Disparities in the Distribution of Pedestrian

Robert Schneider, PhD
University of Wisconsin-Milwaukee Department of Urban Planning * March 2022

Equity

Pedestrian fatalities and injuries should have an **appropriate impact** for each group…

- Gender
- Age
- Income
- Race/Ethnicity

Equity

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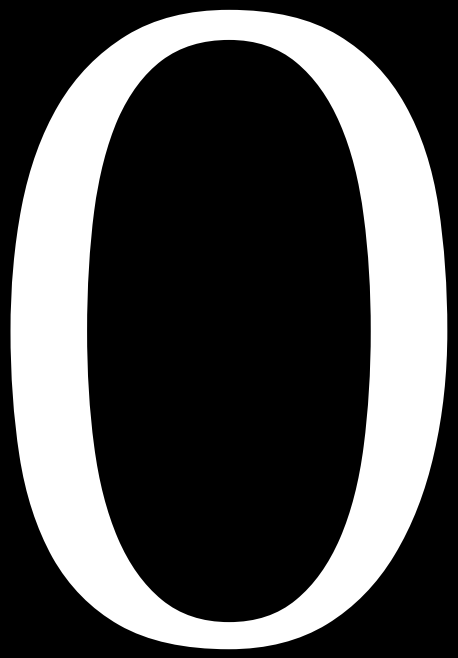


Zero

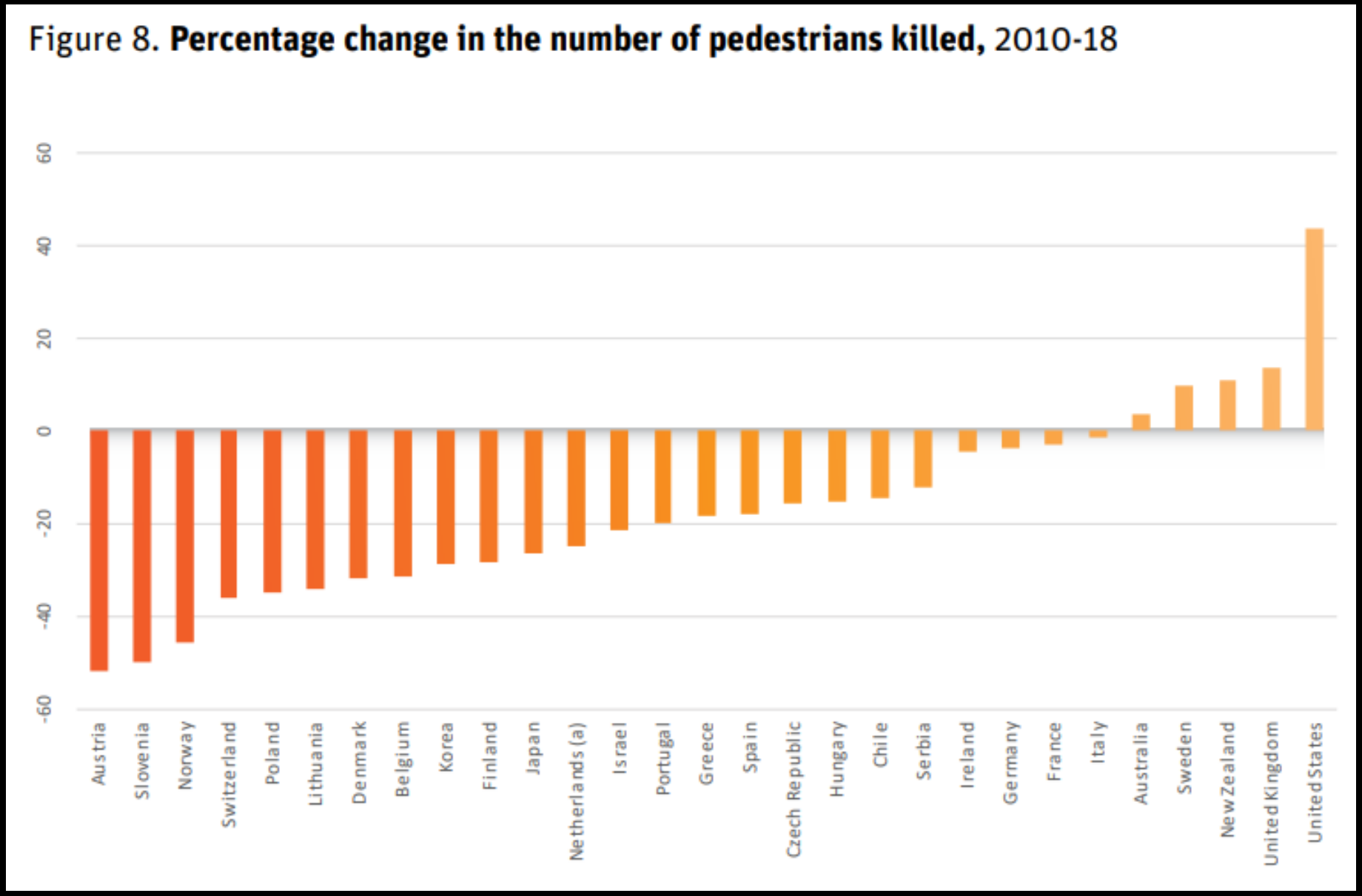
Vision Zero

U.S. DOT Vision for Roadway Safety

Together, we must strive for zero roadway fatalities. Zero is the only acceptable number of deaths on our highways, roads, and streets. The United States Department of Transportation is committed to taking substantial, comprehensive action to significantly reduce serious and fatal injuries on the Nation's roadways. However, no one will reach this goal acting alone. Reaching zero will require U.S. DOT to work with the entire roadway transportation community and the American people to lead a significant cultural shift that treats roadway deaths as unacceptable and preventable.

Source: US Department of Transportation. National Roadway Safety Strategy, https://www.transportation.gov/sites/dot.gov/files/2022-02/USDOT-National-Roadway-Safety-Strategy.pdf, 2022.
p. 5

The US is doing particularly badly



Source: International Transport Forum. *Road Safety Annual Report*, 2020.

Pedestrian injuries: System fundamentals

- **What** causes severe & fatal injuries?
- **When** are they most likely to occur?
- **Where** are they most likely to occur?

- Then we can discuss ***who*** experiences them the most…

What creates pedestrian injury risk?

Factors that affect pedestrian injury severity

- Vehicle impact (travel) speed
- Vehicle mass & front end height
- Pedestrian vulnerability
- Exposure

