

SPEEDING IN CRASHES IN THE UNITED STATES OF AMERICA: A PILOT STUDY USING EVENT DATA RECORDER INFORMATION FROM NASS-CDS

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ABSTRACT

The prevalence of speeding in crashes is only currently reported for fatal crashes in the United States of America (USA) using police reports, and the prevalence reported (27%) is well below that found in a national study that measured travel speeds (65%). The aim of this study was to explore how event data recorder (EDR) data from the National Automotive Sampling System – Crashworthiness Data System (NASS-CDS) database could be used to estimate the prevalence of speeding in crashes in the USA. EDR files collected as part of the NASS-CDS in 2015 were examined to determine the presence and extent of speeding, provided they met certain criteria. AIS coded injury data was also extracted when available to examine speeding by injury severity. 335 EDR files were identified as meeting the criteria. 188 of these had complete AIS coded injury information. From this sample, it was found 61% were speeding, but this reduced to 44% if NASS-CDS weightings were applied. Speeding by more than 10 mph was found in 26% of crashes (16% weighted). Speeding was found to increase with increasing injury severity: 76% of MAIS 3+ crashes involved speeding, and 52% involved speeding by more than 10 mph. EDR data was found to be a useful source of travel speed data that may be used to examine speeding in the USA. It indicates that speeding is a larger problem in crashes than suggested by the current method that uses police reports. Expanding the sample size by using more years of data and calculating the change in impact speed and associated change in injury severity would allow for more robust estimates of the prevalence of speeding and its contribution to road trauma in the USA.

INTRODUCTION

Speed is considered to be a major factor in the frequency and severity of road crashes [1,2]. Speed limits are set with the intention of controlling the maximum speed at which vehicles travel. However, drivers may still travel above the speed limit, termed speeding. A recent large-scale speed survey conducted in the United States of America (USA) by the National Highway Traffic Safety Administration (NHTSA) showed that 64.8% of vehicles were speeding, 40% speeding by more than 5 mph and 18.3% were speeding by more than 10 mph [3].

In the USA the prevalence of speeding in crashes is currently only estimated for fatal crashes. NHTSA defines a crash as speeding related if “any driver in the crash was charged with a speeding-related offense or if a police officer indicated that racing, driving too fast for conditions, or exceeding the posted speed limit was a contributing factor in the crash” [4]. This definition includes what might be termed “inappropriate speed for the conditions” as well as traveling above the speed limit. Even so, the estimate produced by this definition is only 27%, far lower than the percentage of drivers that are speeding or travelling at more than 5 mph above the speed limit in the speed survey [3].

The presence of speeding by a vehicle involved in a crash is often difficult to determine. Determining the travel speed of a vehicle prior to a crash is a specialised discipline known as crash reconstruction which is beyond the scope of most crash reports prepared by police, perhaps with the exception of some fatal crashes. Traditional crash

reconstruction methods rely on pre-impact tyre marks to calculate speed loss prior to impact and often produce an underestimate of travel speed as they cannot determine speed loss prior to the start of the tyre mark. This issue is further exacerbated by the advent of highly effective anti-lock braking systems on vehicles.

The advent of event data recorders (EDRs) provides a new opportunity to accurately ascertain the travel speed of vehicles involved in crashes and provide more accurate estimates of the prevalence of speeding in crashes of all severities. EDRs store a range of data from a vehicle's sensors in the event of a crash. In many cases this includes pre-crash travel speed for 2.5 to 5 seconds prior to the crash, typically recorded at 2 Hz. This data has been shown to be highly accurate for travel speed [5].

This paper details a pilot study that examined how EDR data from the National Automotive Sampling System – Crashworthiness Data System (NASS-CDS) database could be used to estimate the prevalence of speeding in crashes.

METHOD

As part of a separate study, the EDR files collected in NASS-CDS from vehicles crashed in the USA in 2015 were examined to identify EDR files that fulfilled the following criteria;

- From a striking vehicle
- From a vehicle that was not maneuvering (e.g turning)
- Injury severity for at least one vehicle was known
- Crash did not involve a heavy vehicle or motorcycle
- Crash was not a side-swipe or animal only impact
- EDR file had recorded crash data
- EDR file contained pre-impact speed
- Speed limit known

