

Police Accident Report Restraint Usage Accuracy and Injury Severity

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ABSTRACT

Police accident reports (PARs) of motor vehicle collisions typically include information regarding occupant restraint use. It has been suggested that PARs overestimate restraint use. Previous studies comparing PAR restraint usage with that determined during a NASS/CDS in-depth investigation found agreement in approximately 90% of cases. The accuracy of PAR-reported restraint usage for outboard vehicle occupants was compared to that determined by NASS/CDS investigators as a function of injury severity and crash type. Restrained occupants were more likely to be identified correctly in the PAR, and unrestrained occupants were more likely to be accurately identified as injury severity increased. Differences in the accuracy of PAR-reported restraint usage rates for different crash types were small.

INTRODUCTION

Numerous studies have demonstrated the effectiveness of seatbelts in preventing injuries in motor vehicle crashes (MVCs). In order to accurately evaluate seatbelt effectiveness in field accident data studies, it is important to know the accuracy of the data regarding restraint use. Police accident reports (PARs) of motor vehicle collisions typically include information regarding occupant restraint use, including the type of restraint available and whether or not the restraint was used at the time of the crash.

Restraint use can be determined in a number of different ways, including direct observation, verbal information, and by inspection of the restraint system and vehicle structures. Witness marks on restraint systems, such as abrasions on seat belt hardware loading surfaces and transfer of melted plastic to webbing (Moffatt et al., 1984; Gorski et al., 1990; Bready et al., 2000), are used to determine restraint use during a crash. Unique evidence can also be found when a seat belt was in use but the retractor or buckle failed (e.g. Cromack et al., 1990; Toomey et al., 2006). These marks must be distinguished from any marks caused by non-collision events (normal usage, spills, etc.) (examples in Bready et al., 1999). Evidence of occupant contact within the vehicle (damage to trim, blood stains, etc.) and the associated injury pattern may also provide an indication of whether the occupant was restrained. Other information, such as occupant ejection, may also be used to evaluate restraint use or non-use, as the likelihood of complete ejection of restrained occupants is extremely small (e.g., 0.23% reported by Green et al. (1987)). The type and extent of information available depend on factors such as crash severity, impact direction (frontal, rear-end, side impact, rollover), and occupant size. In low-severity impacts, there may be little or no objective evidence of restraint use in a crash.

The PAR often contains no information about how the information about restraint use was obtained. In some cases, the occupants are not in the vehicle when the responding officers arrive and information about restraint use is obtained verbally from the occupants or from other persons responding to the scene (witnesses, first responders). In other cases, restraint use is determined

by a trained and experienced specialist based on direct examination of the vehicle and restraint system and a reconstruction of the event. Such in-depth investigations are more likely to occur when there are serious injuries or fatalities. For example, some police jurisdictions require additional investigation and reporting in crashes involving serious injuries and/or fatalities.

It has been suggested that PARs overestimate restraint use (Guo, 2007; Li, 1999; Brumbelow et al., 2008). Observational studies of restraint use in vehicles in moving traffic or at controlled intersections also report lower usage rates than that reported in PARs. A number of reasons have been cited for this overestimation, including fear of penalties for disobeying mandatory seatbelt use laws. Kim and Lee (1994) found little over reporting of seat belt use in the Hawaii traffic data in their early research, but reported high levels of over reporting in their later research (1999).

Restraint use, as reported in PARs, has been compared to restraint use determined during data collection for the National Automotive Sampling System Crashworthiness Data System (NASS/CDS). This data collection involves an in-depth evaluation of the collision by trained investigators and includes an examination of the vehicle and restraint systems, witness interviews, and reviews of the police report and medical records. Previous studies (Ray et al., 2006; Schiff and Cummings, 2004; Cummings, 2002) comparing PAR restraint usage with that determined during a NASS/CDS investigation have found agreement in about 90% of cases.

Schiff and Cummings (2004) studied unweighted NASS/CDS data from 1993-2000 and found an 87.7% agreement rate between restraint status reported in PARs and that determined during CDS investigations. Restrained occupants were more likely to be identified correctly than unrestrained occupants and restraint use was more likely to be reported accurately as injury severity increased. The authors found a 95.8% overall sensitivity of restraint use between PAR and NASS/CDS investigations. They did not observe large variations in sensitivity among different injury severities. They found that the specificity for unrestrained occupants varied with injury severity and ranged from 53.2% in uninjured occupants to 90.4% in fatally injured occupants.

