How is Traffic Safety Affected by Changes in Traffic Speeds Following Speed Limit Increases?

8th Road Safety and Simulation International Conference 2022

June 09, 2022

Presented By: Nischal Gupta

Megat-Usamah Megat-Johari, Hisham Jashami, Peter T. Savolainen

Overview

- Background
- Research Motivation
- Study Objectives
- Data Collection
- Statistical Methodology
- Analysis Results
- Conclusions
- Future Work

Background

- Setting appropriate speed limits continue to be an important and oft-debated policy issue.
- Increasing speed limits leads to consistent increases in travel speeds.
- These increases have generally been shown to coincide with reduced traffic safety.
  - Increased crash frequency.
  - Increased crash severity.

Research Motivation

- The state of Michigan increased the state's maximum statutory speed limits from 70 to 75 mph on 614 miles of limited-access divided highways.
- The speed limits for heavy vehicles were also increased to 65 mph on highways where the passenger car limit is greater than 65 mph.
- These increases have coincided with increases in speeds and crashes on these same roadways.

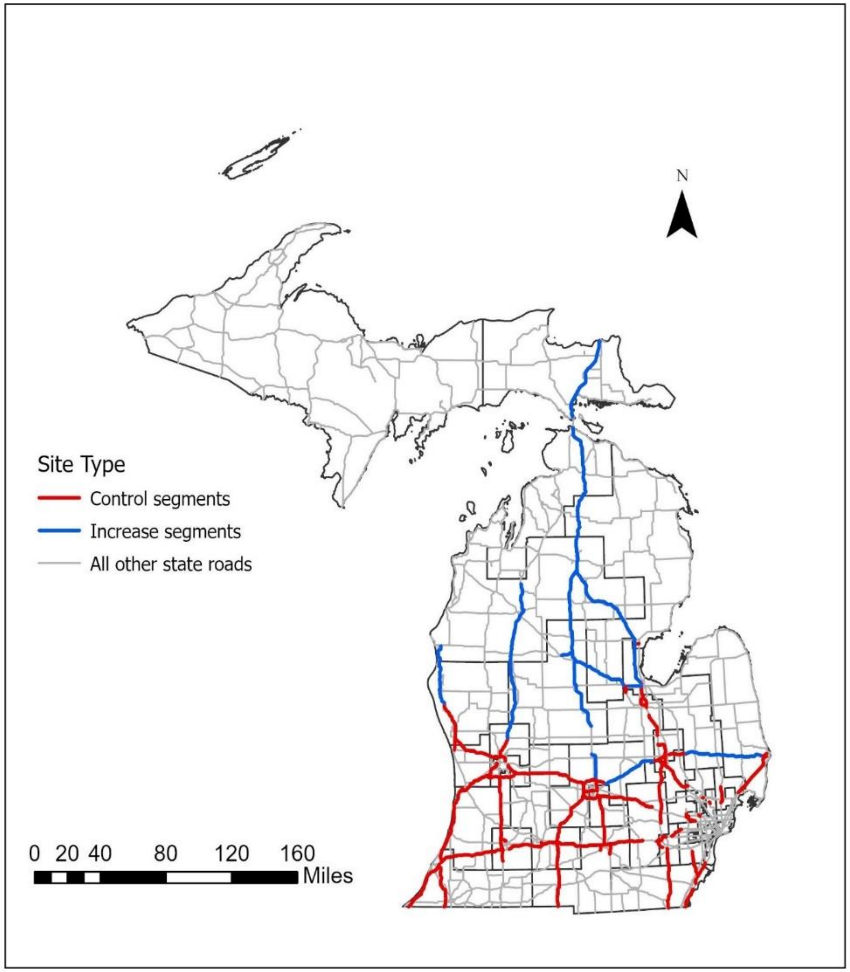
Study Objectives

- The present study examines changes in crash frequency and severity following the 2017 speed limit increase on rural freeways in the State of Michigan.
- The speed-safety interrelationship is evaluated by considering both:
  - Before-after crash trends related to when the speed limit increases went into effect, and
  - Changes in travel speeds that coincided with these speed limit increases.

