetes is the leading cause of nontraumatic lower-extremity amputation in the United States.[3]

In 2022 in Connecticut, 1,582 hospital discharges had a diagnosis code for DNLEA – that is 2.1% of all diabetes-related hospitalizations for that year. The age-adjusted rate of DNLEA hospitalizations in 2022 was 32.9 discharges per 100,000 population. This was an increase from the 2016 rate of 28.4 discharges per 100,000 population (time trend data not displayed in a figure or table).

The levels of DNLEA are toe, foot, below knee, and above knee. Slightly over 72% of DNLEA discharges were toe-only and foot-only amputations (36.7% and 35.5%, respectively). Almost 20% of DNLEA discharges were below the knee-only or above the knee-only amputations (13.6% and 7.1% respectively). The remaining DNLEA discharges were for some combination of amputation level (data not presented in table).

Figure 1. DNLEA by amputation level

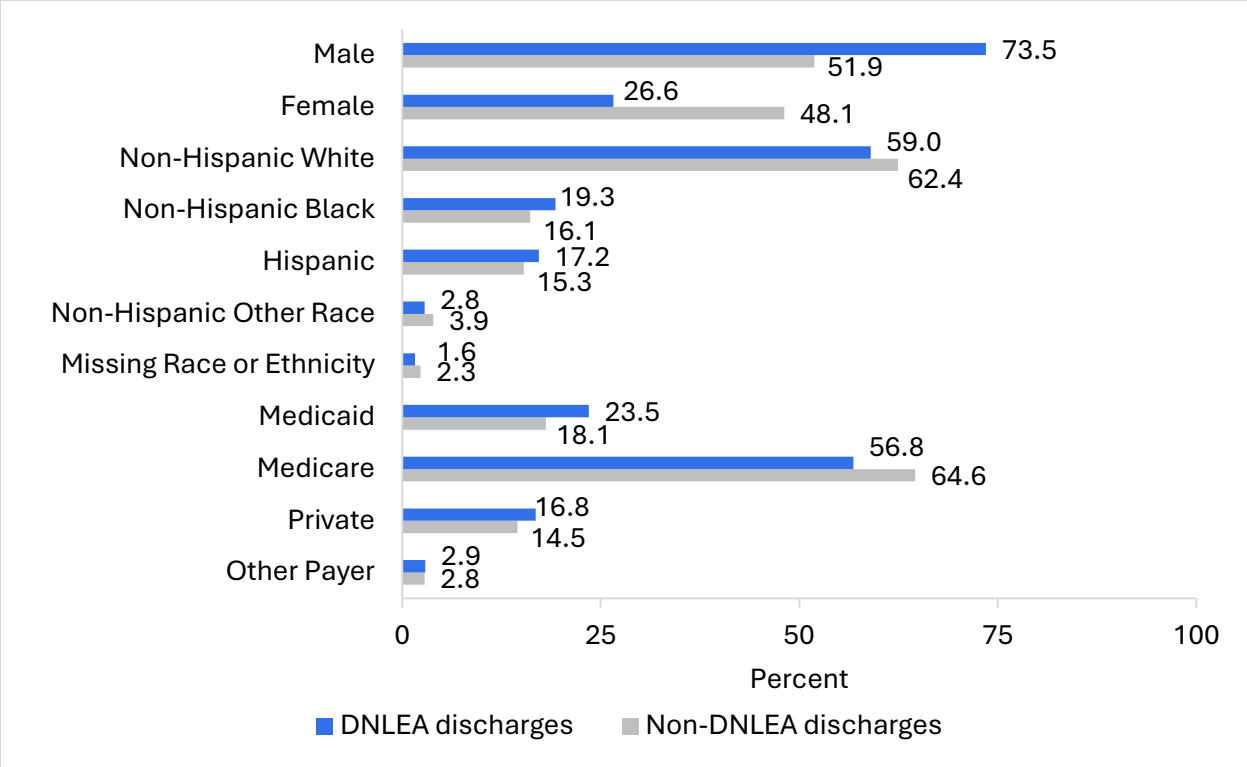


Data source: Connecticut Hospital Discharge Dataset 2022

DNLEA by demographic characteristics

When comparing DNLEA discharges to diabetes-related discharges without lower-extremity amputations, differences by demographic characteristics are evident. There are higher percentages of DNLEA discharges among men, Black and Hispanic residents, and hospitalizations with Medicaid and private insurance as the primary payer compared with non-DNLEA discharges in those same population groups. Also, the mean age of DNLEA discharges is younger than that of diabetes hospitalizations without amputations (63.7 and 67.3 years, respectively). [Figure 2, Table 1]

Figure 2. Distribution of DNLEA and non-DNLEA inpatient hospital discharges by demographic characteristics



Data source: Connecticut Hospital Discharge Dataset 2022

DNLEA by clinical characteristics

Certain comorbidities are associated with increased percentages of DNLEA. The clinical characteristics most closely associated with DNLEA are peripheral artery disease (PAD) with and without gangrene, polyneuropathy, osteomyelitis, foot ulcers, and obesity. [Figure 3, Table 1]

Peripheral artery disease (PAD) is a condition in which the blood flow to the legs and feet is reduced most often due to fatty deposits narrowing or blocking blood vessels. The poor circulation of blood to the lower extremities may lead to gangrene, or the decaying and dying of tissue. Among DNLEA hospitalizations, 51.3% had a PAD with gangrene diagnosis. Comparatively, only 1.1% of non-

DNLEA hospitalizations had a PAD with gangrene diagnosis. Also, 21.5% of DNLEA hospitalizations and 10.3% of non-DNLEA hospitalizations had a diagnosis of PAD without gangrene.[4-6]

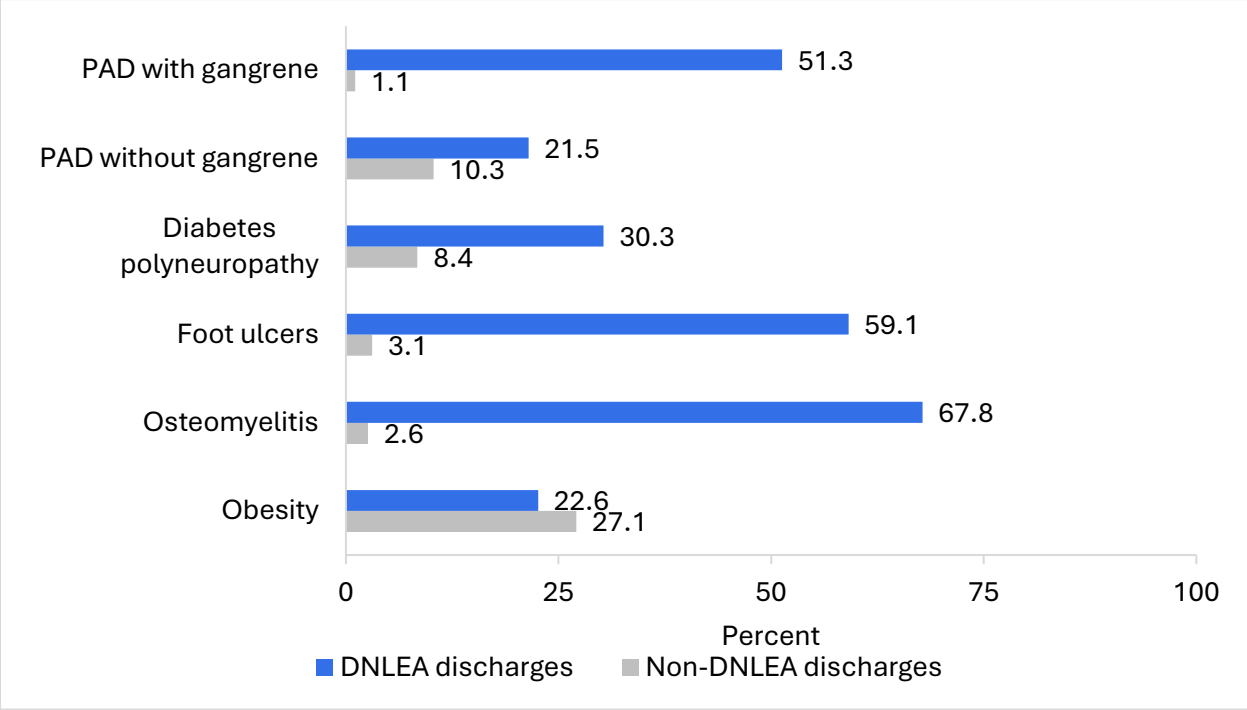
Diabetes may affect the nerves that extend from the spinal cord to the upper and lower extremities. This condition is called diabetes polyneuropathy. The nerve damage caused by diabetes polyneuropathy can lead to numbness and chronic infections in the feet. DNLEA hospitalizations have a higher percentage of polyneuropathy diagnoses compared with non-DNLEA hospitalizations (30.3% and 8.4%, respectively).[7]