Each EDR file was individually checked to match the crash event data stored in the EDR file to the crash sampled in NASS-CDS by a person trained and experienced in interpreting EDR files. The travel speed was defined as the highest speed that the vehicle was recorded to be traveling in the pre-crash time period recorded on the EDR file. This travel speed was compared against the posted speed limit for that vehicle stated in the NASS-CDS database to determine speeding. Information on injury severity according to the maximum abbreviated injury score (MAIS) was also extracted from the NASS-CDS database, when available (injury information is only available for cars less than ten years old)

NASS-CDS sampling has a stratified, multiphase, unequal selection probability design that deliberately oversamples crashes with a higher injury severity. The NASS-CDS database provides case weights that can be used to account for the unequal selection probability. The weights of the sample crashes varied from 4.6 to 15,112. This high degree of variation in the weights means that, when considering small groups of crashes, some care must be taken to ensure that the result is not simply an artefact of the weighting. For example, the crash with the highest weight accounted for 36% of the total moderate injury weights, and 31% of the total serious injury weights, as opposed to 7% of the total sample. No consensus has been reached on how best to deal with this issue. The method suggested by Samaha, Prasad and Nix [6] of attenuating the weights to the 95% percentile value within an injury severity category was applied the data for this study. Weighted, weighted with attenuation, and unweighted results are shown for comparison.

RESULTS

1077 EDR files were collected from 970 crashes as part of NASS-CDS in 2015 and a total of 335 crashes met the criteria. A detailed breakdown of cases excluded is shown in Table 1.

Table 1.
Cases excluded by criterion

Criterion	Number excluded
Non-striking vehicle	244
Vehicle maneuvering	30
Injury severity unknown	210
Heavy vehicle or motorcycle involved	45
Sideswipe or animal strike	56
EDR file contained no data	20
EDR file did not contain speed data	27
Speed limit unknown	3
Total cases excluded	635

Table 2 shows the percentage of vehicles speeding in the 335 crashes. The percentage reduces when the data is weighted according to the weights provided in the NASS-CDS database. Attenuating the weights to the 95th percentile increase the percentages, but they remain closer to the weighted values than the unweighted.

Table 2.
Prevalence of speeding by level of speeding and weighting from 2015 NASS-CDS data

Speeding level	Unweighted		Weighted		Weighted - Attenuated	
	Number	Percentage	Number	Percentage	Number	Percentage
Total cases	335	-	219,124	-	177,243	-
Speeding	205	61.2	95,516	43.6	92,712	52.3
Speeding >8km/h (5mph)	131	39.1	51,333	23.4	50,159	28.3
Speeding >16km/h (10mph)	85	25.4	34,132	15.6	32,958	18.6

The percentage of vehicles speeding by crash injury severity is shown in Table 3. Only 188 of the 335 crashes had injury information available for all vehicles involved in the crash. When considering the unweighted results, the percentage of crashes involving speeding increases with increasing injury severity across all levels of speeding. However, the weighted results (with weighting attenuated) show a decrease in percentage of vehicles speeding for MAIS 2 crashes. The difference in percentage of crashes involving speeding between crash injury severity levels appears to increase at higher levels of speeding.

Table 3.
Prevalence of speeding by level of speeding and weighting from 2015 NASS-CDS data

Speeding level	MAIS 0,1				MAIS 2				MAIS 3+			
	Unweighted		Att. Weight		Unweighted		Att. Weight		Unweighted		Att. Weight	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	128	-	68,185	-	35	-	8,741	-	25	-	1,697	-
Speeding	77	60.2	40,220	59.0	24	68.6	2,745	31.4	19	76.0	1,068	62.9
Speeding >8km/h	52	40.6	26,145	38.3	17	48.6	2,083	23.8	16	64.0	845	49.8
Speeding >16km/h	33	25.8	17,589	25.8	12	34.3	1,418	16.2	13	52.0	736	43.3

DISCUSSION

The unweighted results for speeding (61%) are similar to the levels of speeding found in the US national speed survey conducted by NHTSA but are well above the current estimate of speeding in fatal crashes (27%). Once the results are weighted the percentage of speeding is less than found in the US national speed survey, but still well above the estimated level of speeding in fatal crashes. The exception to this finding is the results for speeding by 10 mph are closer to the NHTSA speeding survey result when they are weighted.

