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EFFECTS OF HIGHER MAXIMUM SPEED LIMITS TO VEHICLE SPEEDS: A BEFORE - AFTER ANALYSIS ON RURAL DIVIDED HIGHWAYS IN VIETNAM

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Abstract

This study is to assess the effects of raising speed limits to vehicle operating speeds on rural divided highways in Vietnam. Vehicle speeds were recorded at three different sites of three routes during the daytime and nighttime, both before and after speed limits on these sites increasing from 80 km/h to 90 km/h. The results have shown that the percentage of speeds exceeding speed limits had a wide range from 0% to nearly 30% with regard to different locations, survey time and speed limits. The extent of speeding in some cases was very high even after speed limit increased. It was found that in most cases, the changes in mean speeds after a higher speed limit was applied were statistically significant at the p-value of 0.05, however, the magnitudes of the mean change varied considerably between locations and survey times. Because four out of six cases under the study having mean speeds increased by over 10 km/h after setting up a higher speed limit, this study suggests that further appropriate measures of speed control and speed management should be applied along with increasing speed limit to ensure traffic safety on rural divided highways in Vietnam.

Keywords: speed limit; vehicle speeds; road safety; rural divided highway.

1. Introduction

It is obvious that vehicle speed plays an important role in traffic safety in terms of frequency and severity of traffic accidents. As an illustration, a meta-analysis made by Elvik et al (2004) has clearly shown that higher travel speeds are often associated with a higher risk of crashes and an increased severity of injuries [1].

Maximum speed limits are often used as a tool to control vehicles' speed for the sake of traffic safety. Under favorable conditions of traffic roadway conditions, motorists are legally required to maneuver their vehicles at a speed of not higher than the maximum speed limits. Previous research has paid much attention on the relationship between speed limits vehicle speeds and traffic safety. The relationship among higher maximum speed limit, operating speed and the concerns of increasing traffic

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accidents has been a controversy story of not only the researchers but also the transport authorities worldwide. Although, higher maximum speed limits are often led to higher vehicle speeds and subsequently an increase in the number of traffic accidents and fatalities [2–8], however, the higher the speed limits, the higher the benefits from reducing travel time and operating cost, especially for high-speed highways. Recently, many jurisdictions over the world have raised speed limits on highways especially on freeway and interstates [8, 9].

In Vietnam, a new maximum speed limit policy was legally introduced and took effect in March 2016 [10]. This is the second time that the speed limits had been increased since 2006. According to the new policy, maximum speed limits for cars on rural divided highways (i.e., highways with a central median and with at least two lanes for each direction) were increased from 80 km/h to 90 km/h. However, the effects of speed limit change on vehicle speeds have not been evaluated and analyzed so far. The purpose of this research, therefore, is to explore the trends of vehicle speeds on rural divided highways in Vietnam where new speed limits are applied. Since, there has been very little information regarding to the effects of speed limit increase on nighttime vehicle speeds, this study examines not only the daytime vehicle speeds as often done in previous research but also the nighttime vehicle speeds.

2. Method

2.1. Study sites and speed data collection

Speed data were collected both before and after changing the speed limit from 80 km/h to 90 km/h at 3 sites located on 3 different rural divided highways in Vietnam including National Highway No. 1A (NH1A) in Thanh Hoa province (km314 + 500), National Highway No. 21B (NH21B) in Nam Dinh province (km18 + 100), and Vo Nguyen Giap road (VNG road) in Hanoi (km11 + 800). The basic elements of the cross-sections of the three roads are illustrated in Fig 1.