PAD and polyneuropathy are associated with the development of foot ulcers among people with diabetes. Foot ulcers that become infected are a main cause of DNLEA. In fact, among DNLEA hospitalizations, 59.1% have a diagnosis of foot ulcer. In comparison, only 3.1% of non-DNLEA hospitalizations have a foot ulcer diagnosis code.[8, 9]

Osteomyelitis, or bone infection, may develop in the lower extremities of people with diabetes because of reduced blood flow to the legs. Restricted blood flow may impair healing and promote the spread of infections. Almost 68% of DNLEA hospitalizations have a diagnosis of osteomyelitis. Only 2.6% of non-DNLEA hospitalizations also have an osteomyelitis diagnosis.[10]

Obesity is associated with increased risk for several diseases or health conditions.[11] However, some studies have shown that obesity may be protective against DNLEA.[12] In this analysis, 22.6% of DNLEA hospitalizations have an obesity diagnosis compared with 27.1% of non-DNLEA hospitalizations.

Figure 3. Distribution of DNLEA and non-DNLEA inpatient hospital discharges by clinical characteristics



Data source: Connecticut Hospital Discharge Dataset 2022

Odds ratios for DNLEA

By calculating odds ratios, the strength of association between risk factors and DNLEA can be assessed. Unadjusted odds ratios provide the strength of association between an individual risk category (e.g., gender) and DNLEA. However, demographic and clinical factors interact to have a collective impact on DNLEA. This interaction is minimized in a multivariable logistic regression model. This type of statistical model produces adjusted odds ratios. These adjusted odds ratios are the risk of DNLEA for each individual factor while holding all other factors constant. The reference for each factor is typically the subgroup with the lowest prevalence or considered to have the lowest risk.

There is an association between gender and DNLEA. The unadjusted odds of a DNLEA diagnosis among men are 2.6 times that of women. When all other factors are held constant, the odds of a DNLEA diagnosis among men decrease to 1.4 times that of women.

The strength of association between race and ethnicity and DNLEA is minimal. The unadjusted odds of a DNLEA diagnosis among residents who are non-Hispanic Black are 1.3 times that of residents who are non-Hispanic White. When the odds ratio is adjusted for the other demographic and clinical factors, this odds ratio decreases to 1.1 and the strength of the association does not reach statistical significance. The strength of association among the other racial and ethnic categories and DNLEA do not reach statistical significance.

Similarly, the strength of association between primary payer and DNLEA is minimal. Before adjustment, discharges for which Medicare is the primary payer are 20% less likely to have a DNLEA diagnosis compared to discharges with private insurance as the primary payer. Also, the odds of a DNLEA diagnosis among discharges for which Medicaid is the primary payer does not vary significantly from those discharges with private insurance as the primary payer. After adjusting for all other factors, the strength of association between any category of primary payer and DNLEA does not reach statistical significance.

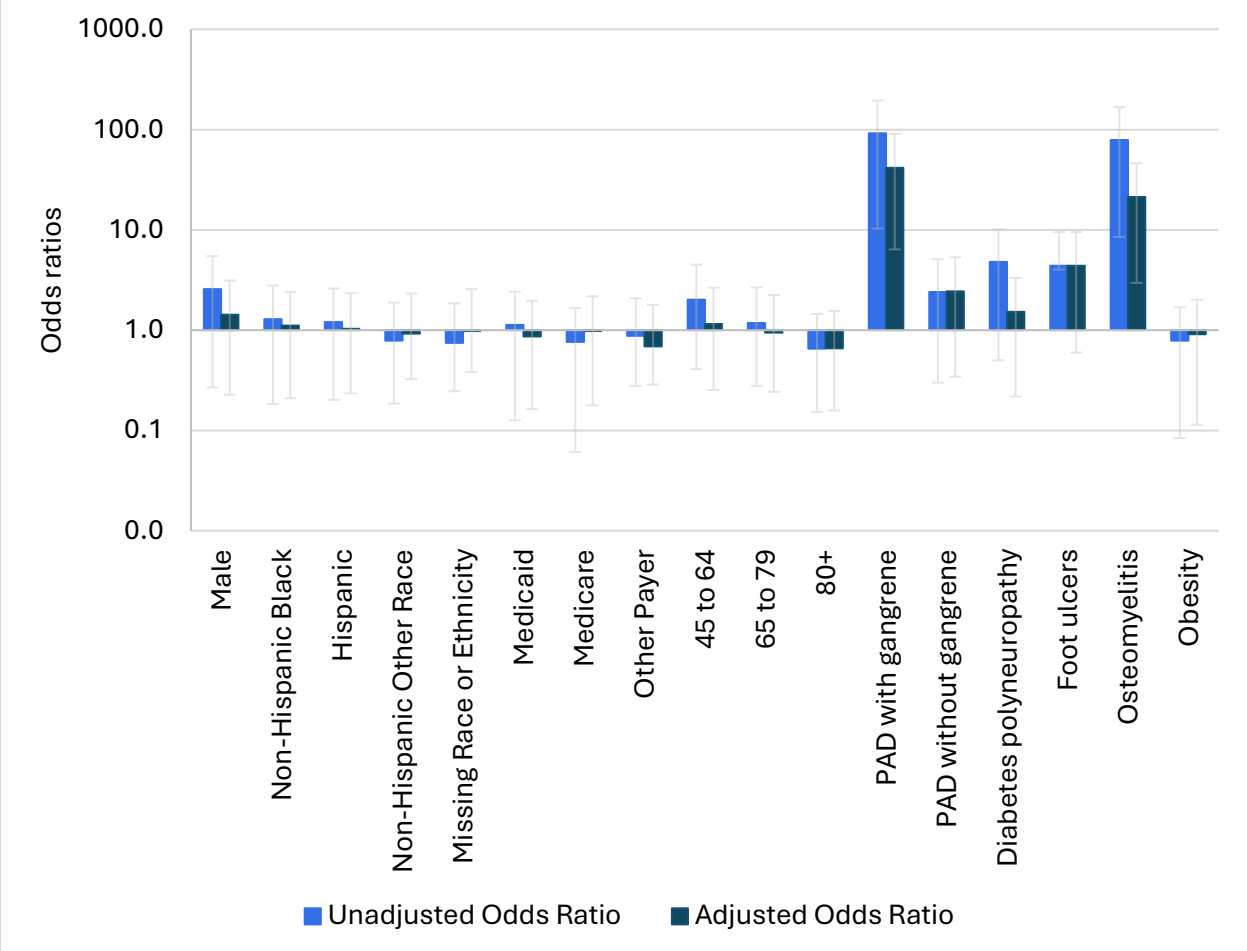
Older age is associated with lower odds of DNLEA compared with the youngest age group. Both the unadjusted and adjusted odds of DNLEA diagnosis among people who are 80 years old or older are 0.7 times that of people who are 18 to 44 years old. In other words, older adults are 30% less likely to have a DNLEA diagnosis compared with adults who are 18 to 44 years old. Regarding 45- to 64-year-old adults, while the unadjusted odds ratio is higher than younger adults, the adjusted odds ratio does not reach statistical significance. For adults aged 65 to 79 years old, neither the adjusted nor age-adjusted odds ratios reached statistical significance.

There are strong associations between PAD with gangrene, PAD without gangrene, diabetes polyneuropathy, foot ulcers, osteomyelitis and DNLEA. PAD with gangrene has the strongest association, with an unadjusted odds ratio of 91.6 and an adjusted odds of 41.5 times that of discharges without diagnosis of PAD with gangrene. Osteomyelitis also has a very strong association with DNLEA. The unadjusted odds of a DNLEA diagnosis among discharges with osteomyelitis are 78.9 times that of discharges without osteomyelitis while the adjusted odds ratio is 21.3. The unadjusted and adjusted odds of a DNLEA diagnosis among discharges with foot ulcer diagnoses are 4.4 times that of discharges without foot ulcers. The unadjusted and adjusted odds

ratios for PAD without gangrene are 2.4 that of DNLEA discharges with no diagnosis of PAD without gangrene. For diabetes polyneuropathy, the odds ratio decreases when adjusted for all other factors – from 4.8 to 1.5.