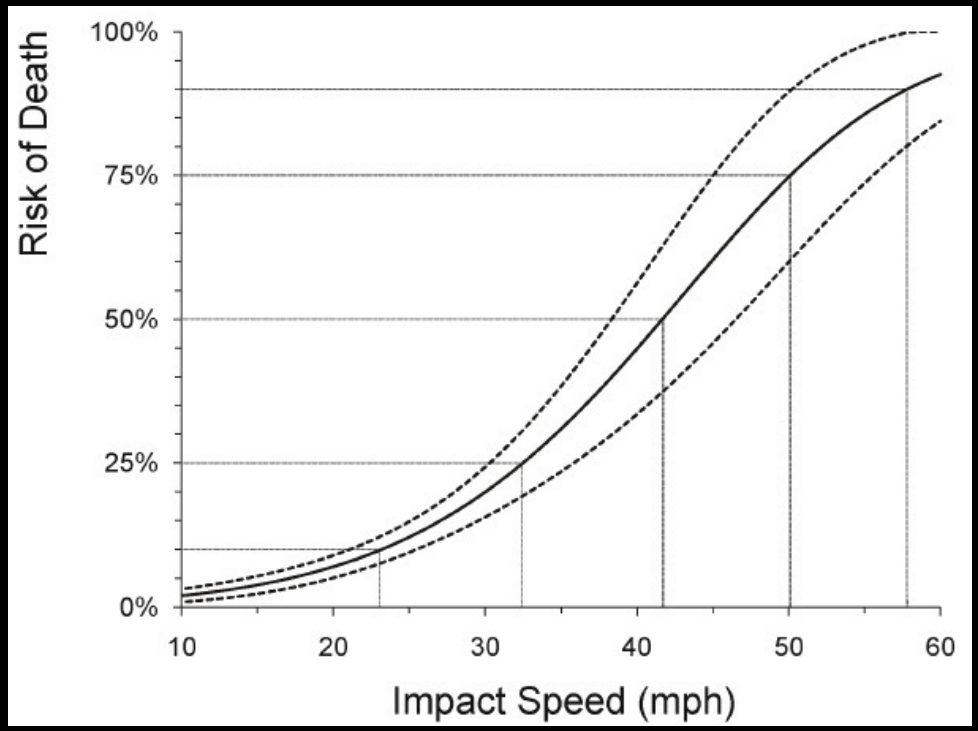
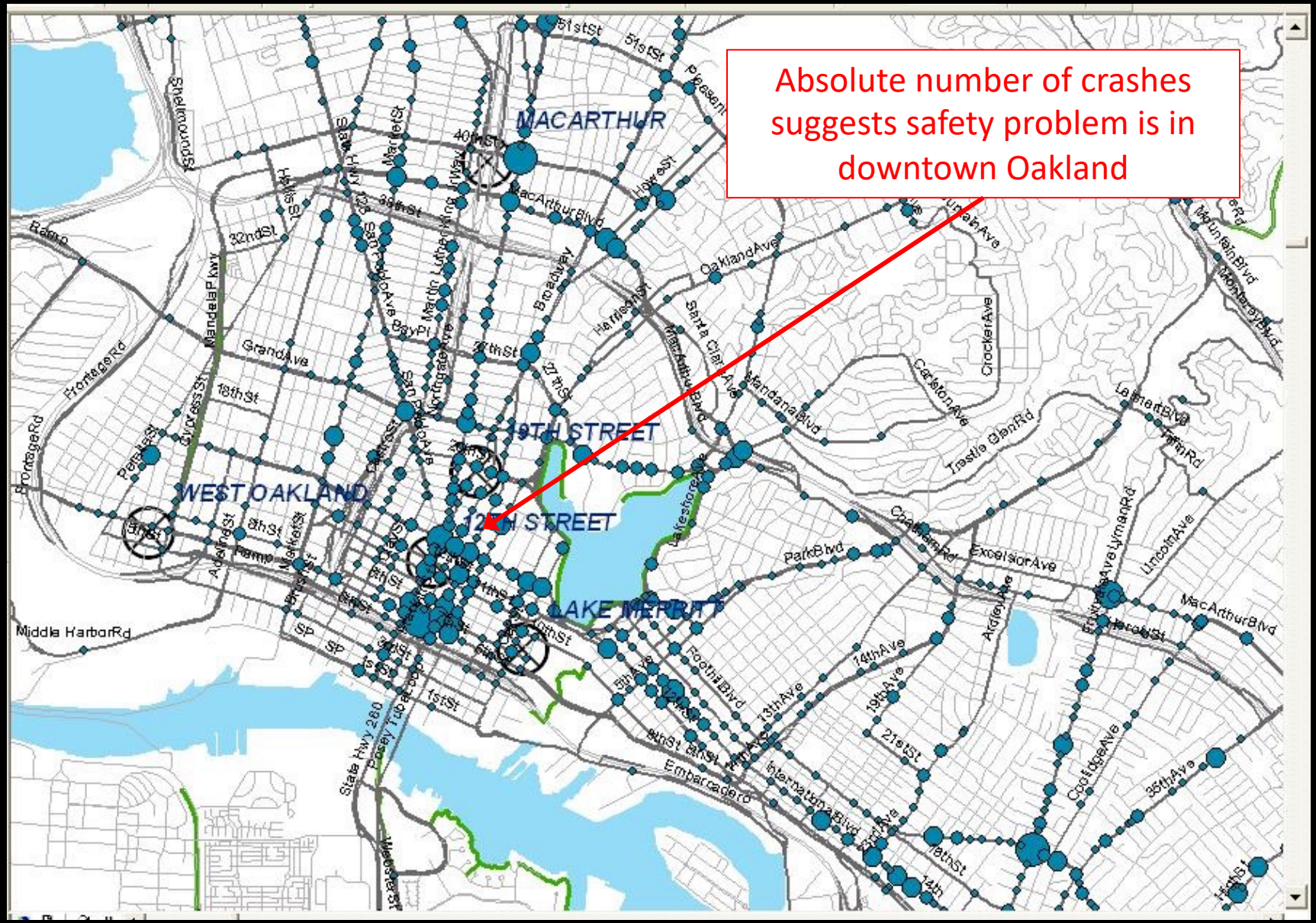


Image source: Tefft, B.C. *Impact Speed and a Pedestrian's Risk of Severe Injury or Death*, AAA Foundation for Traffic Safety, https://www.aaafoundation.org/sites/default/files/2011PedestrianRiskVsSpeed.pdf, September 2011.

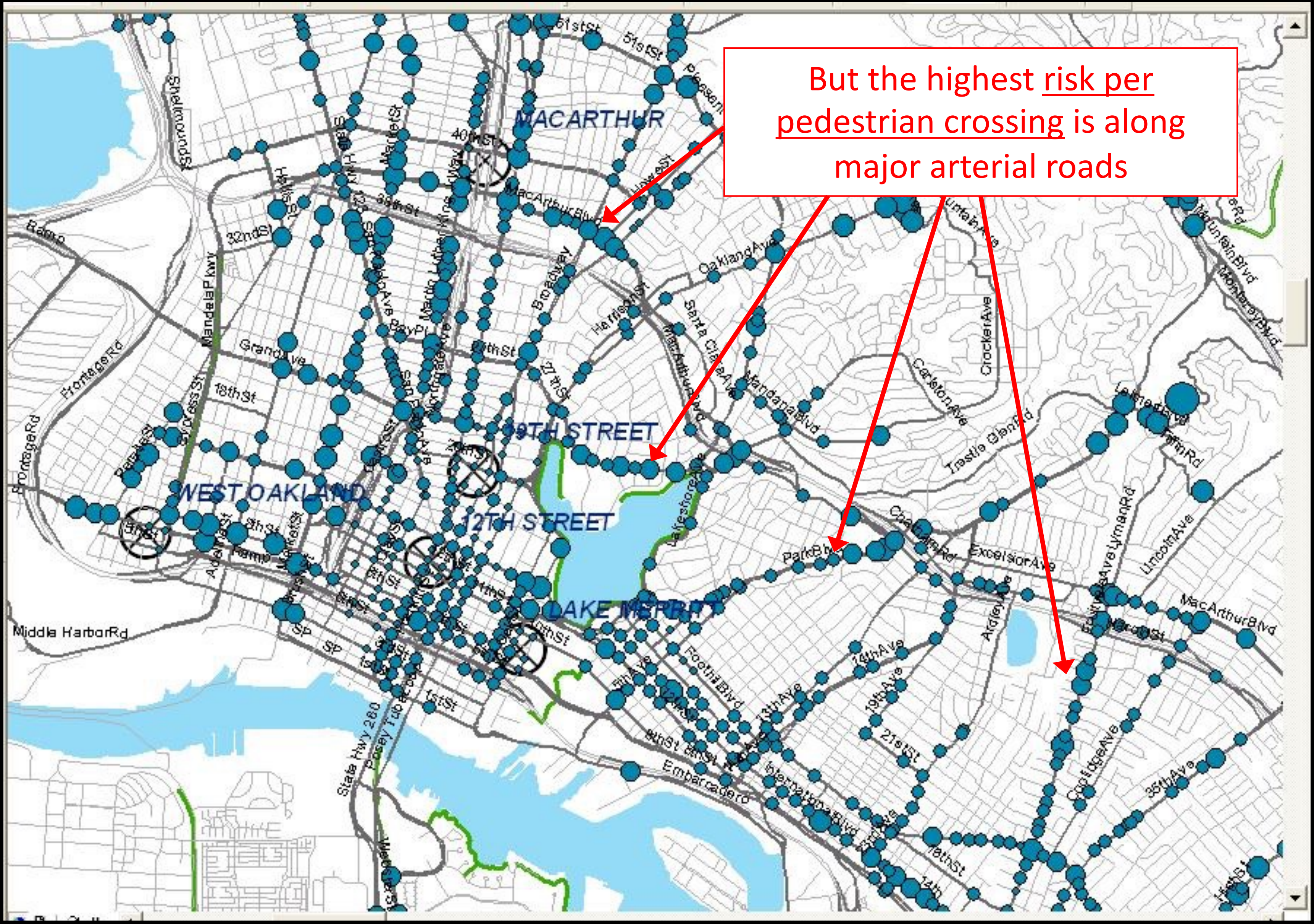
When is pedestrian injury risk highest?