Data Collection

- Site type:
  - **Control sites:** Segments at 70-mph (Red)
  - **Increase-sites:** Segments at 75-mph post 2017 (Blue)

- Crash data
  - Obtained from Michigan State Police
  - Before-period: 2014-2016
  - After-period: 2018-2019



Data Collection

- Speed data:
  - Obtained from probe vehicles
  - Provided by Regional Integrated Transportation Information System (RITIS)
  - Time period: 2016, 2018-2019
  - Speed data obtained at 15-min intervals for the entire year for each segment included in the analysis
    - Data aggregated on annual basis to calculate mean speed, standard deviation of speed, and various speed percentiles
- Traffic volume and roadway geometry data
  - Obtained from Michigan Department of Transportation

Statistical Method

- Crash data are random, discrete, non-negative integers – count models are preferred.
  - Negative binomial model
- Expected number of crashes for segment i, over a given time period is

$$\lambda_i = EXP(\beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon_i) * L$$

  - β_n= parameter estimates from regression model
  - X_n = explanatory variables (e.g., traffic volume, mean speed, roadway characteristics)
  - $EXP(\varepsilon_i)$ = gamma-distributed with mean = 1 and variance = α
  - L = segment length (offset)

Statistical Method

- Analysis combines cross-sectional and longitudinal data
  - Roadway segments repeated for each year over time
- Correlation in crash count at individual locations over the time may occur due to multiple years of data from the same location
- Hence, random effects modeling framework is adopted

Analysis Results

Variable	Total	KA	BC	PDO
Intercept	-2.979*	-8.536*	-6.750*	-2.936*
Period and Site Type: Before-Control	Baseline			
Before Increase	-0.189*	-0.170	-0.134*	-0.172*
After-Control	-0.019	-0.060	-0.078*	-0.013
After-Increase	-0.139*	-0.120	-0.084	-0.123*
Mean speed (mph)	-0.018*	-0.002	-0.024*	-0.021*
SD of speed (mph)	0.068*	0.140*	0.103*	0.065*
Ln(AADT)	0.591*	0.586*	0.810*	0.585*
Percent tucks	-0.008*	N/A	-0.021*	-0.007*

*Indicates significant parameter estimate at 95% confidence

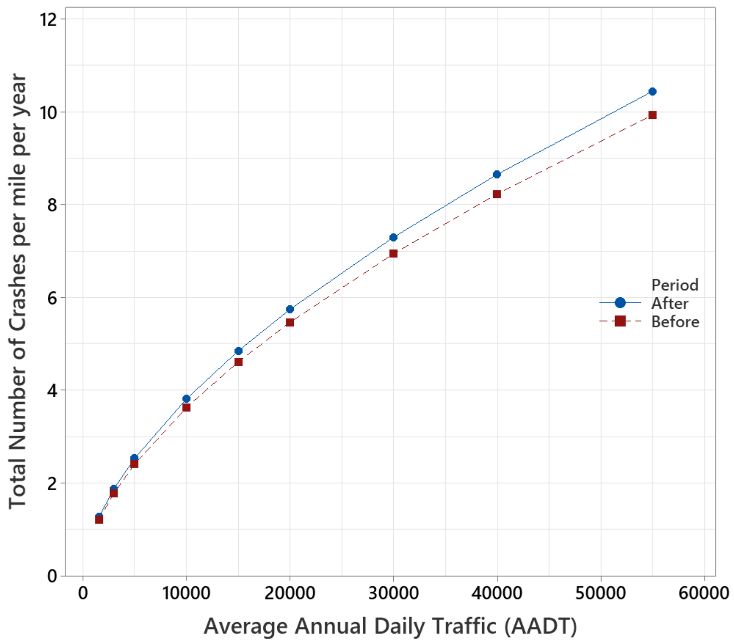
Analysis Results

Variable	Total	KA	BC	PDO
Road Geometry: Tangent	Baseline			
Curve on <40% of segment length	0.163*	0.163	0.115*	0.164*
Curve on >=40% of segment length	0.197*	0.330*	0.245*	0.189*
Median: Graded with Ditch	Baseline			
Graded with ditch with cable median barrier	0.053	-0.015	0.021	0.067*
Median Width: <90 ft	Baseline			
>=90 ft	-0.102*	N/A	-0.093*	-0.107*
Right Shoulder Width: <11 ft	Baseline			
>=11ft	-0.079*	-0.159*	N/A	-0.085*

