ARE WISCONSIN PEDESTRIAN CRASHES REPRESENTATIVE OF NATIONAL TRENDS?

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ABSTRACT

Introduction: The question: "Are Wisconsin Pedestrian Crashes Representative of National Trends?" was asked in the context of how to estimate the denominator of pedestrians using public traffic-ways. Data from the Federal Highway Administration, the National Highway Traffic Safety Administration, the United States Census Bureau, the Wisconsin Department of Transportation and other organizations was used to try and answer it.

Method: Comparisons between national and state level data were made relative to: The number of miles of urban and rural roads in Wisconsin relative to the number of miles nationally, the trends in the frequency of fatal pedestrian crashes, the proportion of these crashes in rural and urban areas and factors that may contribute to them. Demographics at the county level were reviewed to assess which counties may be representative of the state.

Results: In all categories of rural roadway classification, Wisconsin is within one standard deviation of the national mean and median. The median number of miles of the total miles of rural roadways nationally is 64,672 miles. In most categories of urban roadway classification, Wisconsin is within one standard deviation of the mean and median for the nation. The median number of miles of the total miles of urban roadways nationally is 17,568 miles. With 23,578 total miles of urban roadways, it is closest to the national average of the total number of miles urban roadways 23,530.

NHTSA analysis of 2015 pedestrian crash data reported 26% of pedestrian fatalities occurred from 6 to 8:59 p.m. In Wisconsin data from 2011 to 2013, 23% of fatal pedestrian crashes occurred 6 to 8:59 p.m. NHTSA reported the split between fatal urban and fatal rural crashes as: 76% in urban areas and 24% in rural areas. In Wisconsin, the split was 64% urban and 36% rural. Per NHTSA data, 19% of fatally injured pedestrians were 55-years-old or older. A query for fatal pedestrian crashes in Wisconsin for 2017 found that the average pedestrian age was 54 and 43.6% of fatally injured pedestrians were 55-years-old or older.

Discussion: U.S. Department of Transportation data collection programs are amenable to using state government documents, which can be transcribed to compile national level data sets. State level traffic crash data can be disaggregated to the county or municipal levels. Both data sets can be linked to U.S. Census Bureau data for each county, down to the level of the census tract, to characterize the relationship of vulnerable populations such as children and older adults and to features in the environment affecting mobility.

Conclusion: What is lacking are actual counts of pedestrians at a weighted sample of locations to base a statistical inference of the denominator of pedestrian using trafficways on. With the appropriate statistical technique and accurate counts, a nationally representative estimate of vulnerable road users is possible. In-depth local studies involving agreements with law enforcement and county road department would be advantageous.

Introduction

In the U.S., traffic fatalities in urban areas increased by 17.4 percent from 2008 to 2017 while rural fatalities declined by 18.0 percent. This corresponds to the 13.1% increase in Vehicle Miles Traveled (VMT) and the 3.7% increase in the urban traffic fatality rate per 100 million VMT, nationally, over the same period. While passenger vehicle occupant fatalities in urban areas have increased by 9 percent since 2008, there has been a 46% increase in fatal traffic crashes involving pedestrians in urban areas. The trend for traffic fatalities in rural areas over the same period has been decreasing. The changes in these two trends is in line with changing US demographics; there was a 12.7% increase in urban population from 2007 to 2016[1].

The Governors Highway Safety Association (GHSA), has accurately predicted recent trends in pedestrian fatalities. Per the GHSA: (1) Pedestrians now account for a larger proportion of traffic fatalities than they have in the past 33 years. (2) The number of states with pedestrian fatality rates at or above 2.0 per 100,000 population has more than

doubled, from seven in 2014 to 15 in 2016. (3) In Wisconsin, a record 63 pedestrians were killed amounting to a 40% increase in the number of traffic related pedestrian fatalities in 2017 over 2016[2].