Where is pedestrian injury risk highest?



Oakland Reported Intersection Pedestrian Crashes (1996-2005)

Where is pedestrian injury risk highest?



Oakland Estimated Intersection Pedestrian Crash **Risk** (1996-2005)

Common Pedestrian Fatality Characteristics over 40 years

Source: Schneider, R.J. "United States Pedestrian Fatality Trends, 1977 to 2016," *Transportation Research Record*, Volume 2674, Number 9, pp. 1069-1083. DOI: 10.1177/0361198120933636, 2020.

- Pedestrian in roadway or crossing roadway (90%)
- Vehicle traveling straight (83%)
- Pedestrian at mid-block or no traffic signal (80%)
- Roadway speed limit of 35 mph or higher (70%)
- Male pedestrian (70%)
- Male driver (67%)
- Darkness (65%)

Common Pedestrian Fatality Characteristics over 40 years

Source: Schneider, R.J. "United States Pedestrian Fatality Trends, 1977 to 2016," *Transportation Research Record*, Volume 2674, Number 9, pp. 1069-1083. DOI: 10.1177/0361198120933636, 2020.

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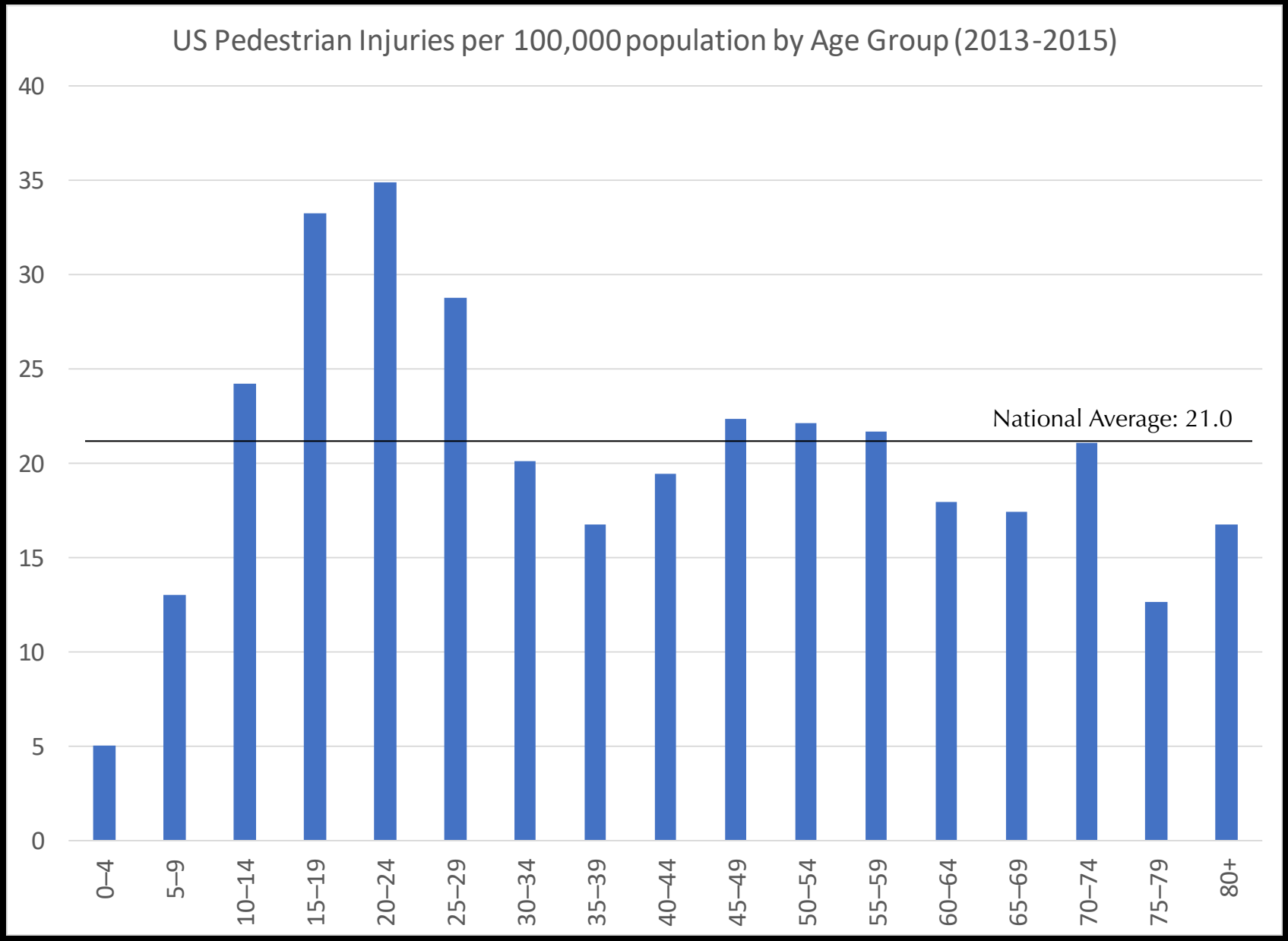
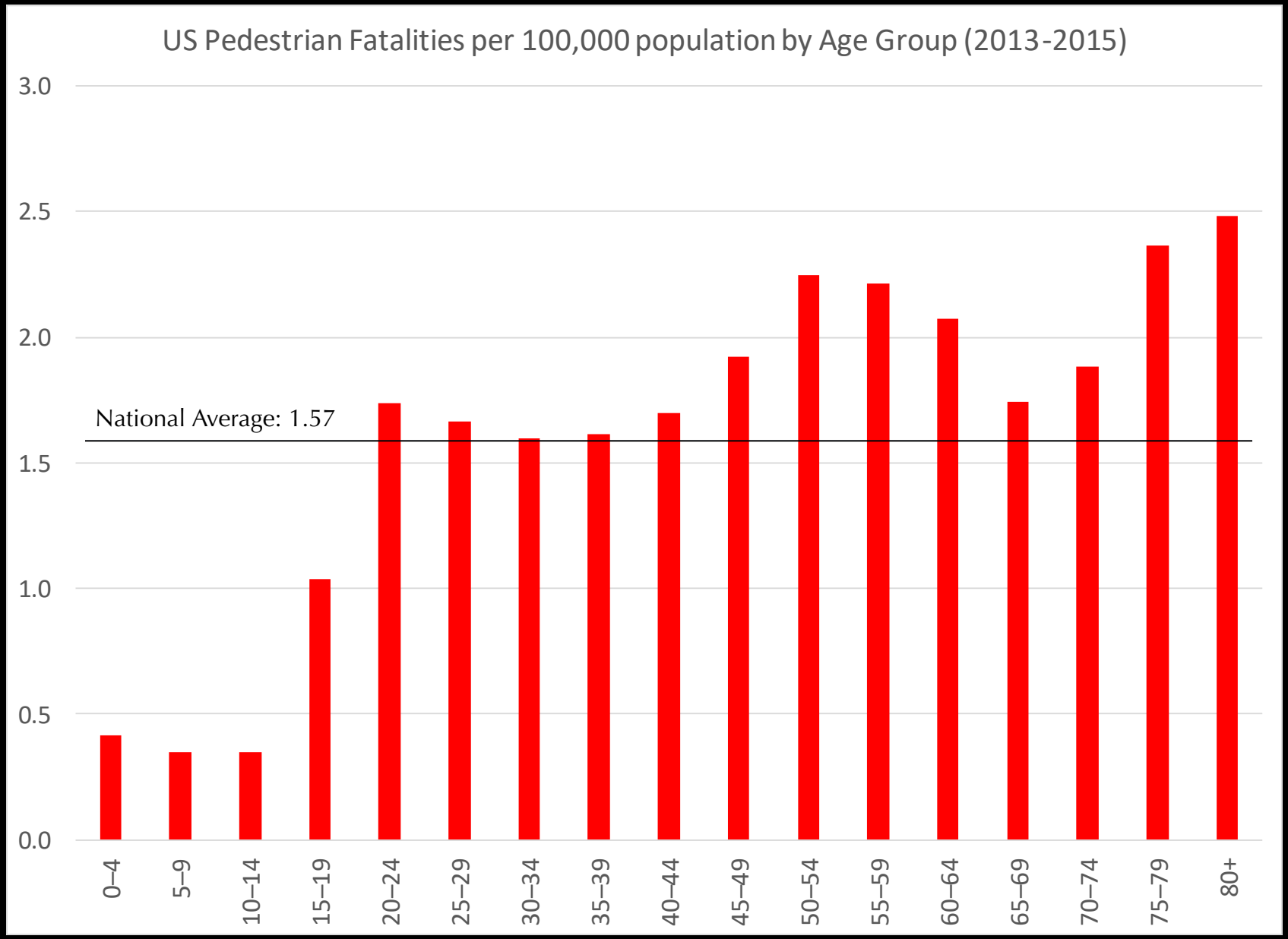
Age: Injuries