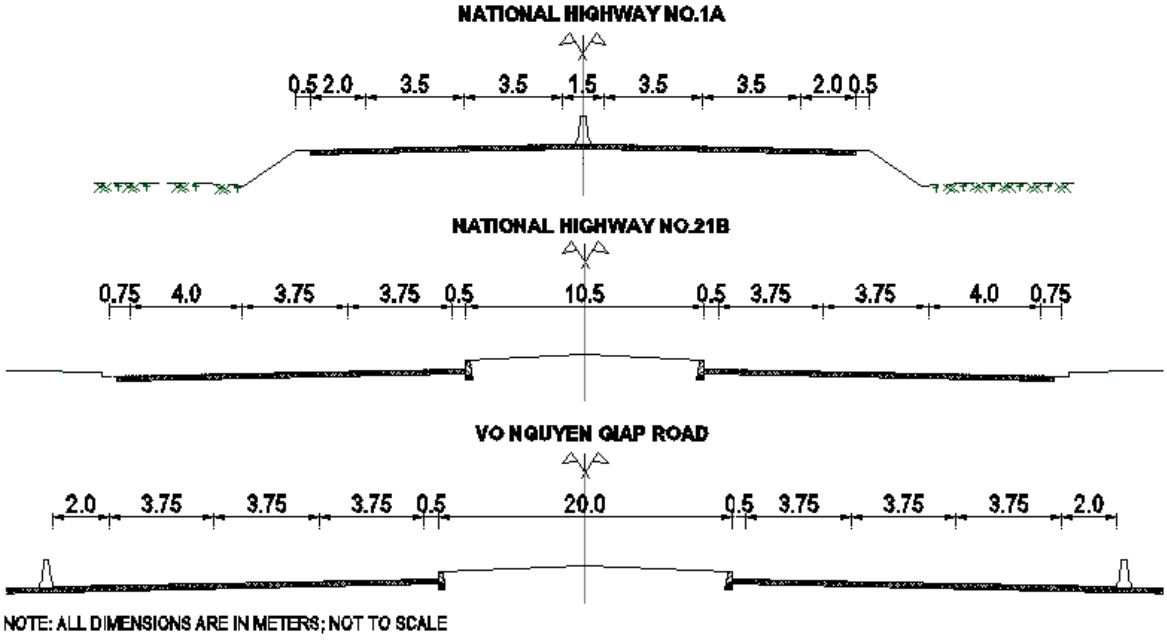

Figure 1. Basic elements of cross-sections of the studied roads

Vehicle speeds were initially measured during the period from October 2015 to December 2015 before the new speed limit of 90 km/h was introduced and took in effects in March 2016 replacing the old speed limit of 80 km/h at all 3 sites. Speed data collection was repeated at the same 3 sites in the period starting from September 2016 to February 2017.

Free-flow vehicle speeds were recorded by using a STALKER ATS radar gun. To ensure obtaining free-flow speeds and reducing the interference caused by other moving objects to recorded speed data, the speed gun was only triggered to the target vehicle when the vehicle was far enough from others on the road judged by the surveyors. Both speed gun and surveyors were carefully hidden by trees, utility poles, or other fixed objects on median or roadside. To minimize the cosine error, the speed gun was located at the nearest traffic lanes and at least 50 m far away from the point where the surveyor released triggering the speed gun.

Speed data were collected during both the daytime (before 19:00) and the nighttime (after 19:00) under good weather conditions. The survey time durations on survey days were kept almost the same for each site. Only one direction was selected to measure vehicles speeds for each site. Only vehicle speeds of passenger cars and light trucks were recorded.

2.2. Analysis

To evaluate changes in vehicle speeds due to speed limit increase, the speed data at each site were separated into 4 groups by study period (i.e., the periods before versus ones after the speed limit increase) and by the survey time (i.e., daytime versus nighttime). Descriptive statistics of the recorded speeds, including the mean speed (Vmean), 85th percentile speed (V85), standard deviation (SD), and percentages of vehicles exceeding the speed limit were calculated for each group of each site. Individual speeds that differ from the group mean by more than three standard deviations were excluded during the descriptive analysis. In addition, a series of t-test were performed to compare the mean speeds between different study periods and survey times. Furthermore, several Levene's test was also used to answer the question whether or not the assumption of equal speed variances between groups is valid.

3. Results

Table 1 summarizes descriptive statistics of vehicle speeds for each group of each site. As shown in Table 1, across all groups, mean speeds (Vmean) range from 63.21 km/h to 76.60 km/h and from 77.59 km/h to 86.58 km/h for the periods before and after raising speed limit, respectively. In addition, 85th percentile speeds (V85) range from 74.80 km/h to 87.42 km/h and from 81.78 km/h to 91.57 km/h for the periods before and after raising speed limit, respectively. There is an inconsistent trend when comparing daytime speed and nighttime speed for each location and each survey period. Daytime mean speeds are higher than nighttime mean speeds at the location "NH1A" in the period before speed limit increase and at the locations "NH1A" and "NH21B" in the period after raising speed, whereas daytime mean speeds are lower than nighttime mean speeds at other cases.

As presented in Table 2, the percentage of speeds exceeding speed limit varies significantly ranging from 0.00% to 29.31%. The extent of speeding is serious as a third of cases has the percentage of speeds exceeding speed limit with a value larger than 25%.

This study performed a number of *t*-test and Levene's tests to explore how different between mean speeds and speed variances between the periods before and after raising speed limit. As presented in Table 3, the mean speeds at the period of before raising speed limit are higher than the mean

Table 1. Summary of descriptive statistics of vehicle speeds

Location	Survey time	N	Min	Max	V85	Vmean	SD
Before raising speed limit							
NH1A	Daytime	54	57.28	104.21	84.01	74.80	11.43
NH1A	Nighttime	47	43.80	82.88	75.61	65.22	9.80
NH21B	Daytime	59	46.84	89.21	74.80	63.21	10.05
NH21B	Nighttime	58	62.04	100.52	84.12	76.60	9.55
VNG road	Daytime	57	49.37	90.93	78.87	71.15	9.10
VNG road	Nighttime	55	50.44	104.06	87.42	74.93	11.57
After raising speed limit							
NH1A	Daytime	82	58.85	101.84	84.50	78.45	7.93
NH1A	Nighttime	41	70.27	89.44	81.78	77.59	4.95
NH21B	Daytime	97	69.86	103.11	91.48	81.82	8.17
NH21B	Nighttime	76	61.19	96.09	88.33	78.66	7.61
VNG road	Daytime	61	73.92	112.10	91.57	86.49	6.92
VNG road	Nighttime	70	78.56	100.07	92.95	86.58	5.80

Note: All speeds are measured by km/h.