The strength of the association between obesity and DNLEA weakens when adjusted for demographic and clinical factors. The unadjusted odds of a DNLEA diagnosis among discharges with an obesity diagnosis is 0.8. When all other factors are held constant, the odds of a DNLEA diagnosis among obesity-related hospitalizations increases to 0.9 and no longer reaches statistical significance. [Figure 4, Table 2]

Figure 4. Adjusted and unadjusted odds ratios for DNLEA by demographic and clinical characteristics with 95% confidence intervals



Data source: Connecticut Hospital Discharge Dataset 2022

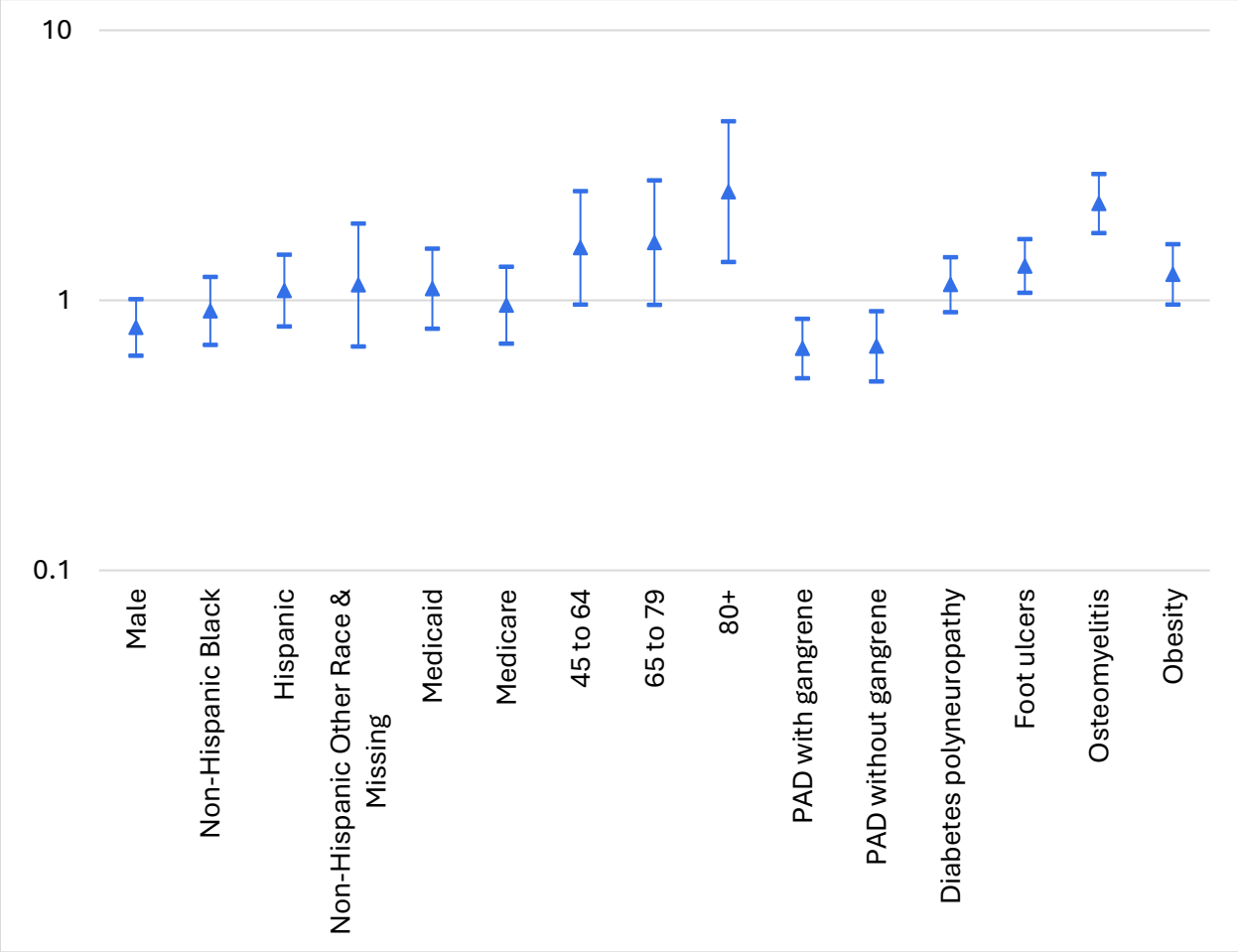
Levels of amputation

Hospital procedure codes identify the level of amputation. These levels include toe, foot, below knee, and above knee amputations. Most DNLEA discharges have a code for only one level. However, some DNLEA discharges have codes for multiple levels, possibly because there were amputations performed on both legs.

Demographic and clinical characteristics are associated with the different levels of amputations. Frequencies, unadjusted odds ratios, and adjusted odds ratios are provided in Tables 3-10. The following paragraphs describe associations with p-values less than 0.05 for the adjusted odds ratios.

There are associations between toe amputations and age, obesity, PAD, osteomyelitis, and foot ulcers. Discharges among adults 80 years old or older with DNLEA are more likely to have toe amputations compared with adults 18 to 44 years old. DNLEA discharges with osteomyelitis and those with foot ulcers are all more likely to have toe amputations compared to DNLEA discharges without these conditions. In contrast, DNLEA discharges without PAD (either with or without gangrene) are more likely to have toe amputations compared to DNLEA discharges with PAD. [Figure 5, Tables 3 and 4]

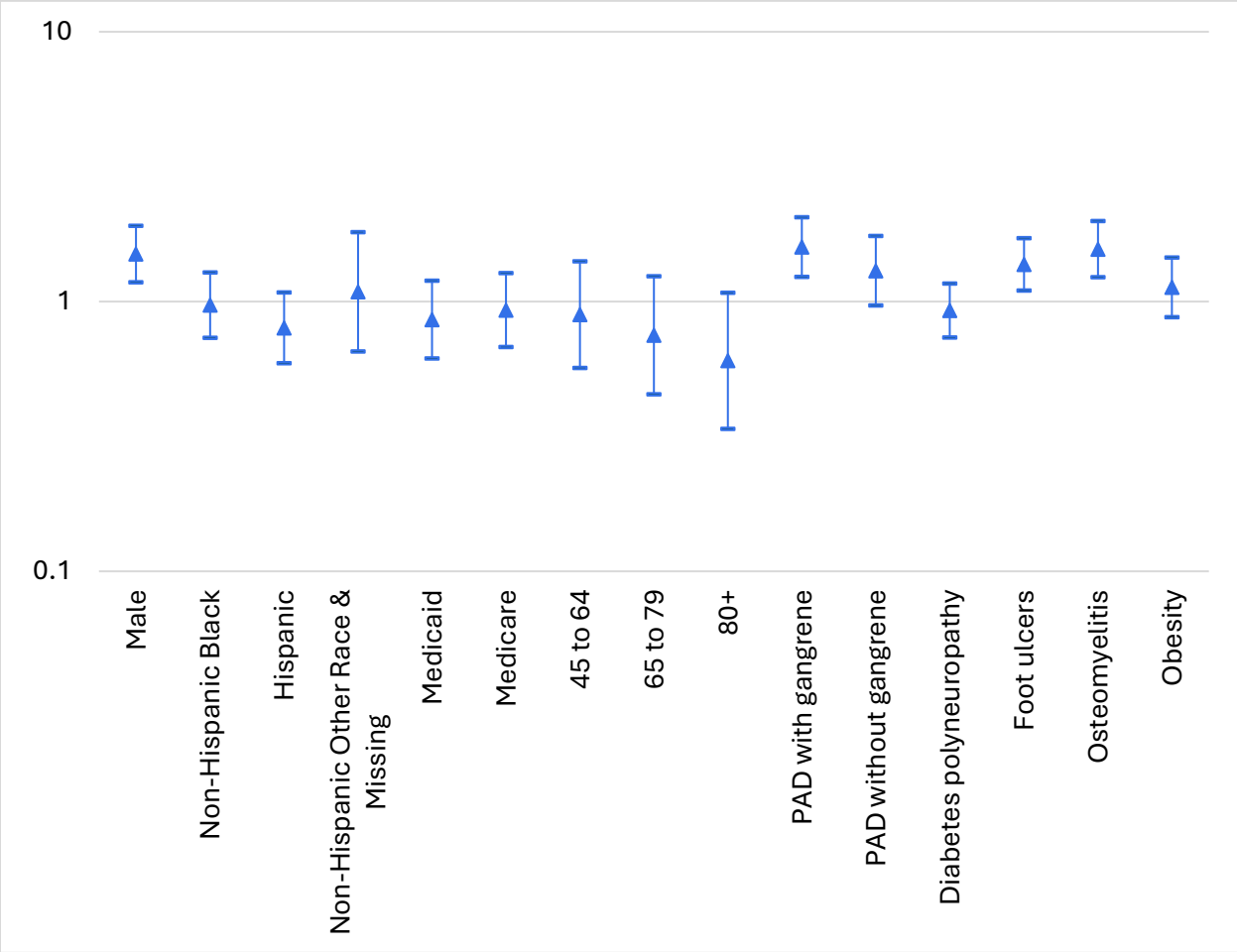
Figure 5. Adjusted odds ratios for toe amputations by demographic and clinical characteristics with 95% confidence intervals