Data Source: National Highway Safety Traffic Administration, Traffic Safety Facts: 2013, 2014, 2015.

Age: Fatalities



Data Source: National Highway Safety Traffic Administration, Traffic Safety Facts: 2013, 2014, 2015.

Age: Fatalities

Relative risk of pedestrian death for 65 and over vs. under 65, by state

State	Percentage of population 65 years and over	Percentage of pedestrian deaths 65 years and older	Pedestrian fatalities per 100,000, under 65 years old	Pedestrian fatalities per 100,000, 65 years and older	Relative risk
Hawaii	15.2%	42.2%	1.22	4.96	4.07
Vermont	15.7%	42.5%	0.44	1.73	3.96
New Hampshire	14.7%	38.1%	0.46	1.65	3.58
Massachusetts	14.4%	33.4%	0.81	2.41	2.98
New York	14.1%	31.3%	1.20	3.34	2.78
Maine	17.0%	35.9%	0.60	1.63	2.73
Rhode Island	15.1%	32.5%	0.95	2.58	2.72
Idaho	13.3%	27.2%	0.60	1.45	2.43
California	12.1%	24.1%	1.49	3.43	2.30
District of Columbia	11.3%	21.8%	3.63	1.65	2.19
National total	**13.7%**	**19.4%**	**1.36**	**2.06**	**1.51**

People 65 years and older are 51% more likely than younger people to be killed as a pedestrian

Source: Smart Growth America and National Complete Streets Coalition. *Dangerous by Design: 2016*, Project team: Emiko Atherton, Yuri Chang, Steve Davis, Alex Dodds, Sam Sklar, Heather Zaccaro, Available online, https://smartgrowthamerica.org/dangerous-by-design/, 2016.