Table 2. Percentage of speeds exceeding speed limit

Location	Survey time	Percentage of speeds exceeding speed limit (%)	
		Before raising speed limit	After raising speed limit
NH1A	Daytime	25.93	4.88
NH1A	Nighttime	4.26	0.00
NH21B	Daytime	5.08	11.34
NH21B	Nighttime	29.31	9.21
VNG road	Daytime	10.53	19.67
VNG road	Nighttime	29.09	25.71

speeds at the period of after raising speed limit. The changes in mean speeds range from 2.06 km/h to 18.61 km/h. Except for the case of location "NH21B" with the survey time of nighttime, all the rest of cases, the changes in mean speeds are statistically significant at the p-value of 0.05 (i.e., the probability for difference between mean speeds of two compared groups is 95%).

To assess the equality of speed variances, the present research uses Levene's test. From the results of the Levene's tests shown in Table 3, it is found that four out of six cases have p-value of less than 0.05, therefore, it could be concluded that in the four cases, there are statistical differences between the speed variances at the periods before and after raising speed limit.

4. Discussions and conclusions

The results of this paper clearly show that vehicle speeds varied significantly from location to location. It means that vehicle speeds on rural divided highways in Vietnam not only depend on

Table 3. Results of mean speed comparisons and test of homogeneity of speed variance

Location	Survey time	Vmean before raising speed limit	Vmean after raising speed limit	Change in Vmean	Test of homogeneity of variances		*t*-test	
					Levene Statistic	Sig.	t	Sig.
NH1A	Day time	74.80	78.45	3.65	9.07	0.003	-2.045	0.044
NH1A	Night time	65.22	77.59	12.36	28.98	0.000	7.612	0.000
NH21B	Day time	63.21	81.82	18.61	4.49	0.036	-12.017	0.000
NH21B	Night time	76.60	78.66	2.06	0.78	0.379	-1.393	0.166
VNG road	Day time	71.15	86.49	15.34	2.64	0.107	-10.351	0.000
VNG road	Night time	74.93	86.58	11.64	16.02	0.000	-6.821	0.000

Note: All speeds are measured by km/h.

speed limit as found in this study but also may depend on other road characteristics which need to be explored in further studies. The variation of mean speeds from location to location may be explained by the differences between the elements of cross sections of the three sites under this study as presented in Fig. 1. The speed data in this study show a trend that a higher mean speed is associated with the site with a larger median width compared to sites with a narrower one.

This research investigated vehicle speeds during both daytime and nighttime. In some cases, nighttime mean speeds are lower than daytime mean speeds, but this is not always the case. Therefore, further studies should be conducted to explore the factors influencing the differences between vehicle speeds during the daytime and nighttime.

The present study has found that the magnitude of speeding on the rural dual roadways in Vietnam is different between the locations and the time of day (i.e., daytime versus nighttime), however the trend is inconsistent. Previous studies have often reported that after increasing speed limit, percentage of speed exceeding speed limit often decreases, but it is not always true in this study. The current research has found that, for some cases the proportions of drivers speeding decreased rapidly after raising speed limit, however for other cases percentage of speeds exceeding speed limit after raising speed limit were even higher than before. From this, it could be concluded that raising speed limit is not always the way to reduce the magnitude of speeding on rural divided highways in Vietnam.

Changes in mean speeds and 85th percentile speeds after raising speed limit from 80 km/h to 90 km/h were observed across all cases with values ranging from 0.49 km/h to 16.68 km/h. This finding is consistent with previous studies [11–14] in which no clear prediction in the extent of 85th percentile speed increase can be given.

Mean speeds increased more than 10 km/h after speed limit increase for four out of the six cases under the study however, mean speeds rose quite slightly with an increase of only less than 4 km/h for other two cases. The results prove that raising speed limit from 80 km/h to 90 km/h on rural divided highways could make vehicle speeds significantly higher in some cases. As stated by WHO [15], a 1 km/h increase in mean vehicle speeds on a road network will result in a 4–5% increase in fatal crashes, the increase of vehicle speeds after raising speed limit from 80 km/h to 90 km/h as found in this study therefore should be viewed as a risk for traffic accidents. Because the mean speeds can increase by more than 15 km/h after a higher speed limit is applied as found in this study, speed control, speeding enforcement and other safety measures should be considered to be applied when

raising speed limits on rural dual roadways.

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