Effect of Residential Street Speed Limit Reduction on Driving Speeds in Portland, Oregon

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Findings

This study analyzed the impacts on motor vehicle observed speeds following a residential speed limit reduction from 40.23 km/hr (25 mi/hr) to 32.19 km/hr (20 mi/hr) in Portland, OR that was accompanied by a public awareness and signage campaign. The study used before and after observations of vehicle speeds collected by pneumatic tube traffic counters. Overall, the analysis suggests that the reduction of posted speed limits to 32.19 km/h (20 mi/h) has resulted in lower observed vehicle speeds and fewer vehicles traveling at higher speeds. The reduction in the percentage of vehicles traveling above 48.28 km/h (30 mi/h) (-1.7%) and 56.33 km/h (35 mi/h) (-0.5%) are larger in magnitude than other speed metrics.

Questions

1. Was there a statistically significant change in mean speed, 85th percentile speed, and proportions of vehicles traveling greater than 40.23 km/hr (25 mi/hr), 48.28 km/hr (30 mi/hr), and 56.33 km/hr (35 mi/hr) after the residential speed limit reduction was implemented and the accompanying public awareness and signage campaign?

2. What is the estimated effect of the speed limit change on observed vehicle speeds?

Methods

The Portland City Council approved an ordinance reducing the speed limit on all residential streets to 32.19 km/hr (20 mi/hr) in January 2018. A residential street is a street that is in a residence district according to Oregon Law ORS 801.430 and has a statutory speed limit. Collector and arterial classifications are not included. The 32.19 km/hr (20 mi/hr) speed limit went into effect on April 1, 2018. The city installed new speed limit signs and updated existing signs over the period of February 2018 to May 2019. The final 32.19 km/hr (20 mi/hr) sign installation increased the number of residential speed limit signs from fewer than 1,000 signs to more than 2,000. An educational and awareness campaign "20 Is Plenty" was also conducted, as well as media campaigns. As part of the effort, nearly 7,000 yard signs were distributed to residents.

Data was collected by the Portland Bureau of Transportation at 58 locations on residential streets using pneumatic tubes placed perpendicular to the direction of traffic flow. Before data was collected between 2013 and 2018, while all after data was collected between February 2019 and July 2019. Both before

and after data were collected during weekdays and a few weekends, with the duration varying between 24-97 hours at each location. Recorded speeds of 0 km/hr or greater than 160.93 km/hr (100 mi/hr) were removed from the data prior to analysis for quality control. The excluded data, as a percentage of total observations, was consistent across the two periods (approximately 8%). After cleaning, 131,452 before and 82,768 after observations were available for analysis. All analyses were conducted using the disaggregate, or raw, speed data.

Available controlling factors included time-of-day, day of the week, vehicle classification, and data extracted from Portland's GIS database on physical and operational aspects of the roadway (curb-to-curb pavement width, number of lanes, presence of sidewalks, curb height, presence of parking signs, and pavement condition). A summary of available controlling factors is given in Table 1.

Findings

Descriptive statistics for the pooled data (all sites) and each site were computed to assess changes in common speed measures. Mean speed increased from 34.76 km/hr (21.6 mi/hr) to 34.92 km/hr (21.7 mi/hr) (0.37% increase). This change was statistically significant due to the large sample size but is not a practically significant change. Median speed and 85th percentile speed remained the same. The percentage of vehicles traveling with speeds greater than 40.23 km/hr (25 mi/hr), 48.28 km/hr (30 mi/hr), and 56.33 km/hr (35 mi/hr) all decreased. The percentage of vehicles with speeds greater than:

- 40.23 km/hr (25 mi/hr) decreased by 0.5%

- 48.28 km/hr (30 mi/hr) decreased by 1.7%

- 56.33 km/hr (35 mi/hr) decreased by 0.5%

All differences were statistically significant with 95% confidence.

