DARKNESS AND DEATH IN THE U.S.: WALKING DISTANCES ACROSS THE NATION BY TIME OF DAY AND TIME OF YEAR

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ABSTRACT

This paper examines walk distances across the United States by time of day and year, using data from the National Household Travel Survey 2016/2017, with the aim to understand factors contributing to higher pedestrian deaths at night across various states. Using hurdle regression to predict daily walk-miles traveled (WMT) and nighttime WMT across the US, the study finds that the decision to walk and distances walked on each survey day and night vary significantly with demographic attributes (like race, income, worker status and education), time of year, latitude, state of residence, and other factors. Longer daylight hours and more nighttime walking do not appear to be the reasons for some states' much higher pedestrian fatality rates. Additionally, there is no evidence from traffic fatality rates due to alcohol consumption or overall alcohol consumption per capita to support this result. Differences in built environments, law enforcement, and aggressive driving may be key factors for much higher pedestrian death rates in southern settings.

KEYWORDS: Walk trips, Walk Distances, Nighttime walking, Pedestrian crashes

INTRODUCTION

Pedestrians make up 17% of US roadway deaths, and this number is rising (NHTSA, 2021). US pedestrian death rates are 2 to 3 times higher per capita and 5 to 10 times higher per walked-mile than those in Western European nations (Buehler and Pucher, 2021). While 10.5% of US person-trips are made by walking (this includes trips made for exercise or recreation, as well as those to workplaces, stores, schools, and other destinations), walking distances are just 0.85% of Americans' person-miles traveled (PMT) (FHWA, 2017). Those in the UK, France, Germany, and, the Netherlands, for example, walk 136%, 118%, 90%, and 45% more than the average American, respectively (Buehler, 2022). Pedestrians are very vulnerable to injury and death, especially in the face of high speeds and bigger vehicles. The US pedestrian death count rose 52% between 2009 and 2019 (NHTSA, 2021). In the State of Texas, pedestrians were about 18% of all roadway deaths in 2021 (TxDOT, 2022), with a total count more than twice that of 2009 (TxDOT, 2014). While most Americans may be aware of the health benefits of walking, walk-trips per household rose just 6.5% from 2001 to 2017, while pedestrian deaths as a share of total traffic crash deaths increased from 12% to 16% during the same period (NHTSA, 2019).

Roughly 75% of US pedestrian deaths occur after sunset and before sunrise (during "nighttime"), with the death count almost doubling between 2009 and 2018 (GHSA, 2020; Tefft et al., 2021). Darkness and nighttime conditions come with a much higher frequency and severity of pedestrian injuries (Rahman et al. 2022; Zhao et.al., 2020). Arizona, California, Florida, Georgia and Texas (all relatively southern US states) accounted for 47% of all US pedestrian deaths while representing just 33% of the nation's population (GHSA 2020). The top 15 states with the highest pedestrian fatality rates are in the nation's southern latitudes (NHTSA 2019, 2022), with New Mexico topping the list at almost 4 pedestrian deaths per year per 100,000 population. When dividing pedestrian fatalities by vehicle-miles traveled (VMT), all top ten US states are relatively southern, with Florida and Arizona taking the lead (at approximately 300 deaths per 100 billion VMT) (NHTSA, 2022). Pedestrians of lower income appear to be at greater risk, with a 1% rise in death rate for every $1000 drop in a US Census tract's median household income (Mansfield et. al, 2018). Those of American Indian origin and Alaska Natives are five times more likely to die as pedestrians, per mile-walked, than White persons; African Americans are twice as likely (Glassbrenner et al., 2022).

People wonder why pedestrians are at much greater risk of death in the US than in comparable nations. Also, why are so many US pedestrians dying at night? And what makes southern US states less safe than northern US states? This study examines the various demographic, location/position, time of day and year attributes that characterize Americans' walk-miles traveled (WMT), in order to offer daytime vs nighttime WMT values for crash rate comparisons. The 2016/17 National Household Travel Survey (NHTS) data are used in hurdle regression models to predict each respondent's WMT and "nighttime" WMT on his/her survey day (with "nighttime" hours being those between sunset and sunrise, and thus varying across the nation, by latitude, longitude, and day of year).

DATASETS ASSEMBLED

The 2016/17 NHTS dataset contains almost 924,000 person-trips (including over 80,000 walk trips) made by nearly 130,000 U.S. households with 264,000 persons from mid-April 2016 through April 2017. Walk trip distances are capped here at 3 miles to avoid very long hikes and runs that are not normally near roadways (or were mis-reported to the NHTS survey team).

About 4% of walk trips were missing household income, education, race, age, gender, worker status, trip miles, mode or origin/destination coordinates; so those records are not analyzed here.

The NHTS data contain origin and destination block groups (within Census tracts) for every trip sampled inside the US, and block group centroids were used for trip origin coordinates. There are 239,780 distinct block groups in the US (US Census Bureau, 2022) and 106,592 within the NHTS trips' origin and destination zones. In addition to a walk-trip's starting position, the trip's timing is key, since 75% of US pedestrian deaths occur in darkness (GHSA, 2020). Python's 'Suntime' library was used to find sunset and sunrise in Coordinated Universal Time (UTC), given trip starting coordinates and date (with NHTS sampling trips from April 2016 through April 2017). UTC time was converted to the local time of trip location with the help of a Python package called 'TimezoneFinder', to determine whether respondent-reported walk-trip start times were before sunrise or after sunset (and labeled "night" or "nighttime"). Table 1 summarizes statistics for all variables used, after applying NHTS population weights (to mimic the entire nation's demographics in 2016/17).