Pedestrian Fatalities & Census Tract Median Income

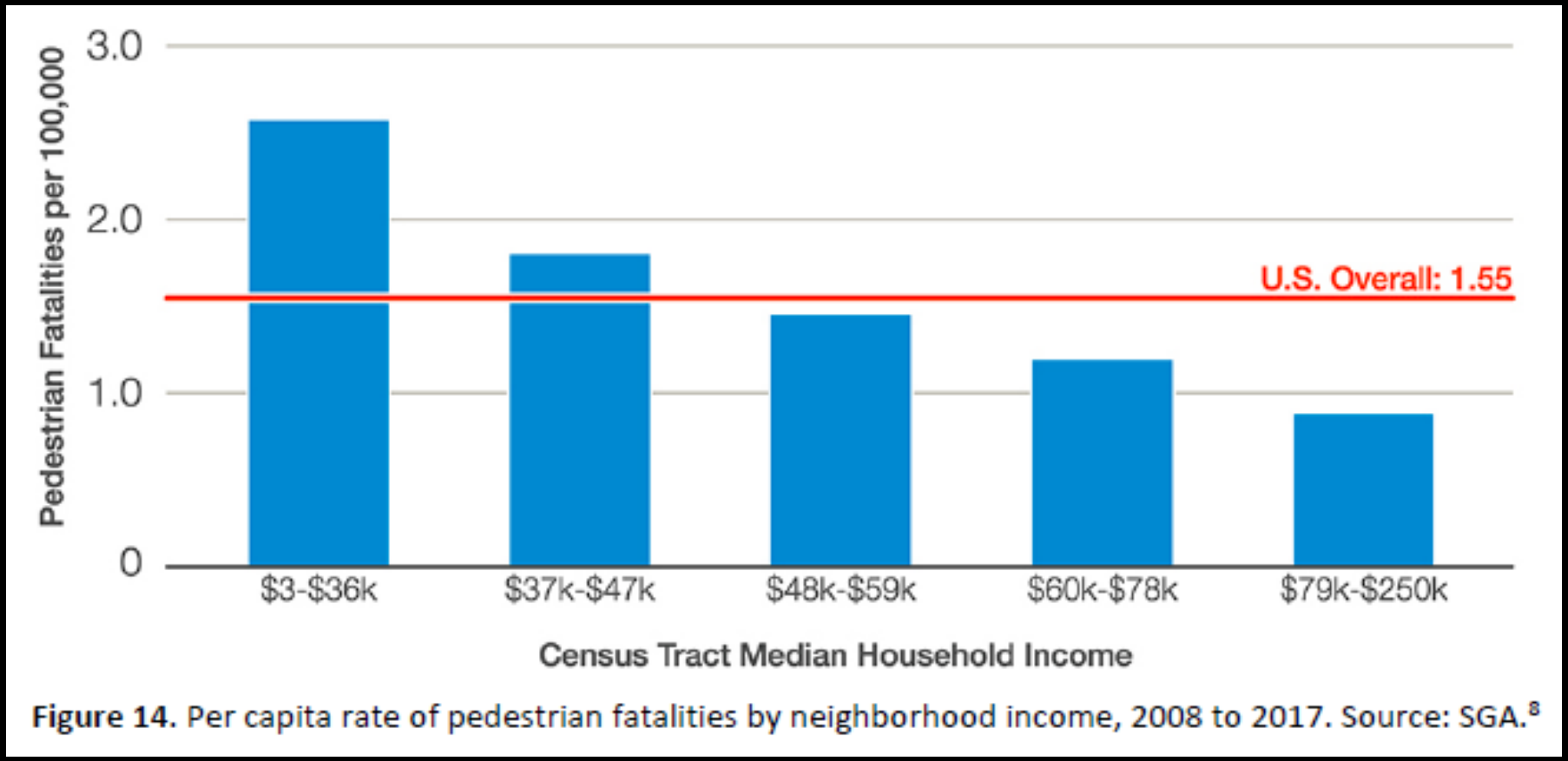


Figure 14. Per capita rate of pedestrian fatalities by neighborhood income, 2008 to 2017. Source: SGA.[8]

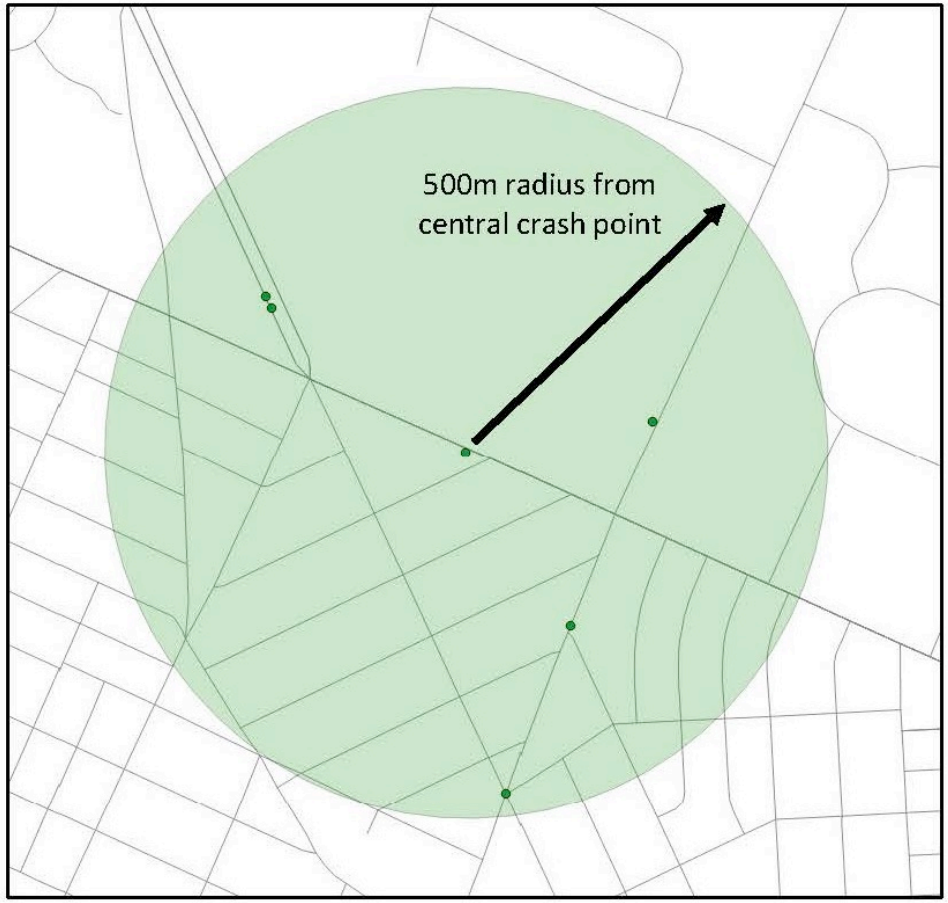
Source: Pedestrian and Bicycle Information Center. Toward a Shared Understanding of Pedestrian Safety An Exploration of Context, Patterns, and Impacts, June 2020.

60 US Fatal Pedestrian Crash Hot Spots

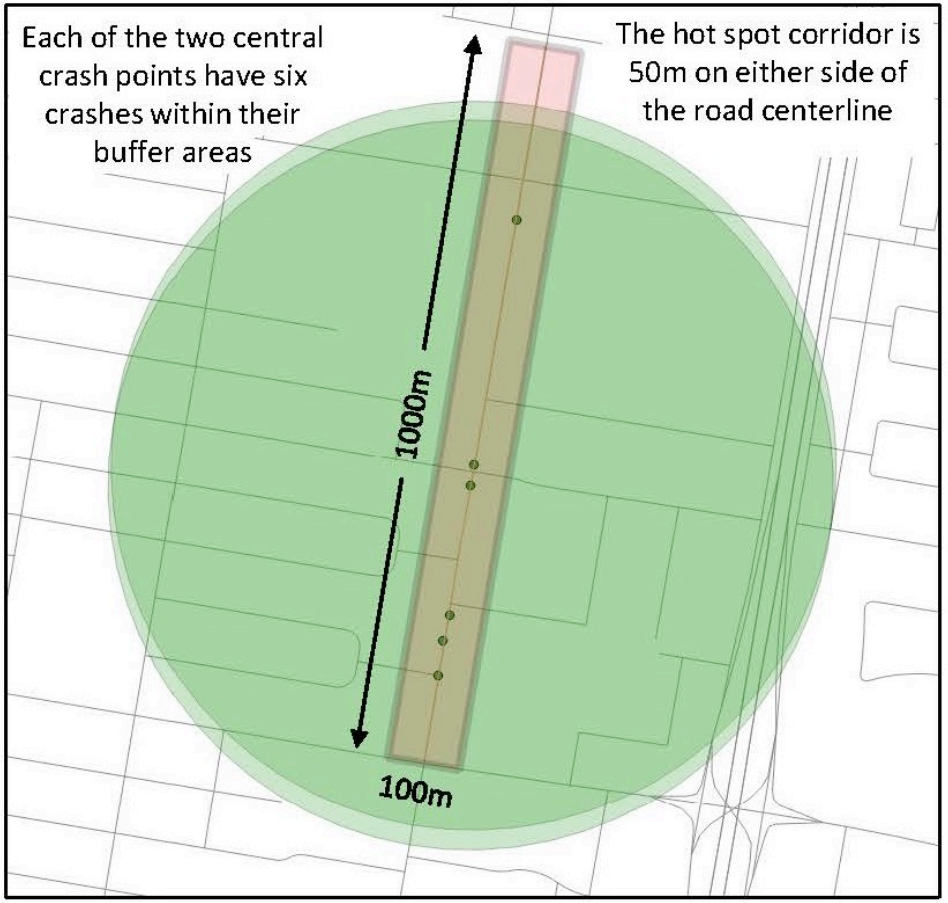
Source: Schneider, R.J., R.L. Sanders, F.R. Proulx, and H. Moayyed. "United States Fatal Pedestrian Crash Hot Spot Locations and Characteristics," *Journal of Transport and Land Use*, 2020.