At the 58 individual sites, changes in speed measures vary by location. As shown in Figure 1, at 33 sites (56.9%) there was a decrease in mean speed, at 43 sites (74.1%) a decrease in median speeds, and at 50 sites (86.2%) a decrease in 85th percentile speed. Decreases were also observed for the percentage of vehicles traveling faster than 40.23 km/hr (25 mi/hr) (74.1%), 48.28 km/hr (30 mi/hr) (69.0%), and 56.33 km/hr (35 mi/hr) (72.4%). Spatial patterns were also investigated, but no apparent spatial patterns among speed changes were present.

Figure 2 shows mean speed changes using a bar plot, sorted by the magnitude of change. Changes in mean speed range from a decrease of 5.63 km/hr (3.5 mi/hr) to an increase of 3.86 km/hr (2.4 mi/hr). The average decrease was 2.25 km/hr (1.4 mi/hr) and the average increase 1.13 km/hr (0.7 mi/hr). Figure 3

Table 1. Summary of Potential Controlling Explanatory Variables

Variable	Frequency	Mean	St. Dev.	Minimum	Maximum
After Speed Reduction Indicator					
1 if after speed reduction, 0 if before	82,768	0.386	0.487	—	—
Speed Bins					
1 if greater than 40.23 km/hr (25 mi/hr), 0 otherwise	51,262	0.239	0.427	—	—
1 if greater than 48.28 km/hr (30 mi/hr), 0 otherwise	12,536	0.059	0.235	—	—
1 if greater than 56.33 km/hr (35 mi/hr), 0 otherwise	1,953	0.009	0.095	—	—
Time-of-Day Indicators					
1 if 6:00 a.m. to 10:00 a.m., 0 otherwise	69,259	0.323	0.468	—	—
1 if 10:00 a.m. to 4:00 p.m., 0 otherwise	47,821	0.223	0.416	—	—
1 if 4:00 p.m. to 8:00 p.m., 0 otherwise	3,752	0.018	0.131	—	—
1 if 8:00 p.m. to 6:00 a.m., 0 otherwise	93,388	0.436	0.496	—	—
Day-of-Week Indicators					
1 if Monday, 0 otherwise	21,219	0.099	0.299	—	—
1 if Tuesday, 0 otherwise	40,592	0.189	0.392	—	—
1 if Wednesday, 0 otherwise	49,528	0.231	0.422	—	—
1 if Thursday, 0 otherwise	57,468	0.268	0.443	—	—
1 if Friday, 0 otherwise	29,524	0.138	0.345	—	—
1 if Weekend, 0 otherwise	15,889	0.074	0.262	—	—
Vehicle Classification Indicators					
1 if motorcycle/bike, 0 otherwise	7,362	0.034	0.182	—	—
1 if passenger vehicle, 0 otherwise	166,130	0.776	0.417	—	—
1 if 2-axle long, 0 otherwise	29,655	0.138	0.345	—	—
1 if bus, 0 otherwise	6,737	0.031	0.175	—	—
Roadway Characteristics					
Surface width (m)	214,220	9.370	1.205	5.486	12.192
Pavement condition index	214,220	58.189	14.794	13	100
Curb height (cm)	214,220	10.391	4.039	0	17.780
Adjacent Signage					
1 if no parking sign, 0 otherwise	44,231	0.206	0.405	—	—
1 if stop sign, 0 otherwise	71,523	0.334	0.472	—	—
Pavement Type					
1 if composite pavement, 0 otherwise	13,867	0.065	0.246	—	—
1 if flexible pavement, 0 otherwise	182,398	0.851	0.356	—	—
1 if OILM[a] pavement, 0 otherwise	9,390	0.044	0.205	—	—
1 if rigid pavement, 0 otherwise	8,565	0.040	0.196	—	—

[a] OILM defined as Oil-Macadam Pavement Streets

shows the change in percentage of vehicles traveling faster than 48.28 km/hr (30 mi/hr). These changes range from a decrease of 29.5% to an increase of 4.4%. The average decrease was 3.8% and the average increase 0.8%.