Table 1. Summary Statistics of 2016/17 NHTS Person Records (n = 254,295 respondents)

	Mean	Median	Std Dev	Min	Max
WMT = Respondent Walk-Miles (on sample day)	0.207	0	1.777	0	270.701459
WMT at "Night" (before sunrise + after sunset)	0.015	0	0.394	0	74.5074911
Age (in years)/10	4.843	5.2	2.179	0.5	9.2
Male*	0.473	0	0.499	0	1
White*	0.815	1	0.388	0	1
African American*	0.074	0	0.261	0	1
Asian*	0.046	0	0.210	0	1
Other Race*	0.065	0	0.247	0	1
Worker (includes Full-time and Part-time workers)*	0.597	1	0.490	0	1
No High School or College Degree*	0.161	0	0.368	0	1
High School Graduate*	0.180	0	0.384	0	1
Some college (e.g., Assoc degree)*	0.263	0	0.440	0	1
Bachelor's degree*	0.211	0	0.408	0	1
Graduate degree*	0.186	0	0.389	0	1
Household Income/ $10,000 (over prior 12 months)	8.247	6.25	5.558	1	20
Daylight on Survey Day (hours) based on origin of first trip	12.013	12	1.781	2	22
Sunday*	0.112	0	0.316	0	1
Monday*	0.154	0	0.361	0	1
Tuesday*	0.155	0	0.362	0	1
Wednesday*	0.154	0	0.361	0	1
Thursday*	0.159	0	0.365	0	1
Friday*	0.157	0	0.364	0	1
Saturday*	0.109	0	0.311	0	1
Summer (June - August)*	0.258	0	0.438	0	1
Winter (December - February)*	0.269	0	0.444	0	1

Spring (March - May)*	0.205	0	0.403	0	1
Fall (September - November)*	0.268	0	0.443	0	1
Southern States (< 40° Latitude)*	0.636	1	0.481	0	1
Northern States (> 40° Latitude)*	0.364	0	0.481	0	1
Hawaii (Trip Origin < 25° Latitude)*	0.003	0	0.050	0	1
25° - 30° Latitude (Trip Origin)*	0.092	0	0.290	0	1
30° - 35° Latitude (Trip Origin)*	0.321	0	0.467	0	1
35° - 40° Latitude (Trip Origin)*	0.220	0	0.414	0	1
40° - 45° Latitude (Trip Origin)*	0.340	0	0.474	0	1
45° - 50° Latitude (Trip Origin)*	0.022	0	0.148	0	1
Alaska (Trip Origin > 50° Latitude)*	0.002	0	0.042	0	1
West Coast Trip Origin (-125> Longitude)*	0.152	0	0.359	0	1
Between Coasts Trip Origin (-125º to -85º Longitude)*	0.459	0	0.498	0	1
East Coast Trip Origin (-85< Longitude)*	0.389	0	0.487	0	1
Alabama Resident*	0.003	0	0.050	0	1
Alaska Resident*	0.002	0	0.042	0	1
Arizona Resident*	0.022	0	0.147	0	1
Arkansas Resident*	0.002	0	0.039	0	1
California Resident*	0.203	0	0.402	0	1
Colorado Resident*	0.004	0	0.060	0	1
Connecticut Resident*	0.002	0	0.042	0	1
Delaware Resident*	0.002	0	0.044	0	1
Wash. D.C. Resident*	0.002	0	0.044	0	1
Florida Resident*	0.010	0	0.102	0	1
Georgia Resident*	0.067	0	0.250	0	1
Hawaii Resident*	0.002	0	0.047	0	1
Idaho Resident*	0.003	0	0.054	0	1
Illinois Resident*	0.008	0	0.087	0	1
Indiana Resident*	0.004	0	0.061	0	1
Iowa Resident*	0.021	0	0.143	0	1
Kansas Resident*	0.002	0	0.046	0	1
Kentucky Resident*	0.002	0	0.049	0	1
Louisiana Resident*	0.002	0	0.042	0	1
Maine Resident*	0.002	0	0.050	0	1
Maryland Resident*	0.011	0	0.106	0	1
Massachusetts Resident*	0.004	0	0.061	0	1
Michigan Resident*	0.006	0	0.077	0	1
Minnesota Resident*	0.005	0	0.069	0	1
Mississippi Resident*	0.002	0	0.040	0	1
Missouri Resident*	0.004	0	0.060	0	1
Montana Resident*	0.002	0	0.050	0	1
Nebraska Resident*	0.002	0	0.047	0	1
Nevada Resident*	0.002	0	0.039	0	1
New Hamp. Resident*	0.002	0	0.046	0	1
New Jersey Resident*	0.004	0	0.067	0	1

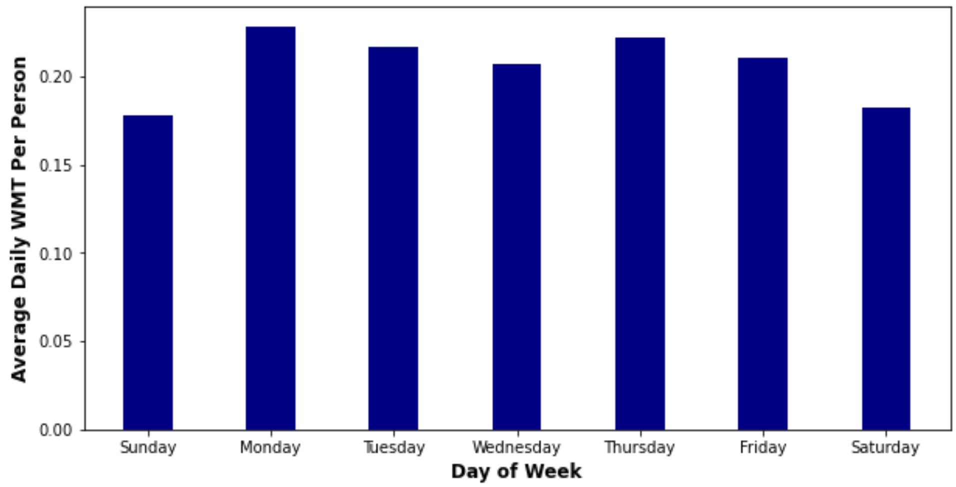
New Mexico Resident*	0.002	0	0.042	0	1
New York Resident*	0.130	0	0.336	0	1
N Carolina Resident*	0.067	0	0.249	0	1
N Dakota Resident*	0.002	0	0.047	0	1
Ohio Resident*	0.008	0	0.088	0	1
Oklahoma Resident*	0.010	0	0.098	0	1
Oregon Resident*	0.003	0	0.055	0	1
Pennsylvania Resident*	0.008	0	0.089	0	1
Rhode Island Resident*	0.002	0	0.041	0	1
S Carolina Resident*	0.053	0	0.223	0	1
S Dakota Resident*	0.002	0	0.049	0	1
Tennessee Resident*	0.004	0	0.059	0	1
Texas Resident*	0.195	0	0.396	0	1
Utah Resident*	0.003	0	0.055	0	1
Vermont Resident*	0.003	0	0.053	0	1
Virginia Resident*	0.005	0	0.073	0	1
Washington Resident*	0.005	0	0.070	0	1
West Virginia Resident*	0.002	0	0.042	0	1
Wisconsin Resident*	0.089	0	0.284	0	1
Wyoming Resident*	0.002	0	0.045	0	1

*Represents indicator variables and they have a value of 1 if true/yes and 0 if false/no (E.g. - For the variable Male, 1 = Male and 0 = Female).