Cummings (2002) used a matched cohort study to evaluate whether the risk of death varied as a function of restraint use depending on the source of the restraint use (police report or trained NASS/CDS investigators). He used NASS/CDS data from 1988-2000 with two front seat occupants in a crash, at least one of whom was fatally injured. There was 91% agreement between the PAR and NASS/CDS restraint status in these crashes. Restrained occupants were more likely to be identified correctly than unrestrained occupants. He found that the risk ratios of a fatal injury for a belted occupant, compared with an unbelted occupant, were similar for

restraint usage data obtained from NASS investigators and from police reports. He concluded that false claims of restraint use by crash survivors were not likely to be an important source of bias.

This work investigates the accuracy of PAR restraint usage compared to that determined by NASS/CDS investigators as a function of injury severity, ranging from no injury to fatal injury, and accident type (frontal, rear-end, near- and far-side lateral, rollover) for outboard vehicle occupants. The effects of differences in injury severity reported in the PAR compared to those reported in NASS/CDS for each collision type and injury severity level were evaluated.

METHODS

This study used data from the NASS-CDS database from 1988-2006 to compare PAR restraint status and NASS/CDS investigator-reported restraint status. The NASS/CDS is an NHTSA-maintained, nationally representative sample of police reported traffic crashes where at least one vehicle was towed from the scene. It includes approximately 5,000 passenger vehicle crashes in the US per year. Collisions are collected in a cluster sampling process, and each crash is assigned a national inflation factor. Data are obtained from PARs and from a detailed investigation that often includes witness interviews, medical record review, vehicle inspections, and reconstruction of the collision.

NASS/CDS contains occupant information including age, gender, type and severity of each injury, seating location, and restraint use. Data are collected on each vehicle involved in the crash, including vehicle type, and manufacturer. Detailed information including whether or not a rollover occurred, and principal direction of force (PDOF) is collected for in-scope vehicles. In addition to the information collected from the investigation of the crash, the database also contains occupant restraint usage and injury severity as reported in the PAR. The NASS/CDS data allow evaluation of the completeness and accuracy of PARs.

Crashes were classified as frontal, rear-end, near-side lateral, and rollovers (Figure 1). Lateral crashes were further broken down into near-side (occupant on the same side of the vehicle as the impact) and far-side (occupant on the opposite side of the vehicle) crashes. All crashes that could not be classified in one of the above-mentioned categories were classified as "other."

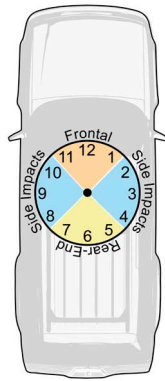


Figure 1. Classification of planar crashes by principal direction of force (PDOF). Rollovers are classified separately.

This study included all occupants aged 16 or over riding in outboard seating positions whose restraint status was known in both the PAR [variable: PARUSE] and the NASS/CDS investigation [variables: ABELTSVAIL, ABELTUSE, AUTFNCT, MANAVAIL, MANUSE]. Occupants who did not have both restraint statuses known were excluded from the study. Additionally, occupants seated in middle seats and those seated in the vehicle but not in designated seating positions (e.g. in a cargo area) were excluded. All occupants seated in an outboard seating position that was listed as being occupied by more than one person were also excluded.

Injury severity was classified using the Abbreviated Injury Scale (AIS). The AIS is a standardized system for classifying the severity and type of injuries an occupant may experience in an automobile accident. It is an anatomically based, consensus-derived, global severity scoring system that classifies each injury by body region according to its relative importance on a 6-point ordinal scale. AIS scores range from 0 (no injury) to 6 ("maximal, currently untreatable"). The maximum AIS score (MAIS) was used as a measure of injury severity. Non-fatal injuries were classified as no injury (AIS 0), minor injury (AIS 1), moderate injury (AIS 2), or serious or greater injury (AIS 3+). Fatalities were considered separately, because fatal crashes are sometimes investigated in more detail by police investigators than non-fatal crashes. To facilitate comparison with the data reported in Schiff and Cummings (2004), injury severity was also reported using the Injury Severity Score (ISS). The ISS is calculated by summing the squares of the maximum AIS scores in each of the three most severely injured body regions.