A series of statistical models were developed to determine the effects of the speed limit reduction while controlling for other available factors. An indicator variable (1 if after reduction, 0 if before) was created to estimate the effects of the reduction.
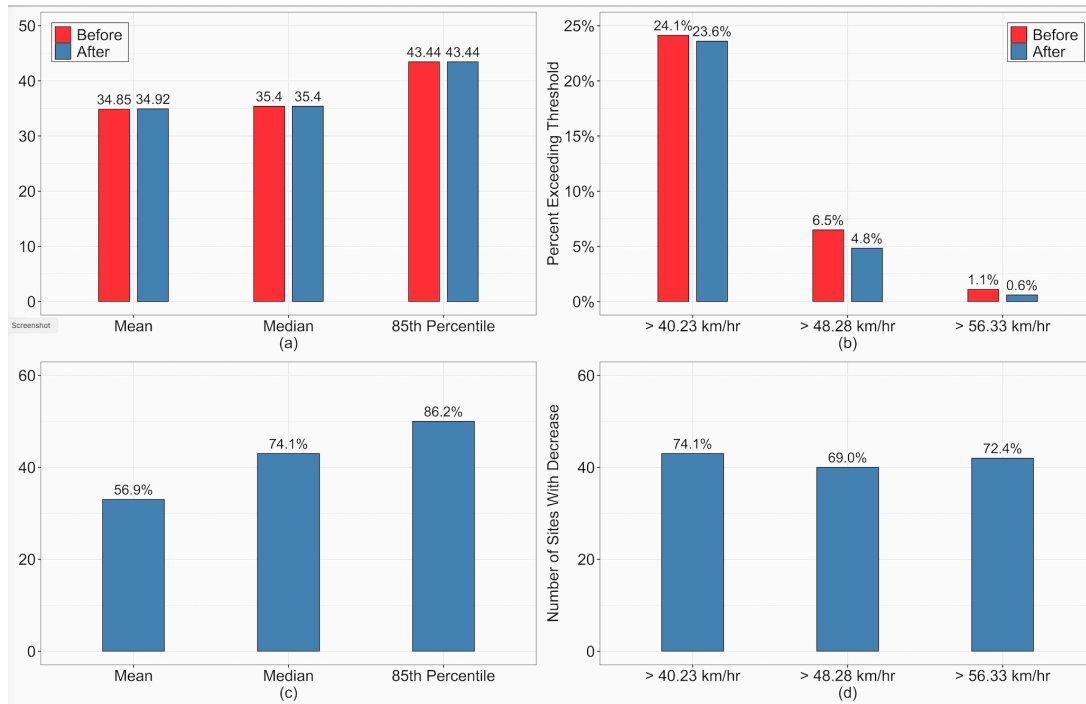
Figure 1. (a) Difference in mean, median, and 85th percentile speed, (b) Difference in speeds of greater than 40.23 km/hr (25 mi/hr), 48.28 km/hr (30 mi/hr), and 56.33 km/hr (35 mi/hr), (c) Number of sites with decrease in mean, median, and 85th percentile speed, and (d) Number of sites with decrease in speeds of greater than 40.23 km/hr (25 mi/hr), 40.28 km/hr (30 mi/hr), and 56.33 km/hr (35 mi/hr)

Final model specifications for the log-linear regression model are shown in Table 2. The estimate for the after-reduction indicator indicates an expected decrease in observed speed of approximately 1.0%, on average. The parameter is significant with well over 99% confidence. This expected decrease is about 3-times greater than the 0.30% observed by Hu and Cicchino (2020) in a similar study.

Model results align with expectations regarding vehicle speeds. Street width is associated with higher speed (Fitzpatrick et al. 2001). Curb height is likely associated with on-street parking and contributes to narrow available travel way (decrease in speed). Pavement quality and ride are likely to be related to vehicle speed, but the literature is sparse. Previous studies have also found that speeds were less on weekends (Bornioli et al. 2018; Giles 2004).