Data source: Connecticut Hospital Discharge Dataset 2022

Foot amputations are associated with gender, PAD with gangrene, osteomyelitis, and foot ulcers. Discharges among men with DNLEA are more likely to have foot amputations compared with those among women. Also, DNLEA discharges with PAD with gangrene, osteomyelitis, and foot ulcers are more likely to have foot amputations compared to DNLEA discharges without these conditions. [Figure 6, Tables 5 and 6]

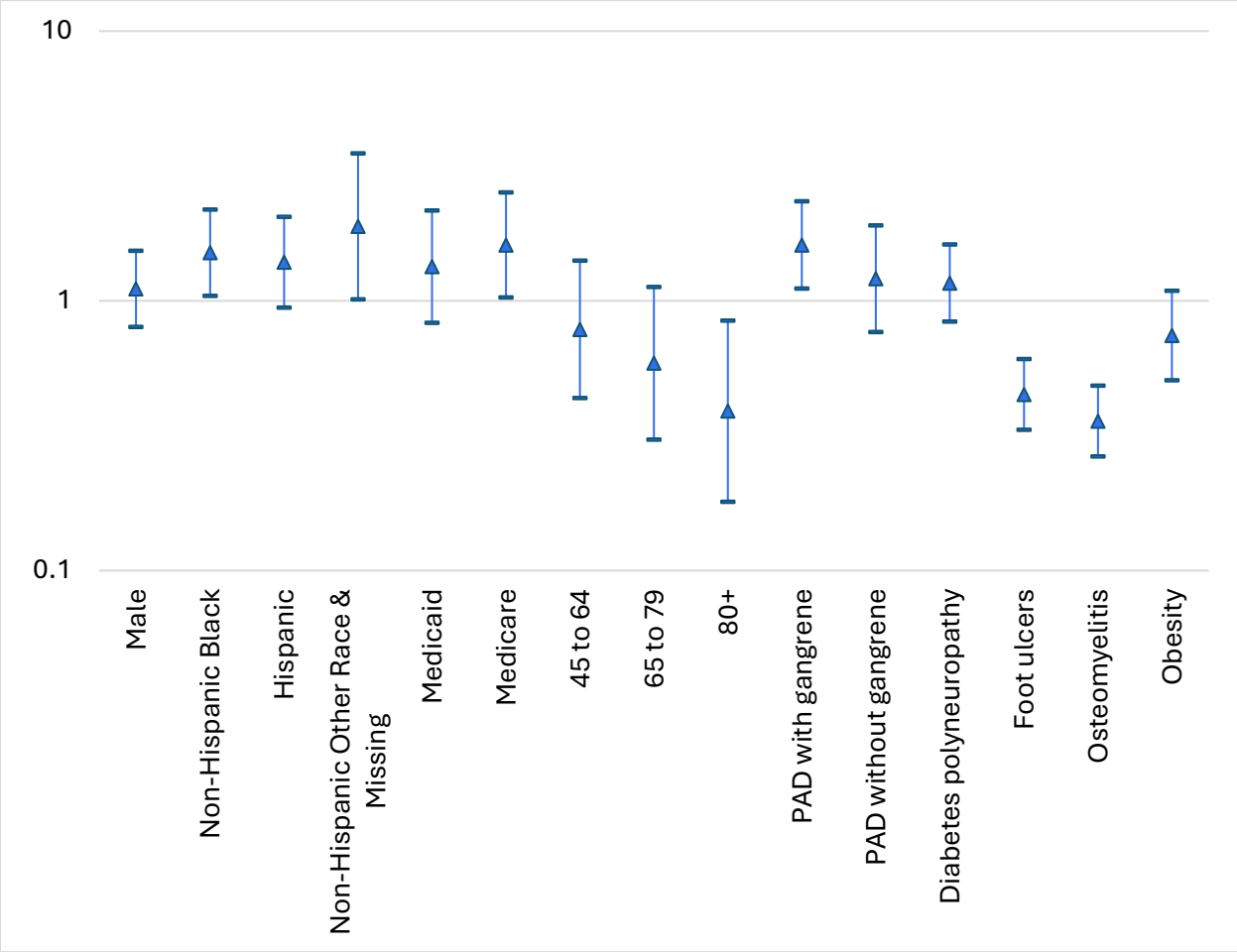
Figure 6. Adjusted odds ratios for foot amputations by demographic and clinical characteristics with 95% confidence intervals



Data source: Connecticut Hospital Discharge Dataset 2022

There are associations between below knee amputation and race and ethnicity, age, primary payer, PAD with gangrene, osteomyelitis, and foot ulcers. DNLEA discharges among Black residents and residents of other races are more likely to have below knee amputations compared with White residents. DNLEA discharges with PAD with gangrene are more likely to have below knee amputations compared to those discharges without PAD with gangrene. DNLEA discharges with obesity, osteomyelitis, and foot ulcers are less likely to have below knee amputations compared to DNLEA discharges without these conditions. [Figure 7, Tables 7 and 8]

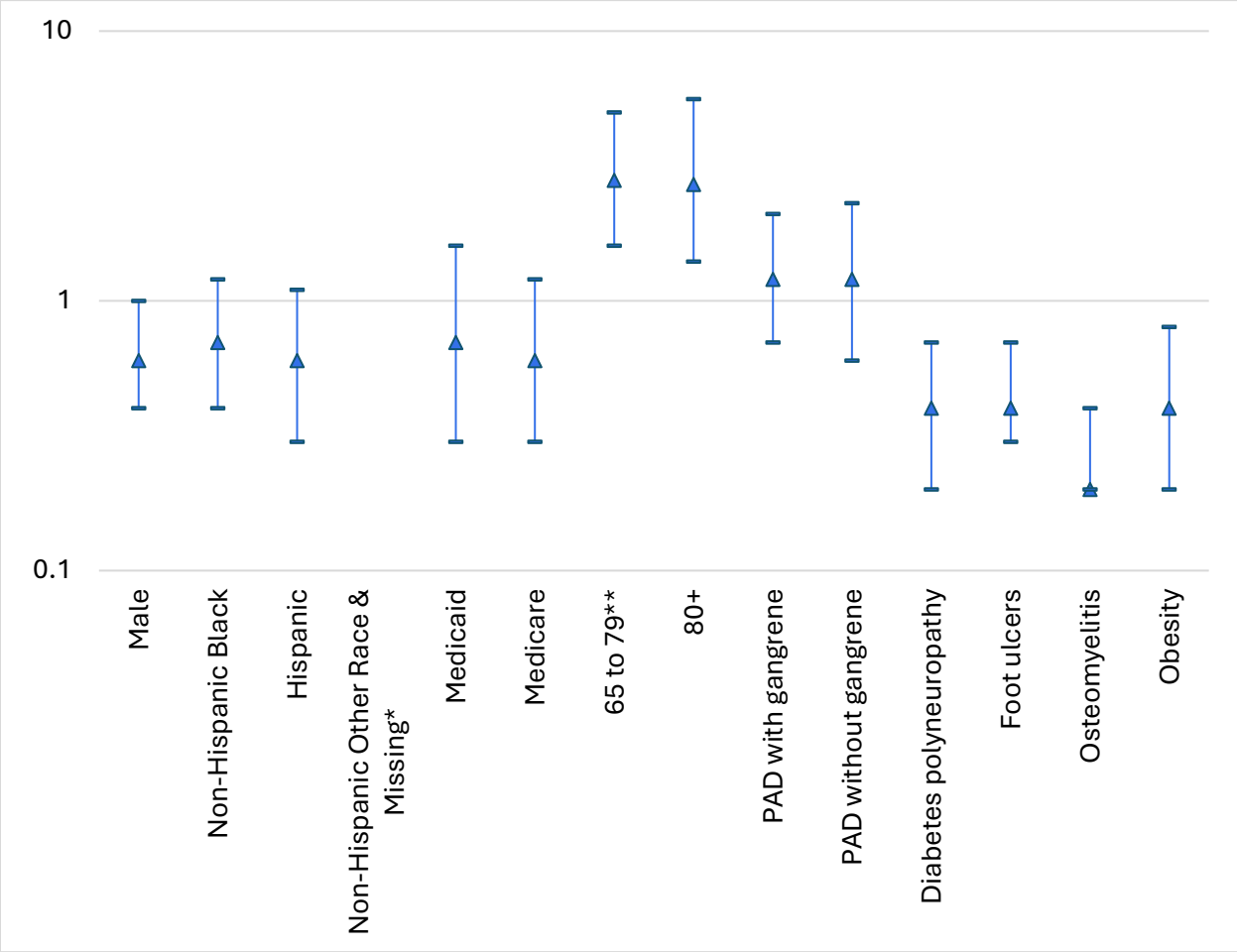
Figure 7. Adjusted odds ratios for below knee amputations by demographic and clinical characteristics with 95% confidence intervals