DATA ANALYSIS

Figures 1, 2, 3 and 4 highlight different WMT choices by day of week, latitude, month of year and darkness. Weekdays, particularly Mondays and Thursdays, are more popular for walking, with approximately 20% more walking distance per person compared to weekends. Walking is highest in Hawaii (per person-day), and this is not due to non-resident visitors (who make up 45% of the Washington DC WMT, and just a few percent of Hawaii's). Unexpectedly, those living in northern US locations (above 40° latitude) walk more than those in southern (continental) settings, even though those in the northern locations experience up to 12% less daylight during the non-summer months (and up to 7% more daylight during summer months) when comparing daylight hours between 35° N and 45° N latitudes (United States Naval Observatory, 2019).

Figure 1. Average WMT per Person per Day by Day of Week and Trip Origin



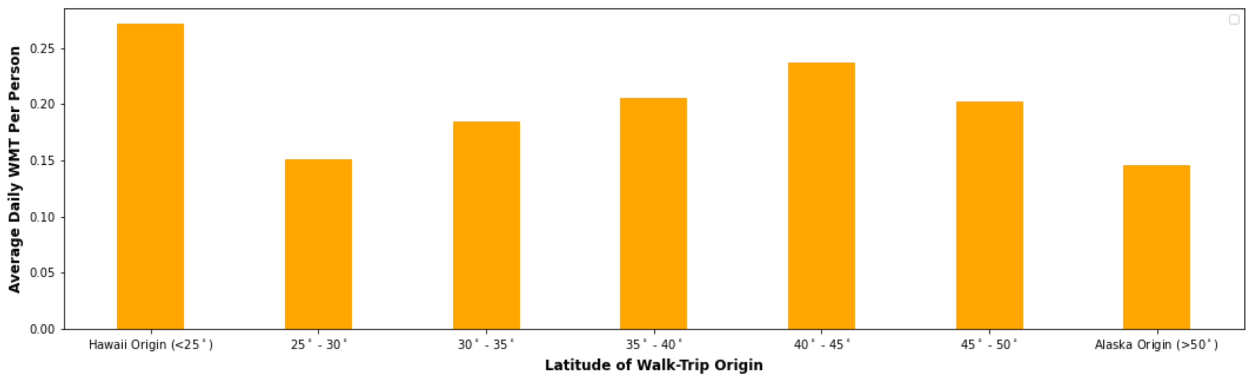
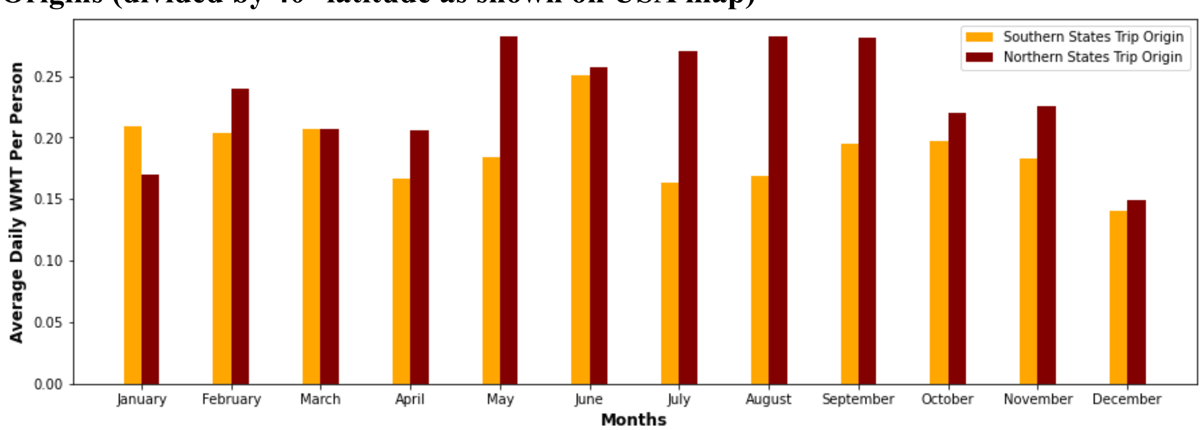


Figure 2 compares average WMT per person by month for walk trips in northern vs southern US settings. Average WMT ranges from about 0.15 to 0.30 per person-day, across months and locations, and is highest in the summers in the northern states and generally higher in the winters in the southern states. Only in the month of January does the average American in a southern US state walk more (on average) than his/her northern counterpart.

Figure 2. Average WMT per Person per Day by Month, for Northern vs Southern Trip Origins (divided by 40° latitude as shown on USA map)



US Census Bureau. (2017). TIGER/Line Shapefiles. https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2017&layergroup=Block+Groups)

Figure 3 also shows average daily WMT by month for different trip origin location categories. The origin locations are split into seven categories by latitude ranging from below 25° latitude (Hawaii) to above 50° latitude (Alaska) in 5° bins. There is a lot of walking in Hawaii, especially in the early summer and fall months. Northern latitudes also see more walking in early summer months, probably due to pleasant weather.