Binary logit model specifications for the three speed thresholds are shown in Table 3. Parameter estimates, in absolute value, increase as the speed thresholds increase. For the after reduction indicator, the change in odds increases in magnitude as the speed threshold increases. The parameter estimate for after the speed limit reduction suggests a 15.9% reduction in odds of observing speeds greater than 40.23 km/hr (25 mi/hr), a 33.6% reduction in odds of observing speeds greater than 48.28 km/hr (30 mi/hr), and a 49.6% reduction in odds of observing speeds greater than 56.33 km/hr (35 mi/hr). These results confirm the inference from the descriptive analysis; specifically, the percentage of vehicles traveling in the higher speed bins decreased after the reduction.
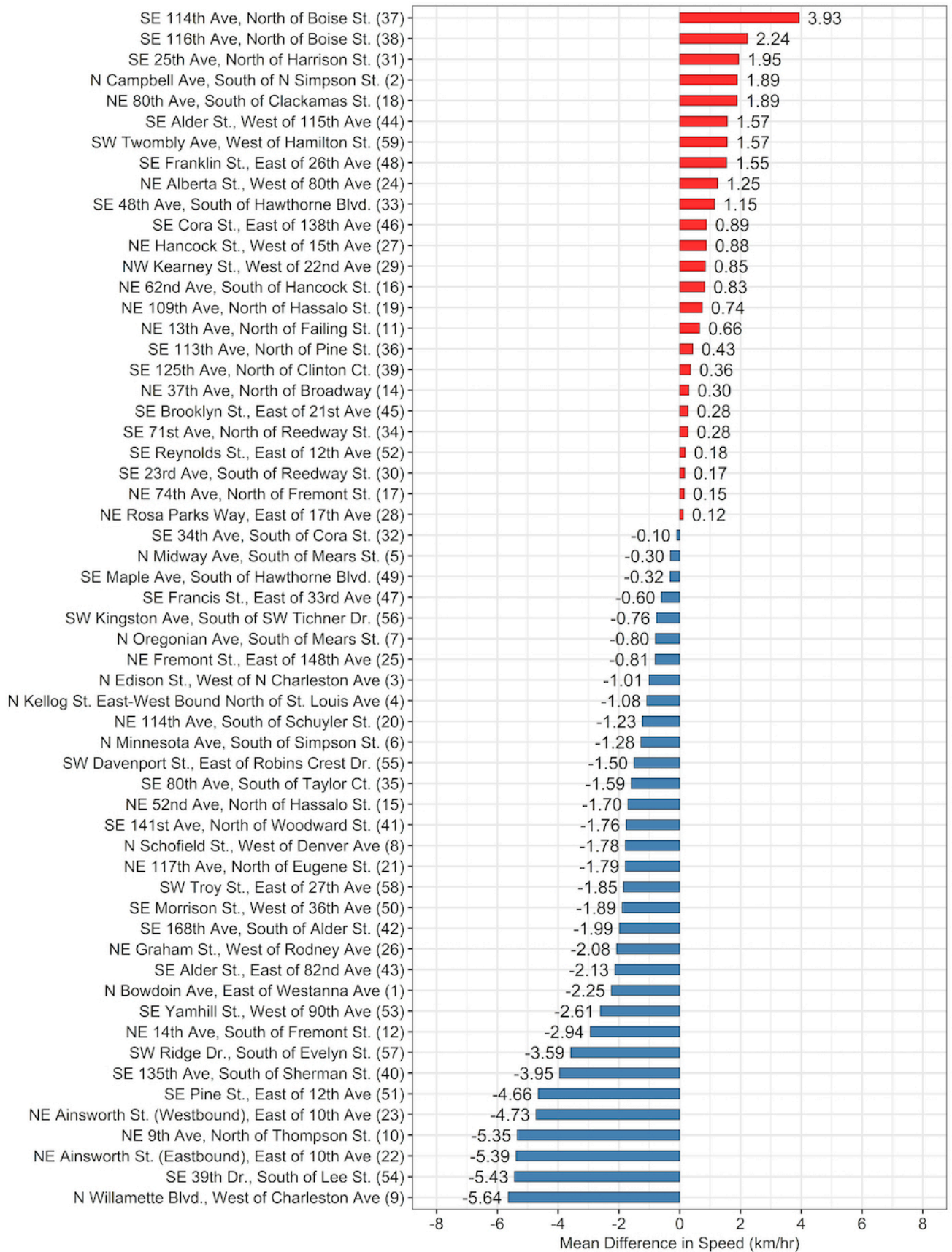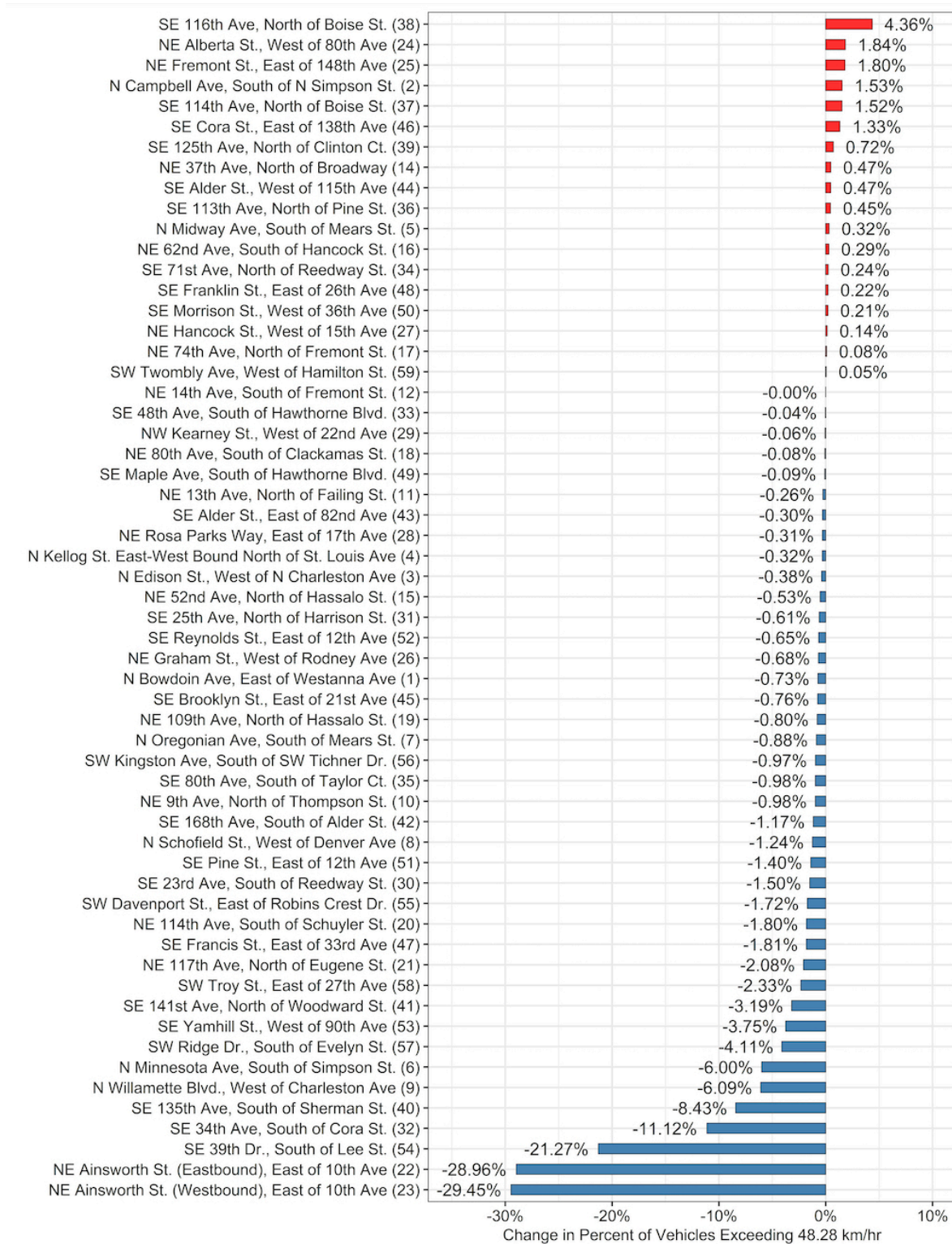
Figure 2. Change in Mean Speeds (km/hr) by Site