Data source: Connecticut Hospital Discharge Dataset 2022

Above knee amputations are associated with gender, age, obesity, osteomyelitis, diabetes polyneuropathy, and foot ulcers. Discharges among women with DNLEA are more likely to have above knee amputations compared with men. DNLEA discharges among older residents are more likely to have above knee amputations compared with younger residents. Also, DNLEA discharges with obesity, osteomyelitis, diabetes polyneuropathy, and foot ulcers are less likely to have above knee amputations compared to DNLEA discharges without these conditions. [Figure 8, Tables 9 and 10]

Figure 8. Adjusted odds ratios for above knee amputations by demographic and clinical characteristics with 95% confidence intervals



Data source: Connecticut Hospital Discharge Dataset 2022
*Value suppressed because N is between 1 and 11.
**The reference group for this analysis is the 45 to 64 years old category. The value for ages 18 to 44 years old is suppressed because N is 1 to 10.

Conclusion

The findings contained in this report support the Connecticut Department of Public Health's efforts to improve access, appropriateness, and feasibility of diabetes self-management education and support (DSMES). DSMES is an evidence-based service in which a person with diabetes works with a diabetes care and education specialist to set and track goals. In DSMES, people with diabetes gain knowledge and skills on how to manage diabetes, practice how to fit diabetes care into their daily routines and find ways to get support. DSMES is associated with many beneficial health outcomes, such as lower hemoglobin A1C levels (i.e., better diabetes control), healthier lifestyle behaviors, and better control of hypertension and high cholesterol. [13]

Healthier lifestyle behaviors and blood pressure and cholesterol control can reduce the risk of PAD, poor blood circulation, and nerve damage.[14] PAD is a key risk factor for DNLEA. Poor blood circulation and nerve damage may lead to unnoticed and untreated sores on the feet.[15] These sores may lead to osteomyelitis and ultimately DNLEA.

DSMES also educates people with diabetes about and encourages foot care.[16] People with diabetes should check their feet every day for cuts and blisters and seek medical care for any sores that are not healing properly. Annual exam of the feet by healthcare professionals is important to assess for nerve damage and blood circulation. For these reasons, continued efforts to expand access to and medical coverage of DSMES are warranted.

Detailed data tables

Table 1. Description of the 2022 Connecticut Hospital Discharge Dataset, by diabetes nontraumatic lower-extremity amputation (DNLEA) status

Demographic/Clinical Group	Characteristic	No DNLEA[a,b] # (%)	Yes DNLEA[a,b] # (%)	p-value[c]
Gender	Male	39,282 (51.9)	1,162 (73.5)	<0.0001
	Female	36,455 (48.1)	420 (26.6)	
Race and Ethnicity	Non-Hispanic White	47,268 (62.4)	933 (59.0)	<0.0001
	Non-Hispanic Black	12,197 (16.1)	306 (19.3)	
	Hispanic	11,575 (15.3)	272 (17.2)	
	Non-Hispanic Other Race	2,932 (3.9)	45 (2.8)	
	Missing	1,766 (2.3)	26 (1.6)	
Primary Payer	Medicaid	13,681 (18.1)	372 (23.5)	<0.0001
	Medicare	48,915 (64.6)	899 (56.8)	
	Private	11,006 (14.5)	266 (16.8)	
	Other	2,123 (2.8)	45 (2.9)	
Age (years)	Mean ± SD	67.3 ± 15.1	63.7 ± 12.3	<0.0001
	18 to 44	6,147 (8.1)	98 (6.2)	<0.0001
	45 to 64	23,857 (31.5)	764 (48.3)	
	65 to 79	29,112 (38.4)	547 (34.6)	
	80+	16,622 (22.0)	173 (10.9)	
Peripheral Artery Disease (PAD) with Gangrene	No	74,878 (98.9)	771 (48.7)	<0.0001
	Yes	860 (1.1)	811 (51.3)	
PAD without Gangrene	No	67,950 (89.7)	1,242 (78.5)	<0.0001
	Yes	7,788 (10.3)	340 (21.5)	
Diabetes Polyneuropathy	No	69,403 (91.6)	1,102 (69.7)	<0.0001
	Yes	6,335 (8.4)	480 (30.3)	
Foot Ulcers	No	73,418 (96.9)	647 (40.9)	<0.0001
	Yes	2,320 (3.1)	935 (59.1)	
Osteomyelitis	No	73,773 (97.4)	510 (32.2)	<0.0001
	Yes	1,965 (2.6)	1,072 (67.8)	
Obesity	No	55,212 (72.9)	1,225 (77.4)	<0.0001
	Yes	20,526 (27.1)	357 (22.6)	
Total	All	75,738 (100)	1,582 (100)	

Data source: 2022 Connecticut Hospital Discharge Dataset

[a] Table values are mean ± SD for continuous variables and n (column %) for categorical variables.

[b] Numbers may not sum to total due to missing data, and percentages may not sum to 100% due to rounding.

[c] P-value is for T test (continuous variables) or χ^2 test (categorical variables).

Table 2. Unadjusted and adjusted odds ratios of factors associated with DNLEA

Characteristic	Unadjusted Odds Ratio	95% CI[a]	p-value[b]	Adjusted Odds Ratio	95% CI[a]	p-value[b]
Gender						
Male	2.6	2.3-2.9	<0.0001	1.4	1.2-1.7	<0.0001
Female	Reference			Reference		
Race and Ethnicity						
Non-Hispanic White	Reference			Reference		
Non-Hispanic Black	1.3	1.1-1.5	<0.0001	1.1	0.9-1.3	0.2717
Hispanic	1.2	1.0-1.4	0.0002	1.0	0.9-1.3	0.7446
Non-Hispanic Other Race	0.8	0.6-1.1	0.0082	0.9	0.6-1.4	0.7103
Missing	0.7	0.5-1.1	0.1433	1.0	0.6-1.6	0.9473
Primary Payer						
Medicaid	1.1	1.0-1.3	0.1433	0.9	0.7-1.1	0.2093
Medicare	0.8	0.7-0.9	0.0001	1.0	0.8-1.2	0.8347
Private	Reference			Reference		
Other	0.9	0.6-1.2	0.4248	0.7	0.4-1.1	0.1105
Age years						
18 to 44	Reference			Reference		
45 to 64	2.0	1.6-2.5	<0.0001	1.2	0.9-1.5	0.3342
65 to 79	1.2	0.9-1.5	0.1374	0.9	0.7-1.3	0.7192
80+	0.7	0.5-0.8	0.0008	0.7	0.5-0.9	0.0233
PAD with gangrene						
No	Reference			Reference		
Yes	91.6	81.3-103.2	<0.0001	41.5	35.1-49.1	<0.0001
PAD without gangrene						
No	Reference			Reference		
Yes	2.4	2.1-2.7	<0.0001	2.4	2.1-2.9	<0.0001
Diabetes polyneuropathy						
No	Reference			Reference		
Yes	4.8	4.3-5.3	<0.0001	1.5	1.3-1.8	<0.0001
Foot Ulcers						
No	Reference			Reference		
Yes	4.4	3.8-5.1	<0.0001	4.4	3.8-5.1	<0.0001
Osteomyelitis						
No	Reference			Reference		
Yes	78.9	70.4-88.5	<0.0001	21.3	18.3-24.8	<0.0001
Obesity						
No	Reference			Reference		
Yes	0.8	0.7-0.9	<0.0001	0.9	0.9-1.1	0.2790