Figure 3. Average WMT per Person per Day by Month, for Trip Origin by Latitude

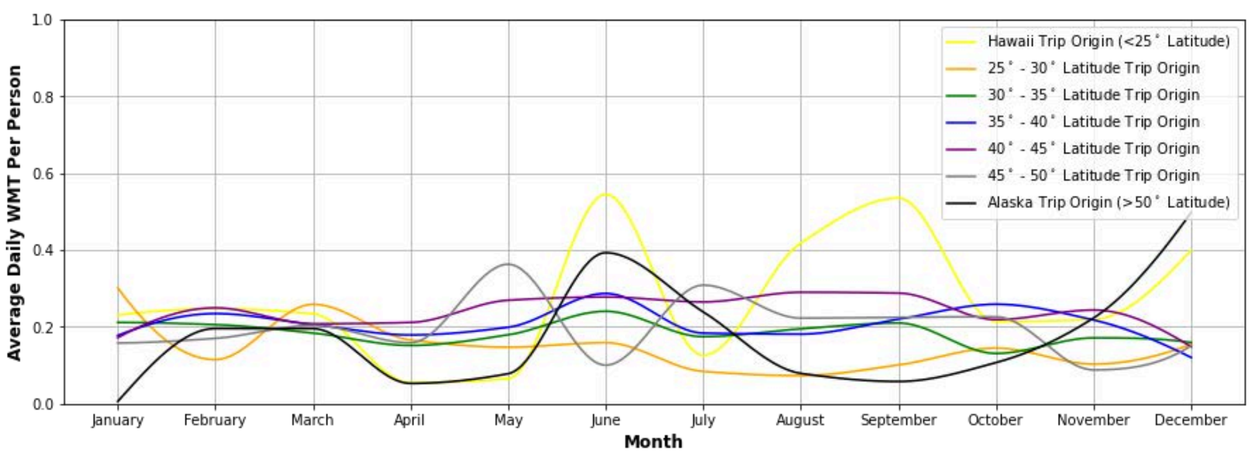
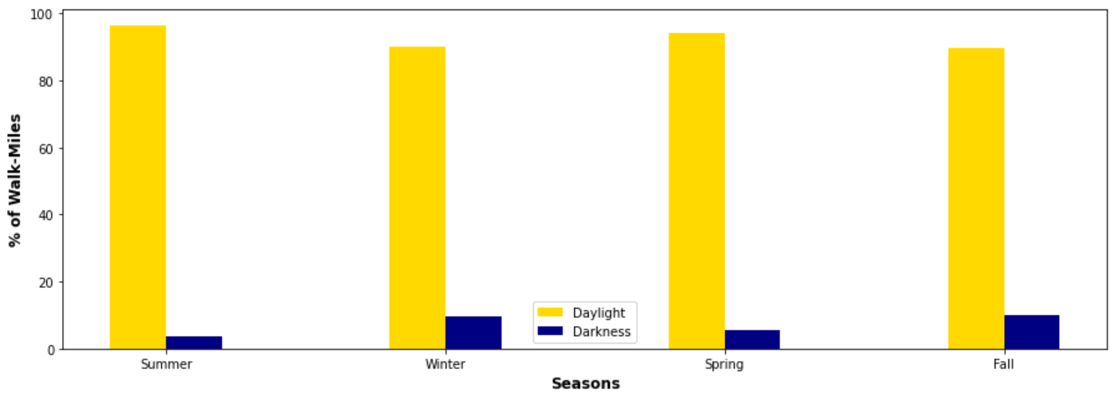
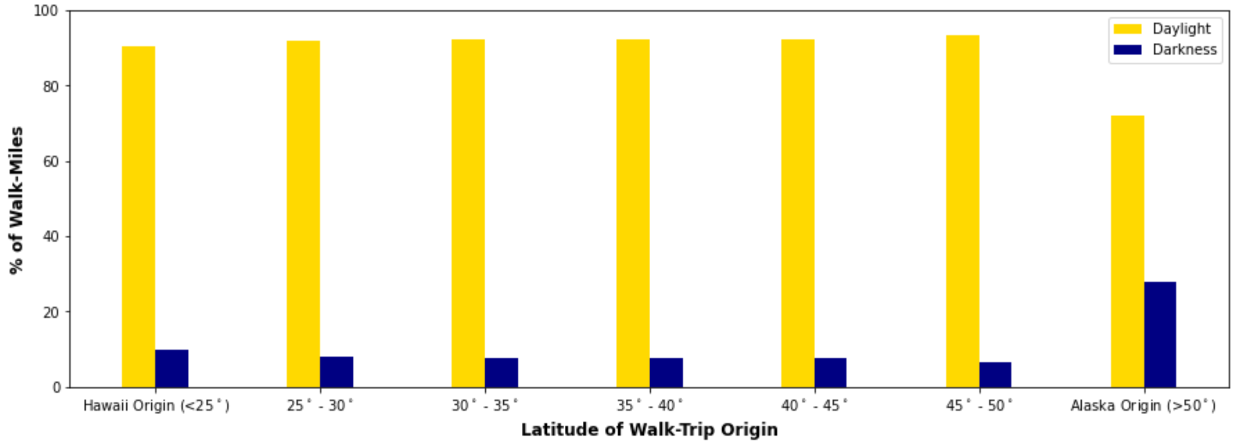


Figure 4 below compares the percentage of walk-miles at "daytime" and "night" by different trip origin location latitude categories and also by season. Almost 30% of the walking in Alaska was at "night". Surprisingly winter and fall seasons saw more walking at "night" as compared to the other months.

Figure 4. Portion of Walk-Miles by Latitude Trip Origin and Season





Stata © statistical software (StataCorp., 2015) was used to estimate the WMT per day per respondent and the WMT per day per respondent at "night" on the survey day. Only 15% of respondents made a walk-trip on the survey day, and only 1.4% made a walk trip at night. Given the high number of observations with a 0 value (making no walk trips for the first model and no walk trips at night for the second), hurdle regression model was considered appropriate as it offers flexibility in its interpretation. So, a hurdle specification splits the dependent variable into two parts: the logistic probability of a respondent not walking at all (and not walking at all at night) on the survey day and an exponential density function for all positive WMT (and positive nighttime WMT) possibilities (Cragg, 1971). Measure of each explanatory variable's practical significance was included for both models. Practical significance was found by increasing each covariate by 1 standard deviation (SD), in every person-day record, and taking the ratio of average WMT predictions after vs before the increase. It indicates the change in average WMT per 1 SD increase. A positive sign indicates increase in WMT, while negative indicates decrease. Population weights were applied to all models to ensure that parameter estimates better reflect the US population.