An occupant's restraint status was misclassified whenever there was a disagreement between the PAR and NASS/CDS restraint statuses. Misclassifications were further classified as restrained or unrestrained. An occupant was misclassified as restrained (false positive) if the PAR reported the occupant as restrained and the NASS/CDS investigation found the occupant to be unrestrained. An unrestrained misclassification (false

negative) occurred when the PAR stated that the occupant was unrestrained and the NASS/CDS investigation found the occupant to be restrained.

RESULTS

Field accident data were obtained from the NASS database from 1988-2006 and included 174,000 adult outboard occupants, with a weighted estimate of over 74 million occupants (Table 1). Crashes were classified as frontal, rear-end, near-side lateral, far-side lateral, and rollovers (Table 1, Figure 1).

	Number of Occupants		Restraint Status Known	
	Raw (x 1000)	Weighted (millions)	Raw (x 1000)	Weighted (millions)
Frontal	89.5	39.0	71.9	32.0
Rear-end	9.4	5.0	8.2	4.5
Near-side	14.5	5.8	12.6	5.3
Far-side	13.4	5.2	11.6	4.7
Rollover	18.8	5.7	15.9	4.9
Other	28.3	14.0	14.9	7.8
Total	173.8	74.7	135.0	59.1

Table 1. Number of occupants available for analysis and number of occupants with known PAR and NASS/CDS restraint status (NASS/CDS 1988-2006).

Occupants involved in crashes that could not be classified into the above-listed categories and were classified as "other." Overall, 79% of the occupants had known restraint status in both the PAR and from the NASS/CDS investigation. The fraction of occupants with known restraint status when the crash type was known ranged from 82% in frontal crashes to 91% for near-side crashes. 55% of occupants in the "other" category had known restraint status. In crashes with multiple occupants, those occupants with known PAR and NASS/CDS restraint status were included.

For the crashes studied, the PARs reported 84.9% of occupants as restrained, and NASS/CDS investigations reported 79.9% of occupants as restrained. The PARs over reported restraint status for all types of crashes (Figure 2). The fraction of occupants reported to be restrained in frontal and lateral collisions was very similar to the restraint fractions in all crashes. The fraction of restrained occupants in rear-end collisions was greater than the restraint fraction for all crashes for both the PARs and the NASS/CDS investigations. Restraint rates of occupants involved in rollovers were lower than the overall restraint rates. Crashes classified as "other" had PAR-reported restraint rates similar to the rates for all crashes. The NASS/CDS-reported restraint usage rate for this crash type was slightly higher than the average for all crash types.

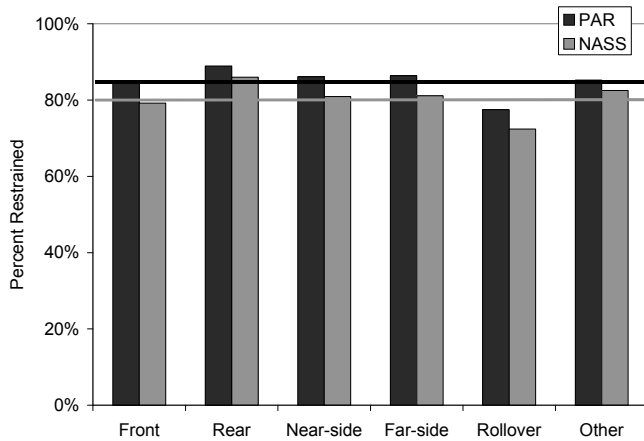


Figure 2. Percentage of occupants classified as restrained in PAR and by NASS/CDS investigation, by crash type. The horizontal lines represent the fraction of restrained occupants in all crashes.

74% of the occupants were riding in passenger cars. Overall restraint use was very similar between passenger cars and light trucks (Table 2). The differences in restraint rates were less than one percent for both the PARs and NASS/CDS investigations.

	PAR Restrained	NASS Restrained
Passenger Cars	85.0%	80.1%
Light Trucks	84.8%	79.4%
Total	84.9%	79.9%

Table 2. Restraint usage rates, by vehicle type.