Data source: 2022 Connecticut Hospital Discharge Dataset

[a]CI = Confidence interval

[b]P-value associated with Wald's χ^2

Table 3. Number and percent of DNLEA toe amputations by demographic and clinical characteristics

Characteristic	No Toe Amputation # (%)	Toe Amputation # (%)	p-value[a]
Gender			
Male	697 (60.0)	465 (40.0)	0.3101
Female	240 (57.1)	180 (42.9)	
Race and Ethnicity			
Non-Hispanic White	544 (58.3)	389 (41.7)	0.6953
Non-Hispanic Black	190 (62.1)	116 (37.9)	
Hispanic	162 (59.6)	110 (40.4)	
Non-Hispanic Other Race & Missing	41 (57.8)	30 (42.3)	
Primary Payer			
Medicaid	210 (56.5)	162 (43.6)	0.4787
Medicare	544 (60.5)	355 (39.5)	
Private	159 (59.8)	107 (40.2)	
Age (years)			
18 to 44	63 (64.3)	35 (35.7)	0.1363
45 to 64	444 (58.1)	320 (41.9)	
65 to 79	338 (61.8)	209 (38.2)	
80+	92 (53.18)	81 (46.8)	
PAD with gangrene			
No	414 (53.7)	357 (46.3)	<0.0001
Yes	523 (64.5)	288 (35.5)	
PAD without gangrene			
No	736 (59.3)	506 (40.7)	0.9624
Yes	201 (59.1)	139 (40.9)	
Diabetes polyneuropathy			
No	671 (60.9)	431 (39.1)	0.0417
Yes	266 (55.4)	214 (44.6)	
Foot Ulcers			
No	50 (67.1)	50 (32.9)	<0.0001
Yes	503 (53.8)	432 (46.2)	
Osteomyelitis			
No	380 (74.5)	130 (25.5)	<0.0001
Yes	557 (52.0)	515 (48.0)	
Obesity			
No	750 (61.2)	475 (38. 8)	0.0028
Yes	187 (52.4)	170 (47.6)	
All	937 (59.2)	645 (40.8)	--

Data source: 2022 Connecticut Hospital Discharge Dataset

[a] P-value is for $\chi 2$ test

Table 4. Unadjusted and adjusted odds ratios of factors associated with DNLEA toe amputations

Characteristic	Unadjusted Odds Ratio	95% CI[a]	p-value[b]	Adjusted Odds Ratio	95% CI[a]	p-value[b]
Gender						
Male	0.9	0.7-1.1	0.3102	0.8	0.6-1.0	0.0618
Female	Reference			Reference		
Race and Ethnicity						
Non-Hispanic White	Reference			Reference		
Non-Hispanic Black	0.9	0.7-1.1	0.2425	0.9	0.7-1.2	0.5394
Hispanic	1.0	0.7-1.3	0.7122	1.1	0.8-1.5	0.5933
Non-Hispanic Other Race & Missing	1.0	0.6-1.7	0.9265	1.1	0.7-1.9	0.6258
Primary Payer						
Medicaid	1.1	0.8-1.5	0.5290	1.1	0.8-1.6	0.5679
Medicare	0.9	0.7-1.2	0.6044	1.0	0.7-1.3	0.8083
Private	Reference			Reference		
Age (years)						
18 to 44	Reference			Reference		
45 to 64	1.3	0.8-2.0	0.2436	1.6	1.0-2.5	0.0686
65 to 79	1.1	0.7-1.7	0.6393	1.6	1.0-2.8	0.0690
80+	1.6	1.0-2.6	0.0767	2.5	1.4-4.6	0.0025
PAD with gangrene						
No	Reference			Reference		
Yes	0.6	0.5-0.8	<0.0001	0.7	0.5-0.9	0.0015
PAD without gangrene						
No	Reference			Reference		
Yes	1.0	0. 8-1.3	0.9624	0.7	0.5-0.9	0.0101
Diabetes polyneuropathy						
No	Reference			Reference		
Yes	1.3	1.0-1.6	0.0419	1.1	0.9-1.4	0.2614
Foot Ulcers						
No	Reference			Reference		
Yes	1.8	1.4-2.6	<0.0001	1.3	1.1-1.7	0.0117
Osteomyelitis						
No	Reference			Reference		
Yes	2.7	2.1-3.4	<0.0001	2.3	1.8-2.9	<0.0001
Obesity						
No	Reference			Reference		
Yes	1.4	1.1-1.8	0.0028	1.2	1.0-1.6	0.0920

Data source: 2022 Connecticut Hospital Discharge Dataset

[a]CI = Confidence interval

[b]P-value associated with Wald's χ^2

Table 5. Number and percent of DNLEA foot amputations

Characteristic	No Foot Amputation # (%)	Foot Amputation # (%)	p-value[a]
Gender			
Male	646 (55.6)	516 (44.4)	0.0011
Female	272 (64.8)	148 (35.2)	
Race and Ethnicity			
Non-Hispanic White	535 (57.3)	398 (42.7)	0.8105
Non-Hispanic Black	177 (57.8)	129 (42.2)	
Hispanic	165 (60.7)	107 (39.3)	
Non-Hispanic Other Race & Missing	41 (57.8)	30 (42.3)	
Primary Payer			
Medicaid	214 (57.5)	158 (42.5)	0.3105
Medicare	537 (59.7)	362 (40.3)	
Private	142 (53.4)	124 (46.6)	
Age (years)			
18 to 44	55 (56.1)	43 (43.9)	0.1452
45 to 64	426 (55.8)	338 (44.2)	
65 to 79	325 (59.4)	222 (40.6)	
80+	112 (64.7)	61 (35.3)	
PAD with gangrene			
No	466 (60.4)	305 (39.6)	0.0579
Yes	452 (55.7)	359 (44.3)	
PAD without gangrene			
No	721 (58.1)	521 (42.0)	0.9709
Yes	197 (57.9)	143 (42.1)	
Diabetes polyneuropathy			
No	645 (58.5)	457 (41.5)	0.5398
Yes	273 (56.9)	207 (43.1)	
Foot Ulcers			
No	50 (63.7)	50 (36.3)	0.0002
Yes	506 (54.1)	429 (45.9)	
Osteomyelitis			
No	334 (65.5)	176 (34.5)	<0.0001
Yes	584 (54.5)	488 (45.5)	
Obesity			
No	718 (58.6)	507 (41.4)	0.3829
Yes	200 (56.0)	157 (44.0)	
All	918 (58.0)	664 (42.0)	--

Data source: 2022 Connecticut Hospital Discharge Dataset

[a] P-value is for $\chi 2$ test

Table 6. Unadjusted and adjusted odds ratios of factors associated with DNLEA foot amputations

Characteristic	Unadjusted Odds Ratio	95% CI[a]	p-value[b]	Adjusted Odds Ratio	95% CI[a]	p-value[b]
Gender						
Male	1.5	1.2-1.9	0.0011	1.5	1.2-1.9	0.0010
Female	Reference			Reference		
Race and Ethnicity						
Non-Hispanic White	Reference			Reference		
Non-Hispanic Black	1.0	0.8-1.3	0.8777	1.0	0.7-1.3	0.8197
Hispanic	0.9	0.7-1.1	0.3290	0.8	0.6-1.1	0.1431
Non-Hispanic Other Race & Missing	1.0	0.6-1.6	0.9470	1.1	0.7-1.8	0.7524
Primary Payer						
Medicaid	0.9	0.6-1.2	0.3158	0.9	0.6-1.2	0.3597
Medicare	0.8	0.6-1.0	0.0632	0.9	0. 7-1.3	0.6429
Private	Reference			Reference		
Age (years)						
18 to 44	Reference			Reference		
45 to 64	1.0	0.7-1.6	0.9456	0.9	0. 6-1.4	0.6257
65 to 79	0.9	0. 6-1.4	0.5420	0.7	0.5-1.2	0.2616
80+	0.7	0.4-1.2	0.1618	0.6	0.3-1.2	0.0875
PAD with gangrene						
No	Reference			Reference		
Yes	1.2	1.0-1.5	0.0580	1.6	1.2-2.1	0.0004
PAD without gangrene						
No	Reference			Reference		
Yes	1.0	0. 8-1.3	0.9709	1.3	1.0-1.8	0.0849
Diabetes polyneuropathy						
No	Reference			Reference		
Yes	1.1	0.9-1.3	0.5390	0.9	0.7-1.2	0.5069
Foot Ulcers						
No	Reference			Reference		
Yes	1.5	1.2-1.8	0.0002	1.4	1.1-1.7	0.0055
Osteomyelitis						
No	Reference			Reference		
Yes	1.6	1.3-2.0	<0.0001	1.6	1.2-2.0	0.0003
Obesity						
No	Reference			Reference		
Yes	1.1	0.9-1.4	0.3830	1.1	0.9-1.5	0.3539