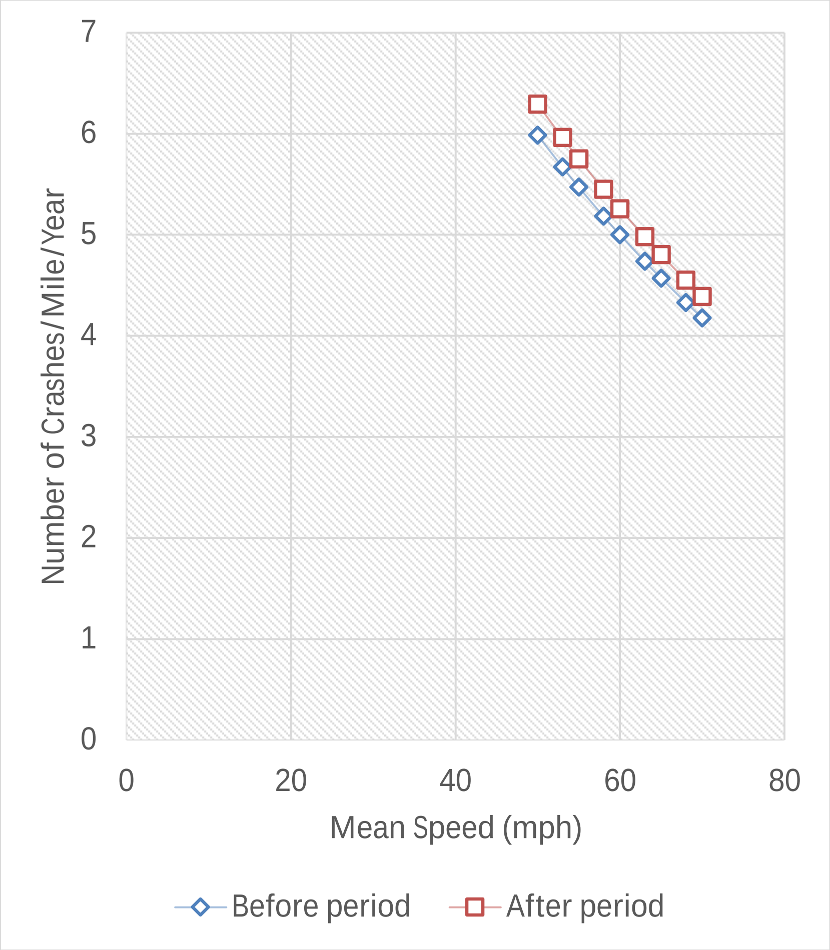
*Indicates significant parameter estimate at 95% confidence