The reason why traffic frequency of pedestrian fatalities is increasing is currently unknown. To try to address the question in terms of what factors contribute to the risk of injury, an accurate estimate the number of pedestrians using the nations trafficways is needed. The question: "Are Wisconsin pedestrian crashes representative of national trends?" was asked in the context of the need to estimate the denominator of pedestrians using trafficways. Data from the Federal Highway Administration, the National Highway Traffic Safety Administration, the United States Census Bureau, the Wisconsin Department of Transportation and other agencies was used to answer it.

Method

State-wide comparisons were made relative to: Trends in the rates of fatal pedestrian crashes in the United States, the proportion of these crashes in rural and urban areas, how many miles of urban and rural roads Wisconsin has relative to the rest of the nation, and the location of the pedestrian when struck and the time of day a conflict occurs. The National Highway Traffic Safety Administration is the source for data on U.S. national trends. The Governors Highway Safety Association and the Wisconsin Department of Transportation (WISDOT) Bureau of Transportation Safety (BOTS) are the primary sources of published data at the state level. This data is supplemented by the analysis of data obtained from queries of state crash reports available from the Traffic Operations and Safety Laboratory (TOPS) at the University of Wisconsin-Madison.

Data on the estimated number of lane-miles by functional system is taken from the Federal Highway Administration publication, Highway Statistics 2017[3]. The sources of demographic data used are the U.S. Census Bureau and data extrapolated from national survey data by Wisconsin Department of Health Services. Milwaukee, Waukesha and Dane counties were selected for a more detailed examination because these three counties account for the majority of pedestrian and bicycle crashes in Wisconsin.

Results

Comparison of Roads by Roadway Classification

Table 1 below provides descriptive statistics of U.S. roads by roadway classification in rural and urban areas. The median number of miles of the total miles of rural roadways nationally is 64,672 miles. Wisconsin has a total of 91,567 miles of roads in rural areas. This is within the standard deviation (SD) for the total miles of rural roads nationally: SD = 40,033 miles. Figure 1 below, depicts the distribution of all road classification types in rural areas nationally.

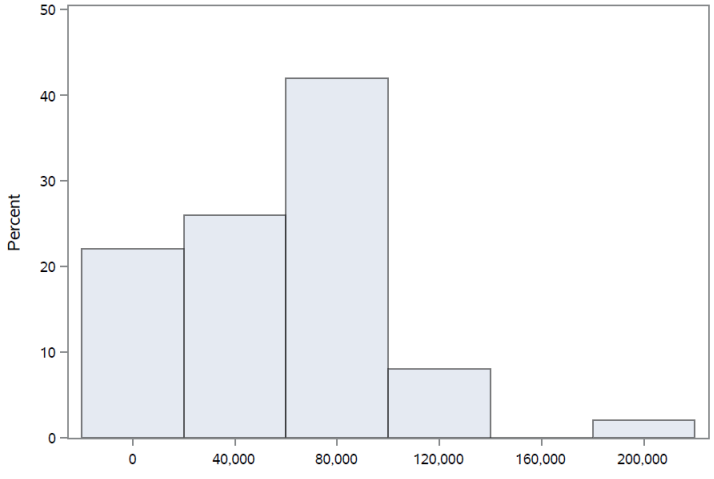
Table 1.