Data source: 2022 Connecticut Hospital Discharge Dataset

[a]CI = Confidence interval

[b] P-value associated with Wald's χ^2

Table 7. Number and percent of DNLEA below knee amputations

Characteristic	No Below Knee Amputation # (%)	Below Knee Amputation # (%)	p-value[a]
Gender			
Male	971 (83.6)	191 (16.4)	0.5049
Female	345 (82.1)	75 (17.9)	
Race and Ethnicity			
Non-Hispanic White	806 (86.4)	127 (13.6)	0.0005
Non-Hispanic Black	241 (78.8)	65 (21.2)	
Hispanic	216 (79.4)	56 (20.6)	
Non-Hispanic Other Race & Missing	53 (74.7)	18 (25.4)	
Primary Payer			
Medicaid	312 (83.9)	60 (16.1)	0.2756
Medicare	735 (81.8)	164 (18.2)	
Private	230 (86.5)	36 (13.5)	
Age (years)			
18 to 44	78 (79.6)	20 (20.4)	0.3766
45 to 64	632 (82.7)	132 (17.3)	
65 to 79	455 (83.2)	92 (16.8)	
80+	151 (87.3)	22 (12.7)	
PAD with gangrene			
No	682 (88.5)	89 (11.5)	<.0001
Yes	634 (78.2)	177 (21.8)	
PAD without gangrene			
No	1022 (82.3)	220 (17.7)	0.0676
Yes	294 (86.5)	46 (13.5)	
Diabetes polyneuropathy			
No	909 (82.5)	193 (17.5)	0.2597
Yes	407 (84.8)	73 (15.2)	
Foot Ulcers			
No	50 (74.2)	50 (25.8)	<.0001
Yes	836 (89.4)	99 (10.6)	
Osteomyelitis			
No	355 (69.6)	155 (30.4)	<.0001
Yes	961 (89.7)	111 (10.4)	
Obesity			
No	1,001 (81.7)	224 (18.3)	0.0037
Yes	315 (88.2)	42 (11.8)	
All	1,316 (83.2)	266 (16.8)	--

Data source: 2022 Connecticut Hospital Discharge Dataset

[a] P-value is for $\chi 2$ test

Table 8. Unadjusted and adjusted odds ratios of factors associated with DNLEA below knee amputations

Characteristic	Unadjusted Odds Ratio	95% CI[a]	p-value[b]	Adjusted Odds Ratio	95% CI[a]	p-value[b]
Gender						
Male	0.9	0.7-1.2	0.5050	1.1	0.8-1.5	0.5335
Female	Reference			Reference		
Race and Ethnicity						
Non-Hispanic White	Reference			Reference		
Non-Hispanic Black	1.7	1.2-2.4	0.0015	1.5	1.0-2.2	0.0290
Hispanic	1.6	1.2-2.3	0.0051	1.4	0.9-2.0	0.0947
Non-Hispanic Other Race & Missing	2.2	1.2-3.8	0.0079	1.9	1.0-3.5	0.0452
Primary Payer						
Medicaid	1.2	0.8-1.9	0.3389	1.3	0.8-2.2	0.2321
Medicare	1.4	1.0-2.1	0.0564	1.6	1.0-2.5	0.0372
Private	Reference			Reference		
Age (years)						
18 to 44	Reference			Reference		
45 to 64	0.8	0.5-1.4	0.4443	0.8	0.4-1.4	0.4146
65 to 79	0.8	0.5-1.4	0.3883	0.6	0.3-1.1	0.1092
80+	0.6	0.3-1.1	0.0956	0.4	0.2-0.8	0.0171
PAD with gangrene						
No	Reference			Reference		
Yes	2.1	1.6-2.8	<0.0001	1.6	1.1-2.3	0.0120
PAD without gangrene						
No	Reference			Reference		
Yes	0.7	0.5-1.0	0.0686	1.2	0.8-1.9	0.4153
Diabetes polyneuropathy						
No	Reference			Reference		
Yes	0.8	0.6-1.1	0.2601	1.2	0.8-1.6	0.3664
Foot Ulcers						
No	Reference			Reference		
Yes	0.3	0.3-0.4	<0.0001	0.5	0.3-0.6	<0.0001
Osteomyelitis						
No	Reference			Reference		
Yes	0.3	0.2-0.3	<0.0001	0.4	0.3-0.5	<0.0001
Obesity						
No	Reference			Reference		
Yes	0.6	0.4-0.8	0.0040	0.7	0.5-1.1	0.1293

Data source: 2022 Connecticut Hospital Discharge Dataset

[a]CI = Confidence interval

[b]P-value associated with Wald's χ^2

Table 9. Number and percent of DNLEA above knee amputations

Characteristic	No Above Knee Amputation # (%)	Above Knee Amputation # (%)	p-value[a]
Gender			
Male	1,083 (93.2)	79 (6.8)	0.0105
Female	375 (89.3)	45 (10.7)	
Race and Ethnicity			
Non-Hispanic White	853 (91.4)	80 (8.6)	0.2910
Non-Hispanic Black	282 (92.2)	24 (7.8)	
Hispanic	[b]	[b]	
Non-Hispanic Other Race & Missing	[b]	[b]	
Primary Payer			
Medicaid	356 (95.7)	16 (4.3)	0.0138
Medicare	813 (90.4)	86 (9.6)	
Private	248 (93.2)	18 (6.8)	
Age (years)			
18 to 44	[b]	[b]	<0.0001
45 to 64	[b]	[b]	
65 to 79	483 (88.3)	64 (11.7)	
80+	151 (87.3)	22 (12.7)	
PAD with gangrene			
No	724 (93.9)	47 (6.1)	0.0119
Yes	734 (90.5)	77 (9.5)	
PAD without gangrene			
No	1144 (92.1)	98 (7. 9)	0.8824
Yes	314 (92.4)	26 (7.7)	
Diabetes polyneuropathy			
No	992 (90.0)	110 (10.0)	<0.0001
Yes	466 (97.1)	14 (2.9)	
Foot Ulcers			
No	50 (85.9)	50 (14.1)	<0.0001
Yes	902 (96.5)	33 (3.5)	
Osteomyelitis			
No	421 (82.6)	89 (17.5)	<.0001
Yes	1,037 (96.7)	35 (3.3)	
Obesity			
No	1,113 (90.9)	112 (9.1)	0.0003
Yes	345 (96.6)	12 (3.4)	
All	1,458 (92.2)	124 (7.8)	--

Data source: 2022 Connecticut Hospital Discharge Dataset

[a] P-value is for $\chi 2$ test

[b]Suppressed because N is 1 to 10.

Table 10. Unadjusted and adjusted odds ratios of factors associated with DNLEA above knee amputations

Characteristic	Unadjusted Odds Ratio	95% CI[a]	p-value[b]	Adjusted Odds Ratio	95% CI[a]	p-value[b]
Gender						
Male	0.6	0.4-0.9	0.0112	0.6	0.4-1.0	0.0346
Female	Reference			Reference		
Race and Ethnicity						
Non-Hispanic White	Reference			Reference		
Non-Hispanic Black	0.8	0.5-1.4	0.4509	0.7	0.4-1.2	0.2166
Hispanic	0.8	0.5-1.4	0.4154	0.6	0.3-1.1	0.0871
Non-Hispanic Other Race & Missing	[c]	--	--	[c]	--	--
Primary Payer						
Medicaid	0.6	0.3-1.1	0.1190	0.7	0.3-1.6	0.3901
Medicare	1.4	0.9-2.3	0.1856	0.6	0.3-1.2	0.1488
Private	Reference			Reference		
Age (years)						
18 to 44	[c]	--	--	[c]	--	--
45 to 64	Reference			Reference		
65 to 79	2.9	1.9-4.6	<0.0001	2.8	1.6-5.0	0.0003
80+	3.3	1.9-5.9	<0.0001	2.7	1.4-5.6	0.0051
PAD with gangrene						
No	Reference			Reference		
Yes	1.6	1.1-2.4	0.0126	1.2	0.7-2.1	0.4789
PAD without gangrene						
No	Reference			Reference		
Yes	1.0	0.6-1.5	0.8833	1.2	0.6-2.3	0.6077
Diabetes polyneuropathy						
No	Reference			Reference		
Yes	0.3	0.2-0.5	<0.0001	0.4	0.2-0.7	0.0041
Foot Ulcers						
No	Reference			Reference		
Yes	0.2	0.1-0.3	<0.0001	0.4	0.3-0.7	0.0003
Osteomyelitis						
No	Reference			Reference		
Yes	0.2	0.1-0.2	<0.0001	0.2	0.2-0.4	<0.0001
Obesity						
No	Reference			Reference		
Yes	0.3	0.2-0.6	0.0006	0.4	0.2-0.8	0.0144