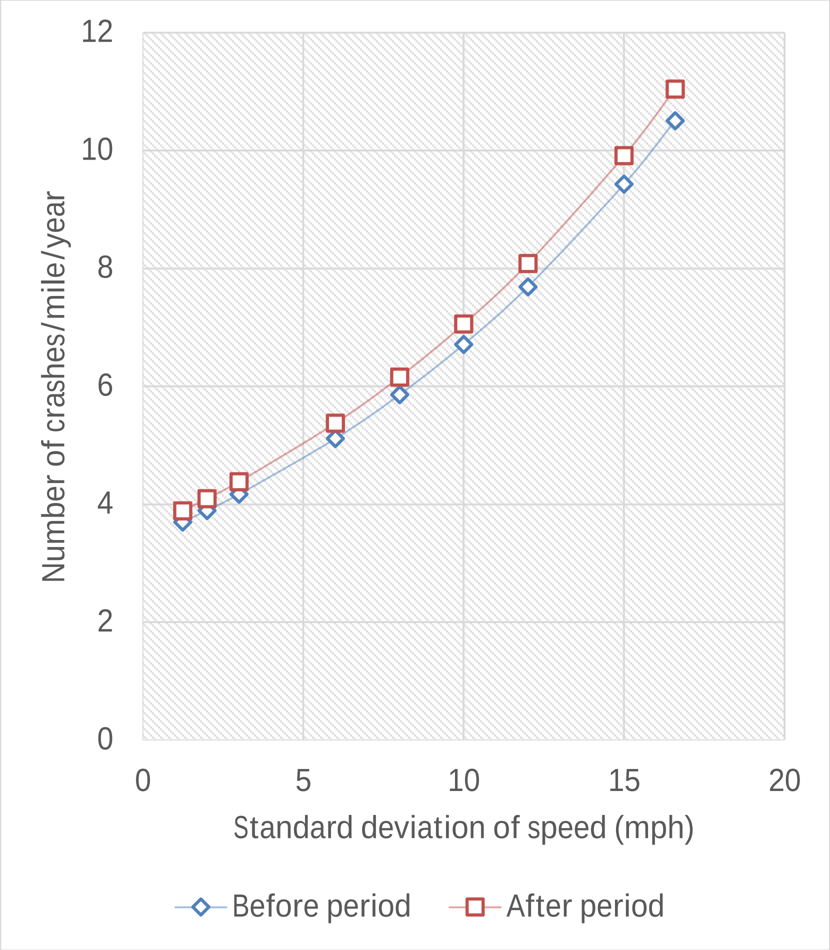
Analysis Results

Site-Type	Average Change in Crashes between Before and After Period			
	Total	KA	BC	PDO
Control	-1.9%	-5.8%	-7.5%	-1.3%
Increase	5.1%	5.1%	5.1%	5.0%