RESULTS AND ANALYSIS

Table 2 provides parameter estimates for the WMT/person/day model, along with measures of each explanatory variable's practical significance. Workers, those without college degrees, Caucasians, older persons, and those in higher-income households are less likely to walk on the survey day. Gender was not important for whether or not to take a trip, but males walk about 10% more per day with a 1 SD increase in the indicator variable (after capping each walk trip at 3 miles). Education level is *practically very significant*. Increasing the Bachelor's and Graduate degree indicator variables by 1 SD increases daily WMT predictions by +37.6% and +49.16% (per respondent), respectively. Increasing Age indicator variable by 1 SD decreases WMT predictions per day by almost 40%. Location is also *practically very significant*. Interestingly, a person's resident state, where most of their walk trips occur, is practically very significant for some states. Georgia, California, South Carolina, Wisconsin, and Texas residents walk -32.9%, -35.1%, -39.0%, -51.6 and –58.5% less miles per day with 1 SD increase in indicator variables for those respective resident states. A 1 SD increase in indicator variable for trips originating at longitude greater -85º (east coast) raises average WMT by ~30% per day per person, while keeping all other variables constant. Length of daylight also indicates 22.7% more walking per day (per person) with a 1 SD increase in that variable.

Table 2. Model Estimates for WMT Per Person Per Day Using 2016/17 NHTS Data

Logistic Selection Model for Pr(WMT > 0)				
	Coef.	***T-stat***	***P-value***	***Pract. Sign.***
Constant	-0.8339	-30.100	0.000	
Age/10	-0.0297	-6.700	0.000	*
Worker	-0.1290	-7.520	0.000	*
Household Income/10,000	-0.0060	-4.370	0.000	*
White	Base Race			
African American	0.0982	3.770	0.000	*
Asian	0.1413	4.730	0.000	*
Other Race	0.0554	2.160	0.030	*
No High School or College Degree	Base Degree			
High School Graduate	-0.1506	-5.590	0.000	*
Some Degree	-0.0631	-2.500	0.012	*
Bachelor's Degree	0.2213	8.810	0.000	*
Graduate Degree	0.3702	13.900	0.000	*
Exponential Regression Model (for positive WMT values)				
	Coef.	***T-stat***	***P-value***	***Pract. Sign.***
Constant	-0.5519	-2.430	0.015	
Age/10	-0.1860	-19.450	0.000	-39.52%

Male	0.1911	6.140	0.000	10.01%
Worker	-0.1343	-3.600	0.000	-14.91%
Household Income/10,000	-0.0204	-7.360	0.000	-15.09%
Length of Daylight	0.1149	6.720	0.000	22.71%
White	Base Race			
African American	0.5379	9.590	0.000	19.55%
Asian	0.3520	6.010	0.000	12.46%
Other Race	0.3755	6.470	0.000	11.95%
No High School or College Degree	Base Degree			
High School Graduate	0.5544	8.840	0.000	13.39%
Some Degree	0.4200	7.150	0.000	15.40%
Bachelor's Degree	0.4614	8.050	0.000	37.63%
Graduate Degree	0.4992	8.600	0.000	49.16%
Summer	-0.8873	-2.540	0.011	-7.02%
Winter	0.9572	1.730	0.084	6.69%
Spring	-0.4114	-1.080	0.282	2.13%
Fall	Base Season			
Hawaii Trip Origin [<25º Latitude]	0.1459	0.490	0.622	2.84%
25º - 30º Latitude Trip Origin	0.2593	1.000	0.318	23.21%
30º - 35º Latitude Trip Origin	0.3528	1.520	0.129	28.43%
35º - 40º Latitude Trip Origin	0.2719	1.310	0.190	16.94%
40º - 45º Latitude Trip Origin	0.1075	0.520	0.605	14.04%
45º - 50º Latitude Trip Origin	0.0276	0.110	0.913	2.35%
Alaska Trip Origin [>50º Latitude]	Base Latitude Trip Origin			
Summer * (Hawaii Trip Origin [<25º Latitude])	1.8075	3.530	0.000	NA
Summer * (25º - 30º Latitude Trip Origin)	0.9155	2.310	0.021	NA
Summer * (30º - 35º Latitude Trip Origin)	0.7916	2.320	0.020	NA
Summer * (35º - 40º Latitude Trip Origin)	0.6373	1.870	0.062	NA
Summer * (40º - 45º Latitude Trip Origin)	0.6928	2.060	0.039	NA
Summer * (45º - 50º Latitude Trip Origin)	0.6003	1.630	0.104	NA
Winter * (Hawaii Trip Origin [<25º Latitude])	-0.9772	-1.580	0.114	NA

Winter * (25º - 30º Latitude Trip Origin)	-0.4128	-0.700	0.481	NA
Winter * (30º - 35º Latitude Trip Origin)	-0.8540	-1.530	0.126	NA
Winter * (35º - 40º Latitude Trip Origin)	-0.9692	-1.730	0.084	NA
Winter * (40º - 45º Latitude Trip Origin)	-0.7865	-1.410	0.158	NA
Winter * (45º - 50º Latitude Trip Origin)	-0.7420	-1.300	0.195	NA
Spring * (Hawaii Trip Origin [<25º Latitude])	0.4923	0.740	0.461	NA
Spring * (25º - 30º Latitude Trip Origin)	1.0878	2.670	0.008	NA
Spring * (30º - 35º Latitude Trip Origin)	0.3702	0.970	0.332	NA
Spring * (35º - 40º Latitude Trip Origin)	0.3862	1.000	0.315	NA
Spring * (40º - 45º Latitude Trip Origin)	0.4163	1.090	0.277	NA
Spring * (45º - 50º Latitude Trip Origin)	0.5187	1.260	0.207	NA
Central U.S Trip Origin (-125º to -85º Longitude)	0.2093	2.060	0.040	10.74%
East Coast Trip Origin (-85< Longitude)	0.5313	6.820	0.000	30.31%
West Coast Trip Origin (-125> Longitude)	Base Longitude Trip Origin			
Arizona Resident	-0.7810	-6.080	0.000	-10.82%
Arkansas Resident	0.6792	2.520	0.012	2.67%
California Resident	-1.0747	-11.940	0.000	-35.07%
Colorado Resident	0.4337	3.090	0.002	2.64%
Connecticut Resident	0.9047	3.900	0.000	3.89%
Florida Resident	0.5980	4.380	0.000	6.27%
Georgia Resident	-1.5941	-14.700	0.000	-32.87%
Illinois Resident	0.4847	4.740	0.000	4.30%
Kansas Resident	0.4184	2.310	0.021	1.95%
Kentucky Resident	1.0610	5.130	0.000	5.38%
Louisiana Resident	0.3850	1.780	0.075	1.61%
Maine Resident	0.4268	2.020	0.044	2.15%
Massachusetts Resident	1.1644	9.180	0.000	7.41%
Michigan Resident	0.4716	3.160	0.002	3.70%
Minnesota Resident	0.3378	2.500	0.012	2.35%