US Roads by Roadway Classification and Land Use

Variable	Label	N	N Miss	Minimum	Mean	Median	Maximum	Std Dev
R INTERSTATE	R INTERSTATE	50	3	0	593.5670800	587.2035000	2080.34	376.6118891
R Other Freeways	R Other Freeways	50	3	0	96.8461800	0.2535000	922.7720000	189.9302242
R Principal Arterial	R Principal Arterial	50	3	66.0900000	1808.10	1794.70	7707.71	1284.49
R Minor Arterial	R Minor Arterial	50	3	91.3270000	2656.90	2545.68	10095.64	1974.22
R Major Collector	R Major Collector	50	3	197.0470000	8296.32	7093.88	34888.61	6783.41
R Minor Collector	R Minor Collector	50	3	0	5249.79	4427.09	17431.97	4079.05
R Local	R Local	50	3	859.4580000	40047.99	43755.99	140713.76	27306.13
R Total	R Total	50	3	1363.57	58749.51	64672.30	212918.04	40032.58
U INTERSTATE	U INTERSTATE	50	3	40.2120000	357.6904400	271.1100000	1334.84	310.3636812
U Other Freeways	U Other Freeways	50	3	0	231.7282000	118.9200000	1471.59	314.5254374
U Principal Arterial	U Principal Arterial	50	3	104.5650000	1328.07	991.5465000	7041.80	1369.32
U Minor Arterial	U Minor Arterial	50	3	151.6160000	2217.28	1626.93	11392.56	2173.29
U Major Collector	U Major Collector	50	3	0.6940000	2424.66	1913.57	12833.52	2614.57
U Minor Collector	U Minor Collector	50	3	0	102.2485400	2.7810000	1021.10	209.3700610
U Local	U Local	50	3	920.6190000	16868.02	12195.12	70664.52	16273.96
U Total	U Total	50	3	1452.39	23529.70	17568.47	100309.58	22518.16
R&U Total	R&U Total	50	3	4430.13	82279.21	81022.59	313227.62	54314.40

Figure 1.

Distribution of U.S. Rural Roads All Classifications



The median number of miles of the total miles of urban roadways nationally is 17,568 miles. Wisconsin has a total of 23,578 miles of roads in urban areas. This is within the standard deviation for total miles of urban roads nationally: SD = 22,518 miles. Figure 2 depicts the distribution of all road classification types in urban areas nationally.

Figure 2.

Distribution of U.S. Urban Roads All Classifications

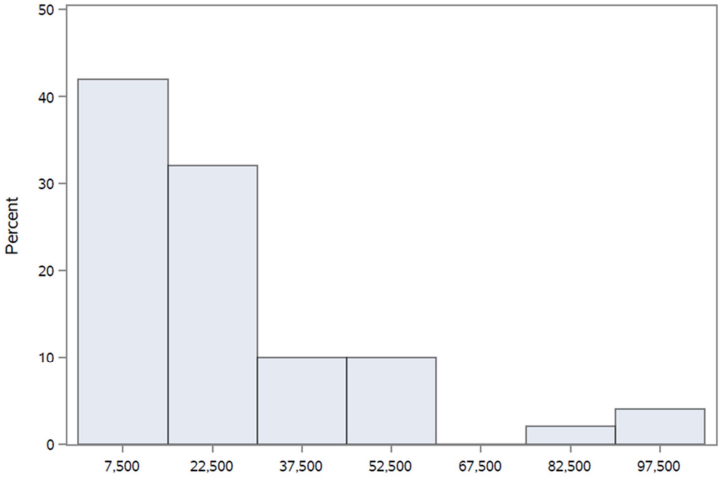


Table 2 provides descriptive statistics of Wisconsin rural roads by roadway classification. In every category of rural roadway classification, Wisconsin is within one standard deviation of the U.S. National mean and median. Nationally, Wisconsin ranks 7th highest with 62,491 total miles of rural roadways.

Table 2.

Miles of Rural Roadway by Classification U.S. Mean and Median VS Wisconsin Total Miles

Roadway Classification	National Mean	National Median	Wisconsin	SD
Rural Interstate	594	587	464	376.6
Rural Freeway	97	.25	189	189.9
Rural Principal Arterial	1808	1795	2926	1284.4
Rural Minor Arterial	2657	2546	4741	1974.2
Rural Major Collector	8296	7094	12134	6783.4
Rural Minor Collector	5250	4427	8621	4079
Rural Local Roads	40048	43756	62491	27306.1
Total All Rural Roadways	58,750	64,672	91567	40,032

Table 3 provides descriptive statistics of Wisconsin urban roads by roadway classification. Except for roadways classified as urban minor collector, Wisconsin is within one standard deviation of the U.S. National mean and median. Nationally, Wisconsin ranks 20th with 23,578 total miles of urban roadways. Minnesota with 22,208 total miles of urban roadways ranks 19th and Missouri with 24,367 total miles of urban roadways ranks 21st. In almost every category of urban roadway classification, Wisconsin closely approximates the U.S. National average.