- Motor-vehicle-involved crashes on public roads where person died within 30 days
- Latitude & longitude coordinates since 2001 (97% of pedestrian fatalities)
- Pedestrian fatalities on freeways excluded
- Crashes with >1 fatality counted once
- Two eight-year analysis periods:
  - 2001-2008 = 29,939 fatal pedestrian crashes
  - 2009-2016 = 32,397 fatal pedestrian crashes

Hot Spot Identification



No hot spot corridor identified: Six fatal crashes occurred within this buffer area, but there was not a single roadway with six or more fatal crashes within 1000m.



Hot spot corridor identified: There is a single roadway with six or more fatal crashes within 1000m. The corridor could be shifted north by 100m or south 200m, but it was selected to start at an intuitive roadway intersection.

Regional Highway (39 corridors)

US Highway 19, New Port Ritchey, FL

Regional Highways: high-speed, multilane, high AADT, long block lengths, many driveways, few signalized crossings. Single-story commercial & big box stores. Large parking lots. Surrounding = low-density residential.

Image Source: Google Street View, 2018.

Regional Highway (39 corridors)

MD Highway 193, Langley Park, MD

Regional Highways: high-speed, multilane, high AADT, long block lengths, many driveways, few signalized crossings. Single-story commercial & big box stores. Large parking lots. Surrounding = low-density residential.

Image Source: Google Street View, 2018.

Urban Primary Arterial Roadway (9 corridors)

N Grand Boulevard, St. Louis, MO

Urban Primary Arterial Roadways: Still high-speed, multilane, high AADT, but not as big & fast as regional highways. More signalized crossings. Some off-street & on-street parking. Surrounding = Black and Hispanic residents common.

Image Source: Google Street View, 2018.

Urban Primary Arterial Roadway (9 corridors)

FL Highway 934, Miami, FL

Urban Primary Arterial Roadways: Still high-speed, multilane, high AADT, but not as big & fast as regional highways. More signalized crossings. Some off-street & on-street parking. Surrounding = Black and Hispanic residents common.

Image Source: Google Street View, 2018.

New York City Thoroughfare (12 corridors)

Canal Street, New York, NY (Manhattan)

NY Thoroughfares: 25 mph-speed, most multilane, moderate AADT, very high pedestrian activity. Many signalized crossings. On-street parking. Surrounding = Dense, mixed-use.

Image Source: Google Street View, 2018.

60 Hot Spots: General Locations

- **Sunbelt metro regions**
  60% of the unique hot spot corridors.
- **National or state highway systems**
  57% of the unique hot spot corridors. These often prioritize automobile speed and throughput.
- **New York City**
  14 corridors (10 in Manhattan). These have high pedestrian volumes + vehicle volumes.

60 Hot Spots: Roadway Characteristics

- **Multi-lane roads**
  97% had 3+ lanes to cross. 70% had 5+ lanes to cross.
- **High speed limits**
  77% were 30+ mph. 50% were 40+ mph.
- **High traffic volumes**
  62% had 25,000+ AADT.
- **Few crossing opportunities**
  57% had ≤ 2 signalized intersections in 1000m.

60 Hot Spots: Land Use & Socioeconomics

- **Commercial land uses**
  All had adjacent commercial land uses.
- **Bus routes**
  75% had bus stops.
- **Lower-income neighborhoods**
  75% in neighborhoods with <75% regional AMI.
- **Communities of color**
  53% were majority Hispanic or Black (US pop = 39%).

Pedestrian Fatalities by Race/Ethnicity

Source: Sanders, R.L. and R.J. Schneider. “An Exploration of Pedestrian Fatalities by Race in the United States,” Under review, 2022.

Pedestrian Fatalities by Race/Ethnicity

Race/Ethnicity	Pedestrian fatalities per million population	Pedestrian fatalities per million pedestrian trips
Native American	54.4	0.577
Black	23.9	0.199
Hispanic	15.9	0.154
White	12.6	0.103
Asian	11.9	0.081
US Average	*16.6*	*0.138*

Data sources: Fatality Analysis Reporting System, 2012-2017; National Household Travel Survey, 2017

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Native American	54.4	0.577	**+318%**
Black	23.9	0.199	**+44%**
Hispanic	15.9	0.154	**+12%**
White	12.6	0.103	**-25%**
Asian	11.9	0.081	**-41%**
US Average	*16.6*	*0.138*	

Data sources: Fatality Analysis Reporting System, 2012-2017; National Household Travel Survey, 2017

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Pedestrian Fatalities by Race/Ethnicity

- 2012-2017 FARS data
- Multinomial logit models examining variables associated with pedestrian fatalities for Asian, Black, Hispanic, and Native American pedestrians compared to White pedestrians
  - Roadway design & operations
  - Time & environment
  - Behavior & contributing circumstances
  - Pedestrian age & gender

Source: Sanders, R.L. and R.J. Schneider. "An Exploration of Pedestrian Fatalities by Race in the United States," Under review, 2022.

Roadway Design & Operations

(Model with FARS variables only)

	+ (higher than **White**)	- (lower than **White**)
Asian	4+ lanes Freeway	30+ mph speed limit
Black	4+ lanes Arterial roadway Freeway Local road	40+ mph speed limit
Hispanic	4+ lanes Freeway Local road	40+ mph speed limit
Native American		Local road

Source: Sanders, R.L. and R.J. Schneider. "An Exploration of Pedestrian Fatalities by Race in the United States," Under review, 2022.

Roadway Design & Operations

(Model with FARS & Census neighborhood variables)

	+ (higher than **White**)	- (lower than **White**)
Asian		50+ mph speed limit
Black		
Hispanic	4+ lanes Local road	
Native American		

Source: Sanders, R.L. and R.J. Schneider. "An Exploration of Pedestrian Fatalities by Race in the United States," Under review, 2022.

Time & Environment

(Model with FARS & Census neighborhood variables)

	+ (higher than **White**)	- (lower than **White**)
Asian		
Black	Darkness	
Hispanic	Weekends Sunbelt	
Native American	Darkness	

Source: Sanders, R.L. and R.J. Schneider. "An Exploration of Pedestrian Fatalities by Race in the United States," Under review, 2022.

Behavior & Contributing Circumstances

(Model with FARS & Census neighborhood variables)

	+ (higher than **White**)	- (lower than **White**)
Asian	Crossing in crosswalk	Pedestrian alcohol Hit & run
Black	Hit & run	Pedestrian alcohol Crossing in crosswalk
Hispanic	Pedestrian alcohol Speed-related	Driver going straight
Native American	Pedestrian alcohol	Speed-related

Source: Sanders, R.L. and R.J. Schneider. "An Exploration of Pedestrian Fatalities by Race in the United States," Under review, 2022.

Pedestrian Characteristics

(Model with FARS & Census neighborhood variables)

	+ (higher than **White**)	- (lower than **White**)
Asian	Age >64	Male
Black	Age <16	Age >64
Hispanic	Age <16 Male	Age >64
Native American		Age >64

Source: Sanders, R.L. and R.J. Schneider. "An Exploration of Pedestrian Fatalities by Race in the United States," Under review, 2022.