Montana Resident	-0.7429	-2.920	0.004	-3.62%
Nevada Resident	0.7839	3.960	0.000	3.12%
New Jersey Resident	1.3097	11.570	0.000	9.10%
New York Resident	-0.2780	-3.100	0.002	-8.93%
North Carolina Resident	-1.4188	-17.020	0.000	-29.78%
North Dakota Resident	-0.9812	-3.750	0.000	-4.46%
Ohio Resident	0.7295	5.100	0.000	6.61%
Oregon Resident	0.7911	4.660	0.000	4.46%
Pennsylvania Resident	0.9102	7.740	0.000	8.41%
Rhode Island Resident	0.7199	2.070	0.038	3.03%
South Carolina Resident	-2.2121	-19.630	0.000	-38.98%
South Dakota Resident	-0.9531	-4.300	0.000	-4.54%
Tennessee Resident	0.6282	3.120	0.002	3.79%
Texas Resident	-2.2173	-23.080	0.000	-58.47%
Vermont Resident	-0.6759	-4.030	0.000	-3.54%
Virginia Resident	0.4695	3.460	0.001	3.50%
Washington Resident	0.8988	5.040	0.000	6.49%
Wisconsin Resident	-2.5557	-33.770	0.000	-51.61%
Residents from Remaining 27 states + Wash. D.C	Base State of Residence			
Final log-likelihood				2.46E+07
Pseudo R-square				0.0568
Number of observations				254,295

* Asterisked variables carry the practical significance values shown in the exponential regression model.
N/A's are shown with interaction terms, since each variable's overall impact is shown in that variable's earlier row.
All covariates with a p-value less than 0.10 were removed.

Table 3 provides parameter estimates for the "Nighttime" WMT model, along with measures of practical significance. All covariates in Table 1 were initially included, and then systematically removed if they had a p-value greater than 0.10. There is a higher chance of making a "nighttime" walk trip on the survey day if the person has a college degree, is male, African American, worker and/or of lower household income. The second, exponential regression estimating those "nighttime" walk distances indicate similar trends as the previous model. A 1 SD increase in indicator variables for Bachelor's and Graduate degrees corresponds to a +36.6% and 46.6% increase in miles walked per day person, respectively. Similarly, increasing Texas and Wisconsin resident indicator variable by 1 SD decreases daily WMT predictions by -47.0% and -53.6% (per respondent), respectively. A 1 SD increase in indicator for trips originating in the central U.S (between -125º and -85º longitude) raises average WMT per person per day by +31.4%. Estimates also indicate that 1 SD increase in indicator variable for 45º - 50º latitude band lowers average WMT per person at night by -17.8%. This could suggest that lower pedestrian fatality rates in northern states compared to southern states may be attributed to people in the northern region walking less during darkness.

Table 3. Model Estimates for WMT Per Person Per Day at "Night" using 2016/17 NHTS Data

Logistic Selection Model for Pr(Nighttime WMT > 0)				
	Coef.	***T-stat***	***P-value***	***Pract. Sign.***
Constant	-2.316	-46.500	0.000	
Male	0.076	2.490	0.013	*
Worker	0.112	3.280	0.001	14.65%
Household Income/10,000	-0.011	-3.720	0.000	*
All Other Races	Base Race			
African American	0.091	1.760	0.079	*
No College Degree	Base Degree			
Bachelor's Degree	0.177	3.770	0.000	*
Graduate Degree	0.269	5.970	0.000	*
Exponential Regression Model				
	Coef.	***T-stat***	***P-value***	***Pract. Sign.***
Constant	0.753	1.300	0.194	
Age/10	-0.106	-3.350	0.001	-20.63%
Male	0.241	2.900	0.004	24.08%
Household Income/10,000	-0.021	-2.480	0.013	-23.97%
All Other Races	Base Race			
African American	0.577	5.720	0.000	23.48%
Asian	0.552	2.670	0.008	8.17%