Figure 3. Change in Percent of Vehicles With Speed Greater Than 48.28 km/hr (30 mi/hr) by Site

Table 2. Log-Linear Regression Model Specifications for Observed Speed

Variable	Coefficient	Std. Error	p-value
Constant	2.341	0.020	<0.0001
Before/After Period			
1 if after speed reduction, 0 if before	-0.010	0.001	<0.0001
Time-of-Day			
1 if 6:00 a.m. to 10:00 a.m., 0 otherwise	-0.007	0.001	<0.0001
1 if 4:00 p.m. to 8:00 p.m., 0 otherwise	0.028	0.005	<0.0001
Day-of-Week			
1 if Wednesday, 0 otherwise	0.056	0.002	<0.0001
1 if Thursday, 0 otherwise	0.025	0.002	<0.0001
1 if Friday, 0 otherwise	0.016	0.002	<0.0001
1 if Weekend, 0 otherwise	-0.081	0.003	<0.0001
Roadway Characteristics			
Natural logarithm of surface width	0.088	0.005	<0.0001
Natural logarithm of pavement condition index	0.107	0.002	<0.0001
Curb height	-0.011	0.000	<0.0001

Table 3. Binary Logit Model Specifications of Speeds Greater Than 40.23 km/hr, 48.28 km/hr, and 56.33 km/hr

Variable	Greater Than 40.23 km/hr				Greater Than 48.28 km/hr				Greater Than 56.33 km/hr			
	Coefficient	Std. Error	p-value	OR[a]	Coefficient	Std. Error	p-value	OR[a]	Coefficient	Std. Error	p-value	OR[a]
Constant	-5.256	0.167	<0.0001		-9.728	0.329	<0.0001		-12.289	0.829	<0.0001	
Before/After Period												
1 if after speed reduction, 0 before	-0.173	0.011	<0.0001	0.841	-0.409	0.020	<0.0001	0.664	-0.686	0.054	<0.0001	0.504
Time-of-Day												
1 if 6:00 a.m. to 10:00 a.m., 0 otherwise	-0.090	0.011	<0.0001	0.914	-0.204	0.021	<0.0001	0.816	-0.373	0.056	<0.0001	0.688
1 if 4:00 p.m. to 8:00 p.m., 0 otherwise	0.181	0.037	<0.0001	1.199	0.318	0.059	<0.0001	1.374	0.796	0.110	<0.0001	2.217
Day-of-Week												
1 if Wednesday, 0 otherwise	0.543	0.014	<0.0001	1.721	0.810	0.030	<0.0001	2.247	0.784	0.082	<0.0001	2.191
1 if Thursday, 0 otherwise	0.433	0.014	<0.0001	1.542	0.938	0.028	<0.0001	2.555	1.094	0.075	<0.0001	2.985
1 if Friday, 0 otherwise	0.373	0.017	<0.0001	1.452	1.182	0.031	<0.0001	3.261	1.419	0.077	<0.0001	4.132
1 if Weekend, 0 otherwise	-0.757	0.028	<0.0001	0.469	-0.985	0.070	<0.0001	0.374	-1.177	0.197	<0.0001	0.308
Roadway Characteristics												
Natural logarithm of surface width	0.348	0.041	<0.0001	1.417	0.408	0.077	<0.0001	1.504	0.162	0.189	0.390	1.176
Natural logarithm of PCI[b]	0.734	0.018	<0.0001	2.084	1.268	0.040	<0.0001	3.554	1.568	0.108	<0.0001	4.797
Curb height	-0.057	0.003	<0.0001	0.945	-0.015	0.006	0.011	0.985	0.040	0.015	0.009	1.040

[a] estimated odds ratio

[b] pavement condition index

[*] 40.23 km/hr = 25 mi/hr; 48.28 km/hr = 30 mi/hr; 56.33 km/hr = 35 mi/hr

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