Table 3.

Miles of Urban Roadway by Classification U.S. Mean and Median VS Wisconsin Total Miles

Roadway Classification	National Mean	National Median	Wisconsin	SD
Urban Interstate	357	271	279	310.3
Urban Freeway	232	119	383	314.5
Urban Principal Arterial	1,328	992	1,976	1369.3
Urban Minor Arterial	2,217	1627	2,665	2173.2
Urban Major Collector	2,425	1914	2,746	2614.5
Urban Minor Collector	102	2.8	0	209.3
Urban l Local Roads	16,868	12195	15,499	16,273.9
Total All Urban Roadways	23,530	17,568	23,578	22,518.1

Comparison by Environmental Characteristics

Per an NHTSA analysis of 2015 data on pedestrian crashes[4], nationally 26% of pedestrian fatalities occurred from 6 to 8:59 p.m. in 2015. An analysis of Wisconsin data from 2011 to 2013[5] found that 23% of fatal pedestrian crashes occurred between 6 to 8:59 p.m. NHTSA analysis of 2015 data found 76% of fatal pedestrian crashes were in urban areas and 24% in rural areas. The analysis of Wisconsin data reported that 64% of fatal pedestrian crashes were in urban areas and 36% in rural areas. NHTSA reported that nationally 72% of fatal crashes were non-intersection related and 18% were intersection related. The Wisconsin data analysis reported that 55% of fatal crashes occurred on a roadway between intersections; defined as more than 15m (50 feet) from the nearest intersection[6].

Per NHTSA data 19% of fatally injured pedestrian were 55-years-old or older. A query for fatal pedestrian crashes in Wisconsin for 2017[7] found that the average pedestrian age was 54 and the 24 of the 55 (43.6%) of fatally injured pedestrian were 55-years-old or older. 16 of the 55 (29%) fatal crashes involved pedestrians 65-years-old or older. The average age of the 55+ cohort was 69.5-years-old.

The three post populous counties in the state are Milwaukee, Dane and Waukesha. Milwaukee County has a land area of 6266 square kilometers. Of this, 24 square kilometers (3.8%) is classified as farmland. There are no roadways classed as rural in Milwaukee County. The WISDOT Milwaukee Urban Area includes approximately

72% of Waukesha county. The includes Milwaukee Urban Area has 6,586 miles of roadways. Waukesha County has a land area of 1,439 square kilometers of this, 397 square kilometers (27.5%) is classified as farmland. There are 203 miles of rural roads in Waukesha county. Dane County Land Area has a land area of 3,113 square kilometers. Of this, 2,084 square kilometers is farmland (67%). There are 2072 miles of rural roads in Dane county. Madison is the largest city in Dane county and has 1,959 miles of urban roads.

In the Wisconsin, over the period 2011 to 2013 there were 134 fatal pedestrian crashes. 55 (41%) of the occurred in Milwaukee, Dane and Waukesha counties. Of these 55 fatal pedestrian crashes, 96% were in urban areas and 4% in rural areas. Table 4 presents US Census Bureau[8] demographic data for Milwaukee, Dane and Waukesha counties.

Table 4.