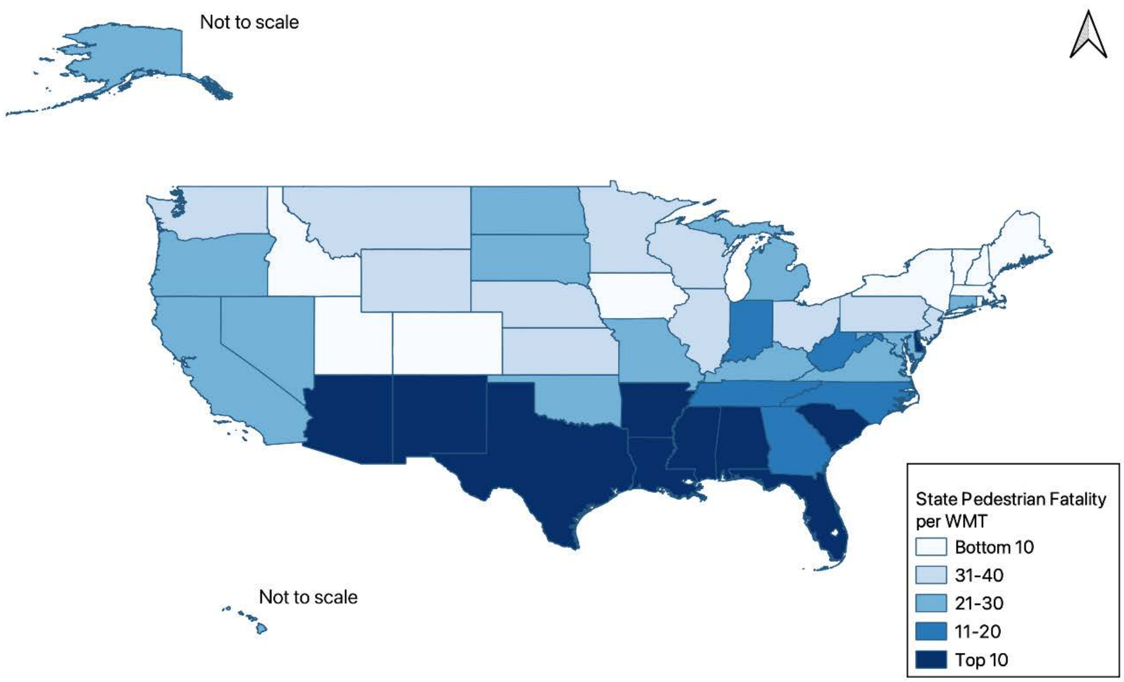
No High School or College Degree	Base Degree			
High School Graduate	0.528	2.650	0.008	19.12%
Some Degree	0.466	2.360	0.018	27.96%
Bachelor's Degree	0.324	1.690	0.092	36.61%
Graduate Degree	0.321	1.680	0.093	46.62%
Spring	0.353	2.840	0.005	15.29%
All Other Seasons	Base Season			
45º - 50º Latitude Trip Origin	-1.323	-1.920	0.055	-17.79%
Remaining Latitude Trip Origin [>50º Latitude <45º]	Base Latitude Trip Origin			
Central U.S Trip Origin (-125º to -85º Longitude)	0.548	2.620	0.009	31.43%
East & West Coast Trip Origin (-125> Longitude>-85)	Base Longitude Trip Origin			
California Resident	-0.833	-5.100	0.000	-28.44%
Connecticut Resident	1.826	4.380	0.000	8.01%
Florida Resident	1.336	4.390	0.000	14.55%
Georgia Resident	-1.155	-5.320	0.000	-25.08%
Hawaii Resident	0.702	2.490	0.013	3.33%
Illinois Resident	1.040	3.120	0.002	9.45%
Kentucky Resident	1.517	5.450	0.000	7.78%
Louisiana Resident	1.832	6.600	0.000	7.90%
Maryland Resident	0.676	2.840	0.004	7.41%
Massachusetts Resident	2.136	14.050	0.000	14.02%
Michigan Resident	0.992	2.140	0.033	7.94%
New Jersey Resident	1.368	6.080	0.000	9.52%
New Mexico Resident	2.008	4.520	0.000	8.70%
North Carolina Resident	-0.912	-3.900	0.000	-20.32%
Ohio Resident	1.819	4.770	0.000	17.29%
Oregon Resident	1.433	2.980	0.003	8.22%
Pennsylvania Resident	1.797	4.580	0.000	17.29%
Rhode Island Resident	1.102	1.730	0.083	4.68%
South Carolina Resident	-1.552	-6.260	0.000	-29.29%

Tennessee Resident	1.563	6.830	0.000	9.69%
Texas Resident	-1.938	-11.300	0.000	-53.61%
Virginia Resident	1.117	4.040	0.000	8.53%
Washington Resident	1.423	3.010	0.003	10.47%
Wisconsin Resident	-2.234	-12.790	0.000	-46.99%
Wyoming Resident	-1.598	-2.550	0.011	-6.99%
Residents from Remaining 25 states + Wash. D.C	Base State of Residence			
Final log-likelihood				-2.71E+07
Pseudo R-square				0.0495
Number of observations				254,295

* Asterisked variables have their practical significance values shown in the exponential regression model for the same variable.
All covariates with a p-value less than 0.10 were removed.

Results show how race, education, age and income status have statistically significant effects on walk-mode and walk distance choices in this large data set. Resident state and longitudes (locations) also have the great impacts, with residents from southern states walking shorter distances (even at night). Length of daylight also has statically significant effects on walk distances. Intriguingly, Americans in southern US locations (which enjoy more sunshine/better lighting and warm weather) do not walk as much, and face higher pedestrian crash risk per mile walked. Dividing pedestrian fatalities (average of 2014 to 2019) (FHWA, 2017; NHTSA, 2022) by WMT extrapolations for each state's resident population (and visitors, which are key in Washington DC's and Delaware's cases), places all southern states among the nation's 10 most deadly, with Alabama and Mississippi topping the list (with 1.01 and 0.98 pedestrian deaths per million WMT). Figure 5 displays a map ranking Pedestrian Fatality by WMT for all US states. Higher ranking states are all concentrated in the southern latitudes.

Figure 5. Rankings of Pedestrian Deaths per Walk-Mile Travelled (WMT) across US States



As noted earlier, southern states lead in terms of pedestrian crash rates per VMT(NHTSA, 2022). Southern states such as Mississippi, New Mexico, South Carolina, Florida, Louisiana, and Arizona rank among the top 10 states with both, the highest pedestrian fatalities per WMT and overall traffic fatalities per VMT.

Alongside all these insights, the mystery of why pedestrian death rates (vehicle and walk-mile traveled) are so high or more often at night in southern states remains. Model results do not suggest that more “nighttime” walking is responsible for higher pedestrian fatalities in southern regions. Neither traffic fatality rates due to alcohol consumption nor overall alcohol consumption per capita support this result (NHTSA, 2022; Wisevoter 2023), but hard-alcohol (ethanol) consumption per capita is highest in California, Florida, and Texas (with Georgia falling close behind) (Vinepair 2020). Differences in built environments and car-centric cultures may also play a role. Southern-latitude states are 7 of the top 10 in VMT per capita, while only three states (DC, Hawaii & California) in the southern latitude appears in the ten states with the lowest annual VMT per capita (U.S. Department of Energy, 2019) and regularly lead in crash deaths per capita (NHTSA, 2022). Table 4 displays pedestrian death rates by WMT, VMT, per capita and by alcohol consumption for all US states.