It would be expected that speeding would be more prevalent in higher injury severity cases as increases in speed are known to increase the risk of serious and fatal crashes more than for less severe crashes [1]. The findings of this study are therefore as expected in that regard. There were too few fatal cases to consider them separately in the analysis, however, fatal crashes alone would be expected to have even higher levels of speeding than MAIS 3+ crashes. The results therefore suggest that the current estimate of speeding in fatal crashes is a gross underestimate. This is despite having a broader definition that includes inappropriate speed in the estimate in addition to speeding. The current NHTSA estimate may only represent cases of speeding much higher than 10 mph as high levels of speeding may be more easily identified by police.

The vehicles in the sample are biased towards newer vehicles, as this was required for both injury information, and travel speed to be present in the EDR file. It is unknown if the age of the vehicle has an influence on speeding, though it may be thought that older vehicles are more likely to be driven by younger drivers [7] who may be more prone to speeding. Young drivers have been found to be more likely to be “speeders” according to a national survey conducted in the USA [8]. If this is the case the results are an underestimate of speeding in the general population.

The sample does not include heavy vehicles or motorcycles. The NHTSA travel speed survey [3] found that heavy vehicles have higher median speeds but lower 85% percentile speeds than passenger vehicles. Motorcycles are not identified separately in the NHTSA travel speed survey. Speeding, as identified by NHTSA for fatal crashes [4], is more common amongst motorcycles than passenger vehicles, but less common amongst heavy vehicles. While motorcycles represent only a small proportion of the vehicle fleet they are over-represented in serious crashes [9]. The limiting of the dataset to crashes involving only passenger vehicles may have resulted in a slight underestimate in terms of the general population, though it is also quite possible that this made no real difference to the result.

A major limitation of this study is the sample size when breaking down the sample for further analysis. This makes using the NASS-CDS weights to correct for the sampling method difficult, as a small number of crashes can become overly influential on the weighted result. Attempts to correct for this by attenuating the results to the 95th percentile value within the injury severity category still yielded the odd result of MAIS2 crashes having a lower percentage of speeding than MAIS0 and MAIS1, and MAIS3+ crashes, as the 6 crashes with the highest weights were all not speeding in a sample of only 35 crashes. Future work could incorporate more years of the NASS-CDS data to increase the sample size and allow it to be analysed in more detail. The soon to be released Crash Investigation Sampling System (CISS), the successor to NASS-CDS, will provide EDR equipment to all field crash technicians [10] and therefore may provide more EDR data per year of data collection for future studies of this kind.

A further limitation is that the selection criteria were designed for a separate study, and this resulted in the exclusion of some cases that may have been relevant to speeding. One of the selection criteria was that the vehicle had to be a striking vehicle, but the struck vehicle in some crashes may also choose to travel faster than the speed limit (e.g. when it is travelling straight through an intersection). A revised set of selection criteria specific to this type of analysis would increase the number of cases included per year of NASS-CDS data.

Traveling above the speed limit is known to increase both the risk of being involved in a crash and the severity of the crash [1,2]. However, it should not be assumed that the elimination of speeding would result in a reduction in crashes that is equivalent to the percentage of vehicles speeding. Doecke and Ponte [11] conducted a preliminary study that estimated the contribution of speeding to road trauma by using EDR data from NASS-CDS to calculate the new impact speed had the vehicle not been speeding. They applied risk curves to this new impact speed to determine the new injury risk and calculate the overall reductions that could be achieved by eliminating speeding. They found that 22% of crashes could be avoided altogether, MAIS 3+ injuries could be reduced by 62% and MAIS

1 and MAIS 2 crashes could be reduced by 27%. These results were based on only 59 crashes from 2013 therefore their results should be viewed as preliminary. Future work in this area should consider applying the method of Doecke and Ponte (2017) to a large sample of NASS-CDS EDR data in order to robustly estimate the contribution of speeding to road trauma in the USA.

A recent National Transportation Safety Board report [12] highlighted that the key solutions to the problem of speeding in the USA are automated speed enforcement (ASE) and the vehicle technology intelligent speed adaptation (ISA), that are not currently implemented on a wide scale. This study, albeit a pilot study, adds further evidence of the large scale of the problem of speeding in the USA and the road safety benefits that could be gained by wide scale implementation of ASE and ISA.

CONCLUSIONS

EDR data is a useful source of travel speed data that may be used to examine speeding in the USA. It indicates that speeding is a larger problem in fatal crashes than suggested by the current method that uses police reports. Expanding the sample size by using more years of data and calculating the change in impact speed and associated change in injury severity would allow for more robust estimates of the prevalence of speeding and its contribution to road trauma in the USA.

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