Key Takeaways

- Correlates for pedestrian fatalities differ significantly by race. ***Why?***
- Significant changes to regression model when census neighborhood data added
- Practitioners can act on these findings to help save lives now
  - Prioritize neighborhoods that experience disproportionate harm

Source: Sanders, R.L. and R.J. Schneider. "An Exploration of Pedestrian Fatalities by Race in the United States," Under review, 2022.

Systemic Safety Solutions…

→ Identify times, locations & situations with high pedestrian risk

→ Prioritize improvements for groups that are at higher risk (*are further from zero*)

Short-term: Change Signs & Signals

Figure 4. Photo. Example of a HAWK treatment in Tucson, AZ.

Original Photo from Richard Nassi. Source: Fitzpatrick, K., S.T. Chrysler, R. Van Houten, W.W. Hunter, and S. Turner. Evaluation of Pedestrian and Bicycle Engineering Countermeasures: Rectangular Rapid-Flashing Beacons, HAWKs, Sharrows, Crosswalk Markings, and the Development of an Evaluation Methods Report, Federal Highway Administration, FHWA-HRT-11-039, Available online: http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf, April 2011.

Short-term: Change Signs & Signals

Image source: Ron Bloomquist, Pedestrian and Bicycle Information Center, www.pedbikeimages.org, 2008.

Medium-term: Redesign roads

Bottom Image Source: Google Street View, 2018.

Long-term:
Change site & land use patterns

Long-term:
Encourage mode shifts

All else equal, communities that have more walking and bicycling are safer for pedestrians, bicyclists, and <u>everyone</u>

Source: Jacobsen, P.L. "Safety in Numbers: More Walkers and Bicyclists, Safer Walking and Bicycling," Injury Prevention, Volume 9, pp. 205-209, 2003.
Source: Marshall, W.E. and N.W. Garrick. "Evidence on Why Bike-Friendly Cities Are Safer for All Road Users," Environmental Practice, Volume 13, Number 1, pp. 16-27, 2011.

Hyden Safety Pyramid

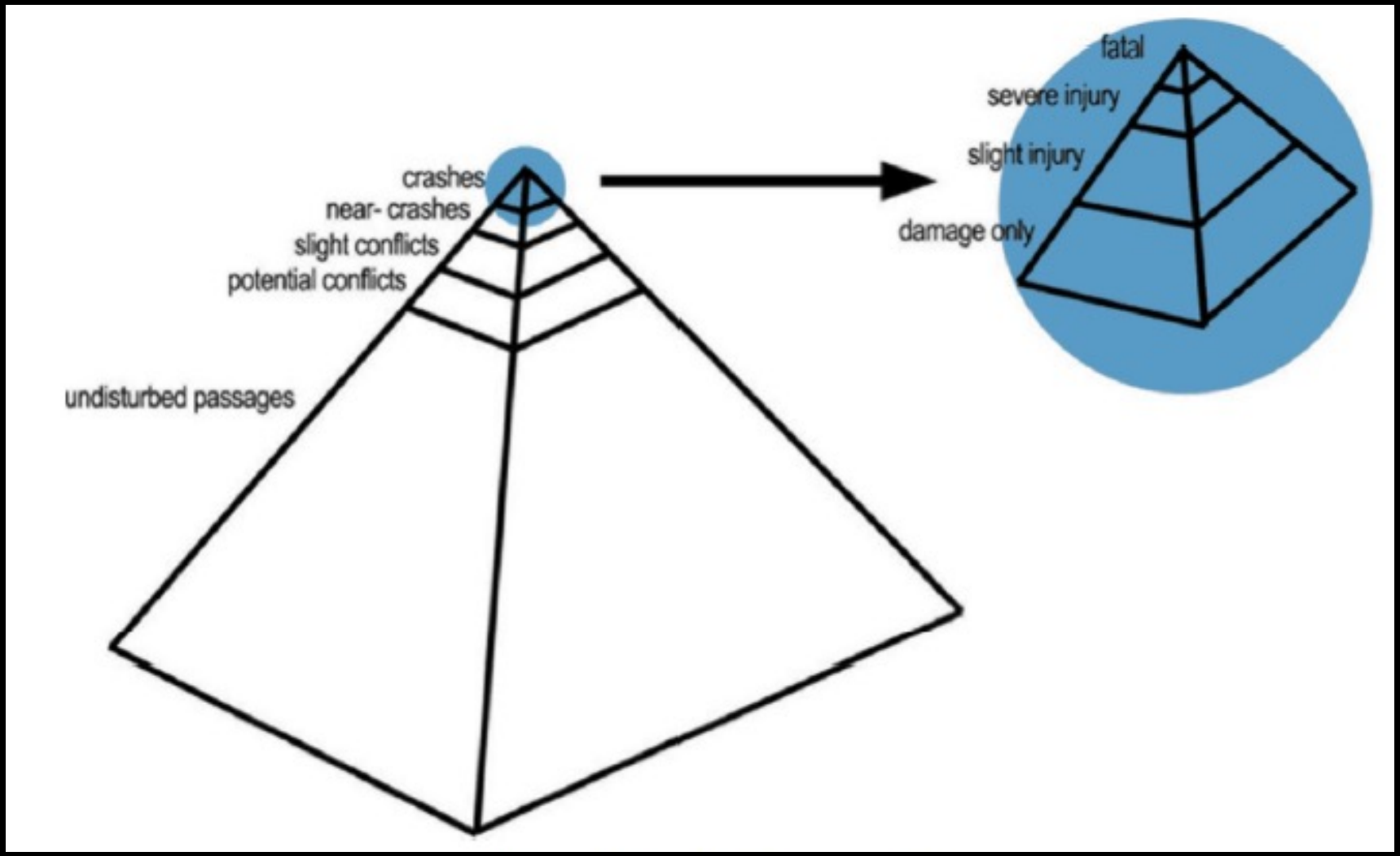
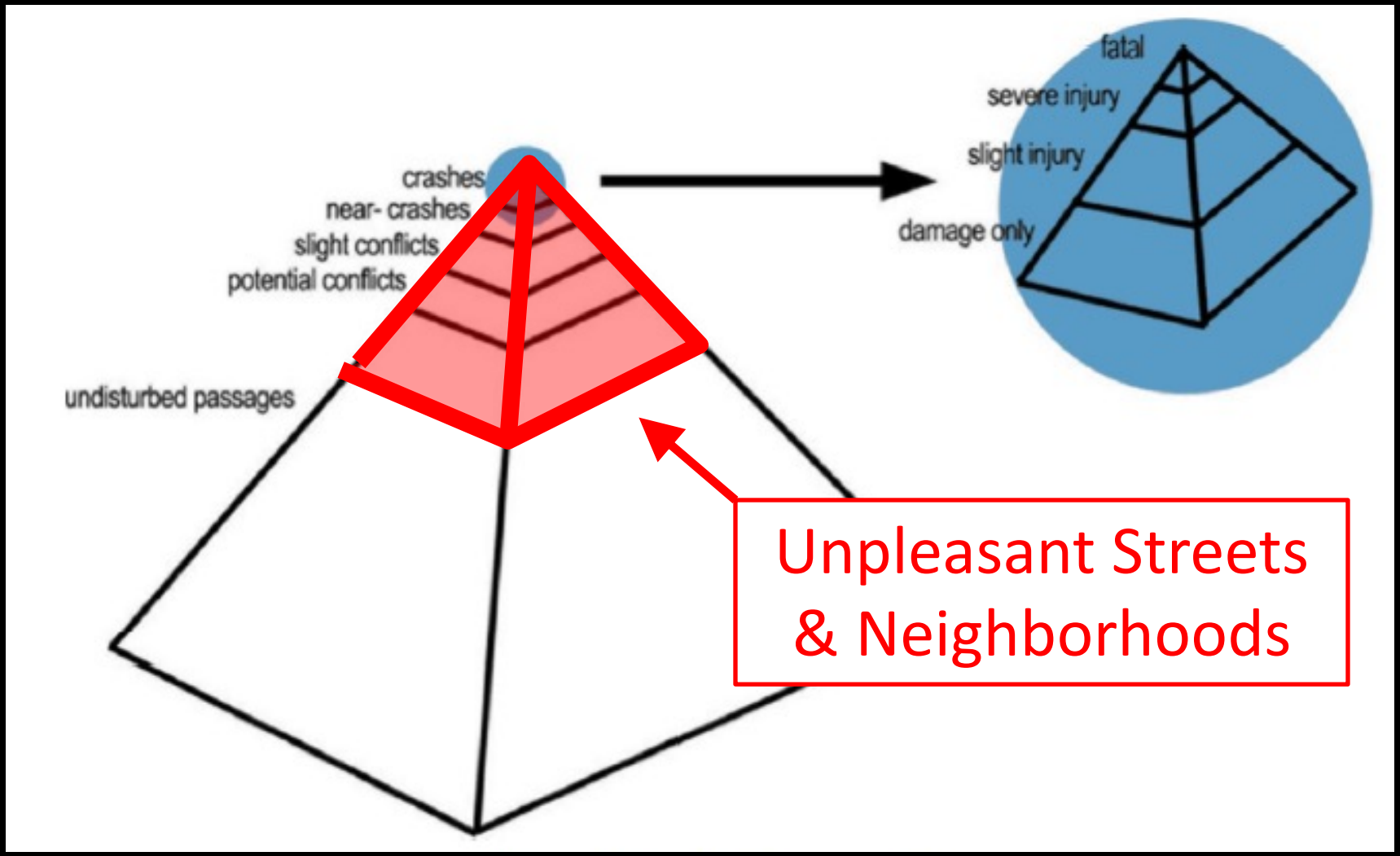