Table 4. Pedestrian Fatality Rates by WMT, VMT & 100,000 Population (n = 254k for WMT)

State	WMT/person/day	Total State WMT/day in Millions	# Ped Deaths (2014-19)	Ped Fatality per Million WMT (2014-19)	Ped Fatality Rate per 100,000 Pop	Annual VMT per capita (2017)	Ped Fatality Rate per 100 Billion VMT	All Traffic Fatality Rates by 100

								M VMT
Alabama	0.07	0.30	659	1.01	2.25	7.07E+10	155.3	1.30
Alaska	0.18	0.12	72	0.27	1.63	5.53E+09	217.1	1.14
Arizona	0.17	1.10	1142	0.48	2.71	6.51E+10	292.6	1.39
Arkansas	0.10	0.31	301	0.45	1.67	3.64E+10	137.8	1.38
California	0.25	9.07	5390	0.27	2.29	3.43E+11	261.6	1.09
Colorado	0.31	1.47	455	0.14	1.36	5.34E+10	142.0	1.09
Connecticut	0.17	0.49	314	0.30	1.46	3.15E+10	166.1	0.79
Delaware	0.19	0.18	177	0.45	3.09	1.05E+10	281.6	1.29
Wash. DC	0.58	0.98	61	0.03	1.48	3.72E+09	273.1	0.61
Florida	0.18	3.28	3944	0.55	3.17	2.19E+11	300.4	1.41
Georgia	0.16	1.59	1340	0.39	2.15	1.25E+11	179.0	1.12
Hawaii	0.25	0.35	170	0.22	1.99	1.08E+10	263.3	0.98
Idaho	0.16	0.31	82	0.12	0.80	1.73E+10	78.9	1.24
Illinois	0.24	2.85	906	0.14	1.18	1.08E+11	139.9	0.94
Indiana	0.12	0.68	549	0.37	1.37	8.18E+10	111.9	0.98
Iowa	0.16	0.50	132	0.12	0.70	3.35E+10	65.7	1.00
Kansas	0.15	0.40	165	0.19	0.94	3.23E+10	85.2	1.29
Kentucky	0.21	0.91	434	0.22	1.63	4.93E+10	146.8	1.48
Louisiana	0.17	0.68	735	0.49	2.63	4.93E+10	248.7	1.42
Maine	0.23	0.38	87	0.10	1.09	1.47E+10	98.3	1.06
Maryland	0.19	1.03	678	0.30	1.88	6.01E+10	188.1	0.89

Massachusetts	0.39	2.48	457	0.08	1.11	6.27E+10	121.5	0.52
Michigan	0.19	1.78	916	0.24	1.53	1.02E+11	150.0	0.97
Minnesota	0.13	0.77	239	0.14	0.72	6E+10	66.4	0.60
Mississippi	0.07	0.19	399	0.98	2.23	4.09E+10	162.6	1.56
Missouri	0.17	0.85	565	0.30	1.54	7.59E+10	124.0	1.11
Montana	0.17	0.19	80	0.19	1.27	1.27E+10	105.4	1.43
Nebraska	0.18	0.33	104	0.14	0.91	2.1E+10	82.6	1.17
Nevada	0.33	0.79	449	0.26	2.54	2.76E+10	271.3	1.06
New Hamp	0.19	0.25	67	0.12	0.83	1.37E+10	81.6	0.73
New Jersey	0.28	2.39	1031	0.20	1.94	7.75E+10	221.7	0.71
New Mexico	0.15	0.28	444	0.73	3.53	2.97E+10	249.4	1.53
New York	0.38	7.22	1670	0.11	1.42	1.24E+11	224.9	0.75
N Carolina	0.16	1.55	1197	0.35	1.95	1.19E+11	167.3	1.19
N Dakota	0.11	0.08	39	0.23	0.86	9.74E+09	66.7	1.02
Ohio	0.18	2.07	730	0.16	1.05	1.2E+11	101.7	1.01
Oklahoma	0.17	0.64	432	0.31	1.83	4.94E+10	145.7	1.43
Oregon	0.20	0.80	426	0.24	1.73	3.68E+10	193.2	1.38
Pennsylvania	0.22	2.58	973	0.17	1.27	1.02E+11	159.5	1.03
Rhode Island	0.33	0.30	72	0.11	1.14	8E+09	149.9	0.75
S Carolina	0.12	0.57	857	0.68	2.85	5.56E+10	257.1	1.74
S Dakota	0.11	0.08	48	0.26	0.92	9.65E+09	82.9	1.03
Tennessee	0.14	0.84	692	0.37	1.72	8.23E+10	140.1	1.37
Texas	0.13	3.41	3576	0.48	2.12	2.73E+11	218.6	1.26
Utah	0.28	0.91	230	0.11	1.25	3.15E+10	121.8	0.75

Vermont	0.30	0.22	31	0.06	0.83	7.43E+09	69.5	0.64
Virginia	0.17	1.43	639	0.20	1.26	8.53E+10	124.8	0.97
Washington	0.22	1.37	547	0.18	1.24	6.14E+10	148.4	0.86
West Virginia	0.08	0.16	141	0.41	1.29	1.91E+10	123.1	1.36
Wisconsin	0.18	0.99	324	0.15	0.93	6.53E+10	82.7	0.85
Wyoming	0.16	0.09	37	0.20	1.06	9.8E+09	62.9	1.44

The model's findings suggest that in addition to the demographic and geographic factors mentioned earlier, other factors such as lack of enforcement, poor design of road infrastructure, weaker licensing laws, and driver culture may contribute to the higher pedestrian fatality rates observed in many southern states. These systemic issues can significantly impact the safety of pedestrians and all other travelers on the roads.

Addressing these challenges and improving road safety in the southern states, as well as across the entire United States, is crucial. It is imperative to prioritize and invest in comprehensive measures that enhance traffic law enforcement, promote safer road design and infrastructure, strengthen licensing regulations, and foster a positive driver culture that prioritizes pedestrian and traveler safety.

By taking proactive steps to address these issues, the United States, particularly its southern states, can work towards ending the streak of daily deaths among pedestrians and all other travelers. This collective effort would not only save lives but also create safer and more sustainable communities for everyone. It is a shared responsibility to make our roads safer and protect the lives of pedestrians and travelers across the country.

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