Data source: 2022 Connecticut Hospital Discharge Dataset

[a]CI = Confidence interval

[b]P-value associated with Wald's χ^2

[c]Excluded from model because N is 1 to 10

Methodology

Data source

The data source is the 2022 Connecticut Hospital Discharge Dataset. DPH receives the dataset annually from Connecticut Hospital Association (CHA). CHA submits Connecticut Hospital Information Management Exchange (CHIME) data on behalf of its member hospitals to DPH. The dataset includes patient demographics, up to 15 diagnosis codes, and up to 10 procedure codes. For this analysis, the dataset was limited to inpatient discharges among Connecticut residents.

Definitions of variables

Above knee amputation: ICD-10-CM codes were used to identify discharges with diabetes (E10, E11, or E13) anywhere on the discharge record along with an ICD-10-PCS procedure code 0Y6 for nontraumatic lower-extremity amputation (LEA) and ICD-10-PCS procedure codes for above knee amputations (0Y62–4, 0Y67, 0Y68, 0Y6C, or 0Y6D).

Age: Age is calculated by subtracting the birth date from the admission date. The age groups are based on the age groups used by the CDC United States Diabetes Surveillance System (https://gis.cdc.gov/grasp/diabetes/diabetesatlas-surveillance.html).

Below knee amputation: ICD-10-CM codes were used to identify discharges with diabetes (E10, E11, or E13) anywhere on the discharge record along with an ICD-10-PCS procedure code 0Y6 for nontraumatic lower-extremity amputation (LEA) and ICD-10-PCS procedure codes for below knee amputations (0Y6F–0Y6H, or 0Y6J).

Diabetes nontraumatic lower-extremity amputation: ICD-10-CM codes were used to identify discharges with diabetes (E10, E11, or E13) listed anywhere on the patient discharge record along with an ICD-10-PCS procedure code 0Y6 for nontraumatic LEA.

Diabetes polyneuropathy: ICD-10-CM codes were used to identify discharges with diabetes polyneuropathy (E10.42 and E11.42) anywhere on the discharge record.

Foot amputation: ICD-10-CM codes were used to identify discharges with diabetes (E10, E11, or E13) anywhere on the discharge record along with an ICD-10-PCS procedure code 0Y6 for nontraumatic lower-extremity amputation (LEA) and ICD-10-PCS procedure codes for foot amputations (0Y6M, 0Y6N).

Foot ulcers: ICD-10-CM codes were used to identify discharges with foot ulcers (E10.621 and E11.621) anywhere on the discharge record.

Gender: Each discharge record has gender categorized as male, female, unknown, or missing. Discharges with unknown or missing values were not included in the analysis. Less than five diabetes-related discharges had unknown or missing gender.

Obesity: ICD-10-CM codes were used to identify discharges with obesity (E66.01, E66.09, E66.1, E66.2, E66.8, E66.9, O99.210, O99.211, O99.212, O99.213, O99.214, O99.215, R93.9, Z68.30,

Z68.31, Z68.32, Z68.33, Z68.34, Z68.35, Z68.36, Z68.37, Z68.38, Z68.39, Z68.41, Z68.42, Z68.43, Z68.44, Z68.45, Z68.54) anywhere on the discharge record.

Osteomyelitis: ICD-10-CM codes were used to identify discharges with osteomyelitis (E10.69 and E11.69) anywhere on the discharge record.

Peripheral artery disease (PAD) with gangrene: ICD-10-CM codes were used to identify discharges with PAD with gangrene (E10.52 and E11.52) anywhere on the discharge record.

Peripheral artery disease (PAD) without gangrene: ICD-10-CM codes were used to identify discharges with PAD without gangrene (E10.51 and E11.51) anywhere on the discharge record.

Primary Payer: Primary payer is grouped into a 3-category variable and a 4-category variable in this report. Both types of variables have categories for Medicaid, Medicare, and Private insurance. The four-category variable has an "other" category that includes other public payers, self-pay, and other payers. The 3-category variable excludes "other" and was used for the analyses for level of amputation due to small numbers. Discharges missing data for primary payer were excluded from analyses due to small numbers.

Race and Ethnicity: All racial groupings (for example, Black or African American, White) exclude persons of Hispanic ethnicity. A Hispanic or Latino/a ethnicity category is included reflecting data separate from race categories. Asian, Pacific Islander, American Indian or Alaskan Native, other race, and multiracial adults are reported as "Non-Hispanic Other Race" due to small numbers and estimates of limited validity. Due to the number of discharges missing race or ethnicity, a "missing" category was included in this report.

Toe amputation: ICD-10-CM codes were used to identify discharges with diabetes (E10, E11, or E13) anywhere on the discharge record along with an ICD-10-PCS procedure code 0Y6 for nontraumatic lower-extremity amputation (LEA) and ICD-10-PCS procedure codes for toe amputations (0Y6P–0Y6Y).

Calculations

Age-adjusted hospital discharge rate for DNLEA: DNLEA hospital discharge data have been directly age-standardized using the 2000 US Standard Million. An age-standardized rate is a weighted average of age specific rates calculated based on the proportion of people in the corresponding age groups of a standard population.[17]

Numbers, percentages, and p-values for the description of the 2022 Connecticut Hospital Discharge Dataset: SAS Proc Freq was used to generate the numbers and percentages of DNLEA and non-DNLEA hospitalizations by categorical demographic and clinical characteristics. Column percentages are presented in Table 1 and Figures 1 and 2. The p-values presented for the categorical variables are for the Chi-square test. SAS Proc Univariate was used to generate the mean age and standard deviation. The p-value for age as a continuous variable is for the T test.

Number and Percent of Levels of Amputation: Proc Freq was used to generate the numbers and percentages of each level of amputation hospitalization by categorical demographic and clinical characteristics. Row percentages are presented in Tables 3, 5, 7, and 9. The p-values presented are for the Chi-square test.

Unadjusted odds ratios: To calculate unadjusted odds ratios, binary, or dummy, variables were created for each category of each variable. The new binary variable was equal to 1 to indicate the presence of the category or 0 to indicate the absence of the category. For example, the gender variable has response options of 1 for male and 2 for female. The new binary variable for male equals 1 if the original gender variable is 1 and 0 if not. Similarly, the new binary variable for female equals 1 if the original gender variable is 2 and 0 if not. The unadjusted odds ratio calculation included demographic and clinical dummy variables as the predictor variables and DNLEA or one of the amputation levels (i.e., toe, foot, below knee, above knees) as the outcome variable. The reference group was either the demographic group with the lowest percentage of DNLEA or the clinical factor of interest. The reference groups binary variable was not included on the right side of the model. Proc Logistic was used to calculate the unadjusted odds ratios, 95% confidence intervals, and p-values.

Adjusted odds ratios: Multivariate logistic regression was used to adjust the risk of DNLEA and levels of amputation by the demographic and clinical variables. DNLEA or each specific amputation level were the outcome variables. The same binary, or dummy, variables from the unadjusted odds ratios were used as predictor variables. The reference group was either the demographic group with the lowest percentage of DNLEA or the clinical factor of interest. The adjusted model controlled for all the following predictor variable categories: gender, race and ethnicity, primary payer, age, PAD with gangrene, PAD without gangrene, diabetes polyneuropathy, foot ulcers, osteomyelitis, and obesity. Proc Logistic was used to calculate the adjusted odds ratios, 95% confidence intervals, and p-values.

Limitations

The Connecticut Hospital Discharge Dataset has limitations. One limitation is data are collected for administrative purposes such as billing and not with public health goals in mind. Another limitation is that dataset contains the number of hospital discharges and not unduplicated patients. Another limitation is the data are cross-sectional. This means the data are collected from individuals at a single point in time. Therefore, the data cannot be used to establish causation because the individuals were not followed over time. The data may be used to establish associations between DNLEA and risk factors.

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