Milwaukee, Waukesha and Dane Counties VS State and National Indicators

	Dane	**Milwaukee**	**Waukesha**	**Wisconsin**	**U.S.**
Population estimates, July 1, 2016,	531,273	951,448	398,424	5,778,708	323,127,513
Persons under 18 years:	20.9%	24.3%	21.9%	22.3%	22.8%
Persons between 18 and 64 years:	66.3%	63%	60.5%	61.6%	62%
Persons 65 years and over:	12.8%	12.7%	17.6%	16.1%	15.2%
High school graduate or higher, percent of persons age 25 years+, 2012-2016:	95.3%	86.9%	95.9%	91.4%	87%
Bachelor's degree or higher, percent of persons age 25 years+, 2012-2016:	49.0%	29.7%	41.6%	28.4%	30.3%
Mean travel time to work (minutes), workers age 16 years+, 2012-2016	20.9	22.4	24.0	21.9	26.1
Median household income (in 2016 dollars), 2012-2016:	$64,773	$45,263	$78,268	$54,610	$55,322

Median household income (in 2016 dollars) for other states 2012-2016: California: $63,783, New York: $60,741 and Virginia: $66,149

Discussion

As most pedestrian crashes occur in urban areas, relative to the total miles of urban roadways, Wisconsin urban roads seem to represent the center of the national distribution well. In terms of the mean the representation nearly is an exact match of the national average, but the distribution is skewed. Relative to the median value of 17,568 miles the total miles of urban roadways nationally, Wisconsin is within one standard deviation.

In terms of the frequency at which pedestrian crashes happen relative to environmental conditions like land use, time of day and relation to an intersection crashes in Wisconsin are aligned with national trends. Where the trend in the data for Wisconsin markedly differs from what is observed nationally is in the age of pedestrians killed. The Wisconsin (WI) age cohorts for persons between the ages of 18 and 64 and persons 65-years-old or older closely approximate the U.S. population. For the 18 and 64 cohorts: WI 61.6% vs 62% U.S. and for the 65+ cohorts: WI 16.1 vs 15.2% US. In the three counties that account for most pedestrian crashes the average size of the 65+ cohort is 14.4%. On the face of it, the size of the cohort aged 55+ is not expected to explain the difference.

Data extrapolated from national survey data by Wisconsin Department of Health Services[9] may offer some insight to the reason for the disparity. In Wisconsin, 526,744 individuals age 65+ are estimated to have some type of disability.

- 232,274 (44%) are estimated to have a hearing impairment
- 111,326 (21%) are estimated to have a cognitive impairment
- 82,738 (15.7%) are estimated to have a vision impairment
- 317,652 (60%) are estimated to have an ambulatory impairment

Unfortunately, data on traffic crashes does not provide information on any physical impairments people involved in the crash whether a driver or a pedestrian and there is no statistically valid estimate of the number of people with physical impairments using public trafficways.

U.S. Department of Transportation data collection programs are amenable to using state government documents, which can be transcribed to compile national level data sets. State level traffic crash data can be disaggregated to the county or municipal levels. If a valid estimate of the of the number of people using public trafficways could be constructed, both data sets can be linked to census data for each county, down to the level of the census tract, to characterize the relationship of vulnerable populations such as children and older adults to features in the environment affecting mobility.

Conclusion

Except for roadways classified as urban minor collector, the inventory of roads in Wisconsin is representative of the nation. In general, the trends in Wisconsin's fatal pedestrian crashes in reflect those in U.S. national data. The difference in the proportion of fatal pedestrian crashes national (19%) and in Wisconsin (41%) is puzzling. The three counties that might serve as locations to draw a sample of a of pedestrian crashes representative of the state represent an area that is 67% urban and 33% rural. If a valid estimate of the of the number of people using public trafficways could be constructed, it appears only a scheme to collect representative sample of crashes in urban areas could be devised for them. A number of rural counties would need to be selected to devise a scheme to collect a representative sample of all pedestrian crashes.

What is lacking are actual counts of pedestrians at a weighted sample of locations to base a statistical inference of the denominator of pedestrian using trafficways on. With the appropriate statistical technique and accurate counts, a nationally representative estimate of vulnerable road users is possible. In-depth local studies involving agreements with law enforcement and county road department would be advantageous.

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