Analysis Results



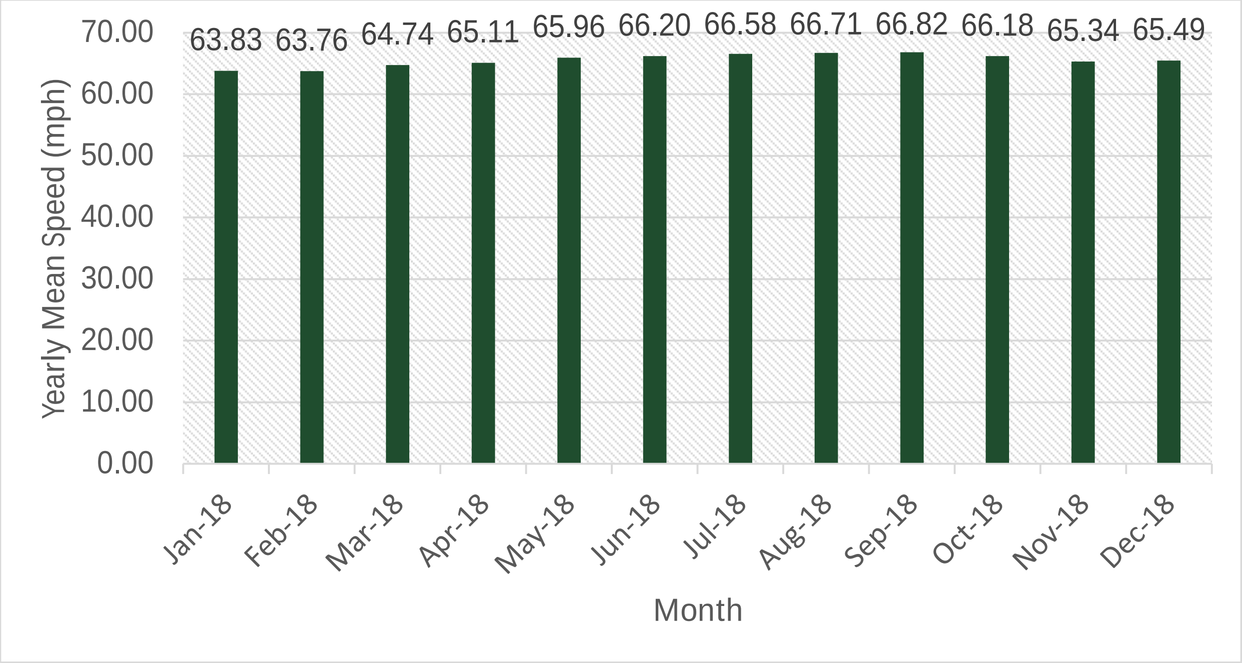


Conclusions

- The 5-mph speed limit increase resulted in 5% increase in crashes across all severities
- Mean speed and variability in speed were both strong determinants of crash frequencies on these roadways
  - Higher mean speeds were associated with lower crash frequencies
  - Greater variability in speeds on a given segment were associated with higher crash frequencies across all severity levels

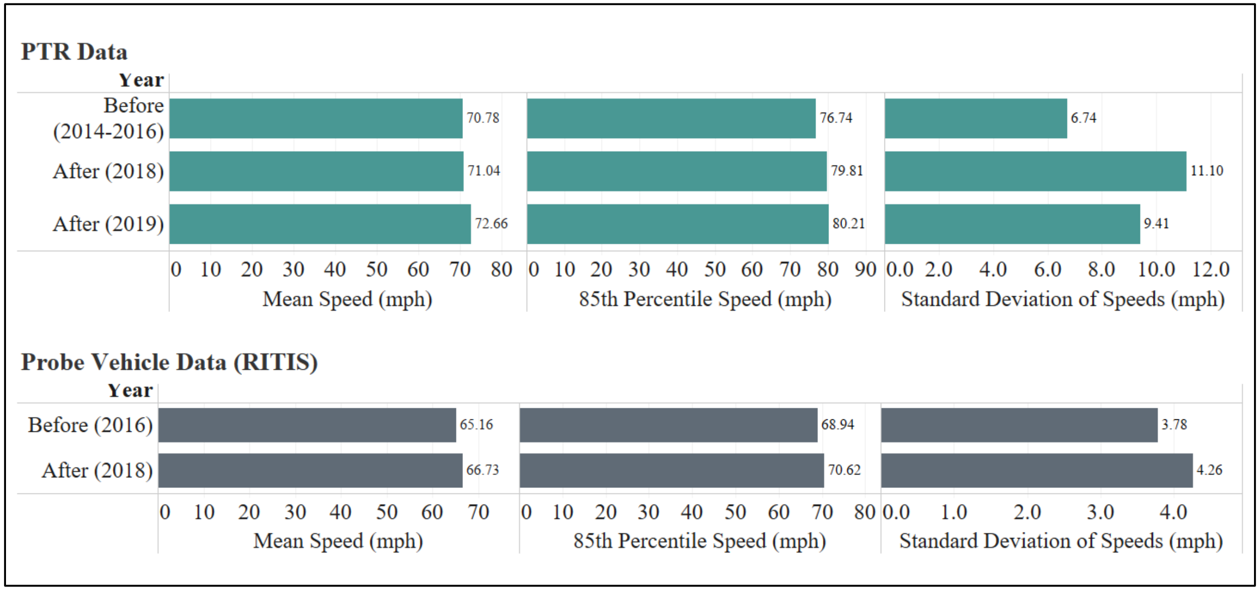
Limitations/Future Work

- Speed data were aggregated at an annual level for each segment
  - Does not capture variations in speed due to season/time



Limitations/Future Work

- Probe vehicle data from RITIS has an over-representation of heavy vehicles



- Standard deviation of speeds calculated in this study accounts for variations in 15-min aggregated speeds on individual speed
    - Variation in speeds across vehicles not accounted for

Thank You!

Comments or Questions?

Nischal Gupta
PhD Student
E-mail: guptanis@msu.edu