The fraction of restrained occupants, by both PAR and NASS/CDS reporting, increased from approximately 71% and 65% respectively to 94% and 88% over the time period studied (Figure 3). The PARs over-reported restraint use throughout the time period by an average of five percentage points (range 3.2% - 7.6%).

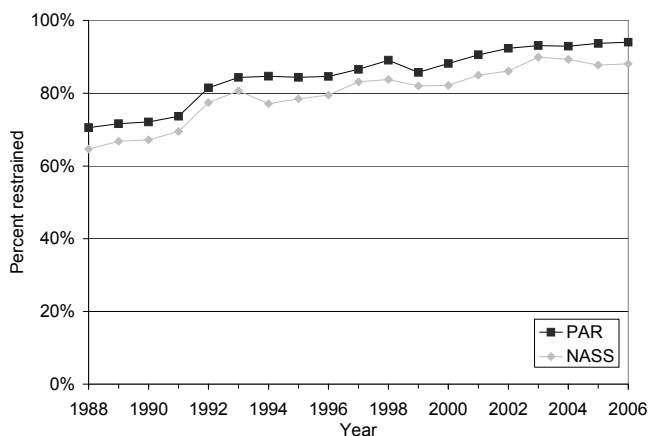


Figure 3. Percentage of restrained occupants in all crashes from 1988 to 2006, by year of crash .

Restraint use decreased with increasing injury severity (Figure 4). Similar results were found using ISS instead of AIS scores (Figure 5). Approximately 4% of the occupants were not included in this portion of the analysis because injury severity data were not available.

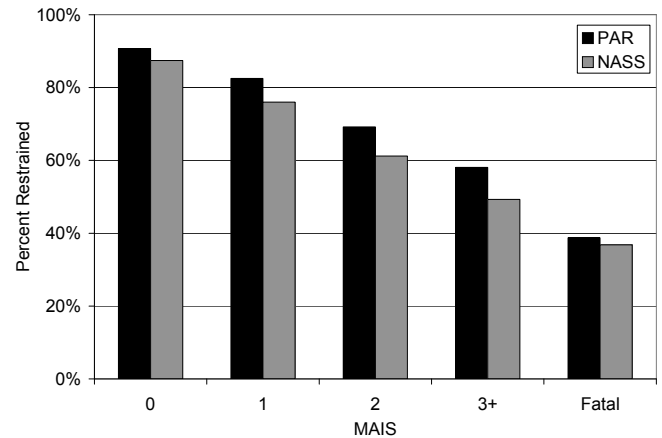


Figure 4. Percentage of restrained occupants in all crashes, by MAIS injury severity.

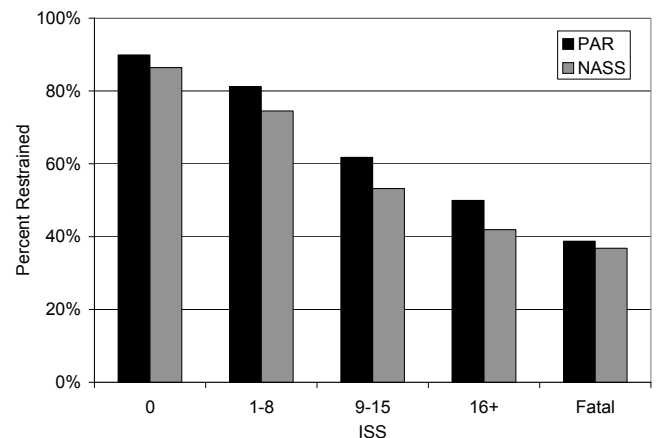


Figure 5. Percentage of restrained occupants in all crashes, by ISS injury severity.

For a given injury severity, the fraction of restrained occupants varied by crash type. For uninjured occupants (AIS 0), restraint rates were similar for all crash types (90.0% - 91.6% PAR, 86.7% - 89.1% NASS/CDS). More variability between crash types was observed in crashes involving injured occupants (Figures 6-9). The fraction of restrained occupants in frontal crashes was similar to the average values for all crashes at each severity level but tended to be slightly less than average in higher severity crashes. The fraction of restrained rear-end and near-side occupants were higher than the average restraint rates for all occupants with non-fatal injuries. The fraction of restrained occupants in rollovers was less than the average at all severity levels other than no injury.