Image Source: Modified from Hyden, C. 1987. The Development of a Method for Traffic Safety Evaluation: The Swedish Traffic Conflicts Technique. In: Astarita, V. and Giofré, V.P. 2019. From traffic conflict simulation to traffic crash simulation: Introducing traffic safety indicators based on the explicit simulation of potential driver errors. Simulation Modelling Practice & Theory, 94, p. 216.

Hyden Safety Pyramid



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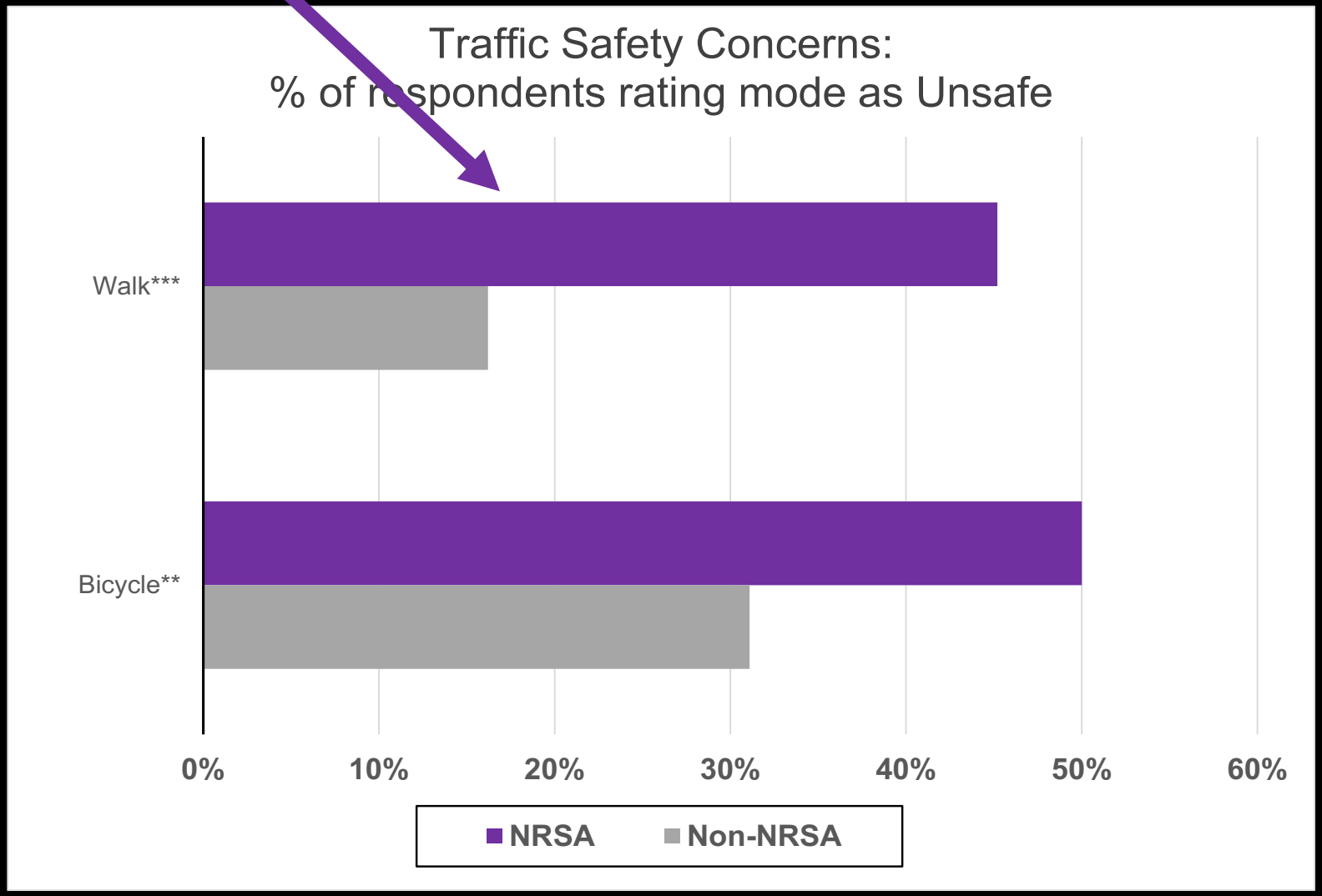
Walking & Bicycling Traffic Safety Concerns in Low-Income Milwaukee Neighborhoods



Source: Schneider, R.J., H. Wiers, and A Schmitz. "Perceived Safety and Security Barriers to Walking and Bicycling: Insights from Milwaukee," Transportation Research Record, Forthcoming, 2022.

Questions & Discussion

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For further information:

Sanders, R.L. and R.J. Schneider. "An Exploration of Pedestrian Fatalities by Race in the United States," Under review, 2022.

Sanders, R.L., R.J. Schneider, and F.R. Proulx. "Pedestrian Fatalities in Darkness: What do we Know, and What can be Done?" Transport Policy, Volume 120, pp. 23-39, 2022.

Schneider, R.J. "United States Pedestrian Fatality Trends, 1977 to 2016," *Transportation Research Record*, Volume 2674, Number 9, pp. 1069-1083. DOI: 10.1177/0361198120933636, 2020.

Schneider, R.J., R.L. Sanders, F.R. Proulx, and H. Moayyed. "United States Fatal Pedestrian Crash Hot Spot Locations and Characteristics," *Journal of Transport and Land Use*, 2020.

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