How the Timing of Motorcycle Accident Investigation Affects Sampling and Data Outcome

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Abstract

Motorcycle accidents that are part of on-scene, in-depth research investigations can be investigated either immediately after they occur, during the police on-scene investigation (while people and evidence are still easily available at the accident scene) or, alternatively, by follow-up, after the crash scene has cleared. However, these two methods appear not to generate identical data. This paper reviews some details of accident investigation methods and compares results of the Hurt study in Los Angeles, the Thailand study and the MAIDS study in Europe.

One-third of the Hurt study cases were investigated by follow-up. These follow-up investigations were biased toward having a disproportionate share of serious injury and fatal cases simply because it is easier to locate vehicles and people in severe crashes than in minor crashes. It is also far more difficult to collect complete information in follow-up investigations that begin after the crash scene has cleared because it may become difficult or impossible to obtain relevant evidence or cooperation of involved parties. At a minimum, research investigators need to examine the motorcycle, collect some information about the rider and helmet use and collect injury information. Follow-up investigations sometimes have little more than this minimum. Immediate on-scene investigations are likely to produce data that is more complete and a more valid representation of the larger motorcycle accident population because on-scene investigations eliminate some sources of bias that are the inevitable result of follow-up investigations.

None of the Thailand investigations were the follow-up variety. No information is available about the distribution of distribution of on-scene and follow-up investigations in the MAIDS study in Europe.

Keywords: Investigation, methodology, on-scene, follow-up, Hurt, Thailand, MAIDS

1. Introduction

It is well understood by those who do scientific research that research findings depend partly on how the data is collected. To put it another way, what a researcher discovers depends partly on what "the world out there" is really like and partly on the methods used to study it. This is certainly true in motorcycle accident investigation. So far, three separate studies have taken an in-depth look at motorcycle accidents in an effort to understand how any why they occur: 1) the so-called Hurt study of 900 crashes in Los Angeles in 1976-77 [Hurt et al., 1981], 2) the Thailand study of 1082 crashes in Bangkok and "upcountry" in 1999-2000 [Kasantikul, 2002a, 2002b] and 3) the MAIDS study of 921 crashes in France, Italy, Germany, Spain and the Netherlands in 1999-2000 [OECD, 2004].

The "gold standard" in motorcycle accident research has been to send a multi-disciplinary team of investigators with specialized training in motorcycle accidents to inspect the accident scene, motorcycle and other vehicle(s) and to interview the involved parties and eyewitnesses immediately after a crash. After this initial on-scene investigation, the team then compiles and integrates the physical evidence from vehicle and scene inspections with interviews and injury information to reconstruct the events that occurred just before, during and after the crash. This reconstruction is then used to identify the causes of the accident and the injuries and the performance of a helmet (if one was worn.) This methodology was first applied in the Hurt study in Los Angeles. Hurt later formalized it in the Common Methodology adopted by OECD and used in both the Thailand and MAIDS research (OECD 1999).

Inevitably, logistical problems in data collection present challenges to collecting data. Ideally, investigators should arrive at the accident scene within minutes (certainly less than one hour) after the crash because the physical evidence from motorcycle crashes – tire skids, scrape marks, broken parts, clothing scuffs and blood – can disappear quickly once police "clear" the accident scene and traffic begins to flow again on the road. An even more important reason for quick arrival is that people leave the scene – motorcyclists, car drivers and eyewitnesses – and they may take their accident-involved vehicle with them. Once people leave the accident scene, locating them and their vehicle becomes far more complicated and time-consuming and they are likely to be far less cooperative. The result is that it is harder to get enough information to begin a follow-up investigation and even harder to complete it. Completed follow-up cases are more likely to have gaps in the information.

Generally speaking, at least two to three team members respond to any accident scene. In order to respond to crashes 24 hours per day, seven days per week, at least four to five investigation teams are needed. It is wonderful if sufficient funds are available to hire and train that many investigators, but the fact is that such generous funding is rare. Thus, researchers are likely to find themselves trying to investigate enough crashes without 24/7 coverage. This sort of around-the-clock investigation capability did occur in Thailand, but not in Los Angeles, where team members investigated crashes during daylight hours seven days per week but only rarely at night. Both the Thailand and

MAIDS studies followed the Common Methodology [OECD, 1999], which allows cases to be investigated up to 24 hours after the collision occurrence.

Similarly, the research contract for the Hurt study allowed up to one-third of the crashes to be investigated by follow-up, as long the investigators physically began inspection of the accident scene or vehicles within 24 hours after the crash. Investigations that were conducted immediately after the crash during the police investigation were referred to informally as “hot” cases; those that were investigated later – usually several hours after the scene had been cleared – were referred to as “warm” cases. For simplicity, the same terminology will be used here.

During the data collection phase of the Hurt study, accident notifications received overnight prompted immediate follow-up telephone calls to find more information about the crash. This included calls to the accident investigation unit of the local police division to obtain basic information about location, persons involved and the identity and disposition of crash-involved vehicles. Calls were also made to the local wrecking yard to see if the motorcycle and/or other vehicle involved had been brought in and were still present. The local hospital to which the rider had been taken was contacted to find out whether the rider had been admitted, transferred or released. If enough evidence could be located to justify an investigation, team members went into action, often traveling to the police station to get a preliminary report, then to the accident scene to photograph and diagram accident evidence and to the tow yard to inspect the motorcycle and any other vehicles. Car drivers were contacted and efforts made to interview them and to examine and photograph their vehicle.

It sounds quite harmless to say “if enough evidence could be located to justify an investigation . . . ” but that “if” turns out to be an important qualification because it acts as a filter that tends to eliminate many low severity crashes – the sort of crash in which a rider with nothing more than bruises and scrapes may simply ride his motorcycle home or call friends to transport him home. These are crashes the police may not investigate at all, or the rider may refuse to cooperate when contacted later or simply disappear into the metropolis (by, for example, giving the police a false phone number.) In contrast, when riders were seriously hurt, the motorcycle was usually towed to a wrecking yard where it available for inspection and the rider was often still at the hospital. Locating an accident-involved car and driver after they left the scene was always difficult, but much easier if the car was also at the wrecking yard.

The Thailand study presented different logistical problems than the Hurt study, because police investigations were perfunctory and their priority was on returning the roadway to normal traffic flow. Follow-up contact with motorcyclists in Thailand was nearly impossible because so few riders had a telephone. As a result, investigations in Thailand had to be done immediately after a crash or not at all. Nearly all the “warm” investigations in Thailand (5% of 723 Bangkok cases and 13% of upcountry cases) took place within an hour of the crash and most were minor crashes in which the vehicles were still operable and parties had little or no injury. In these cases, police had usually instructed the rider and driver to go the local police station in order to complete a police

report and allow normal traffic flow to resume. To be honest, cases that were classified as "warm" investigations in Thailand would have been coded "hot" in Los Angeles, where "warm" usually meant an investigation that began 3-24 hours after the crash.

2. Methodology

Much of the accident investigation methodology has already been discussed in the studies cited above and in other publications (e.g., Smith et al, 2001). Statistical comparisons presented here are mostly chi-square analyses. A two-tailed probability less than .05 is assumed to be statistically significant.

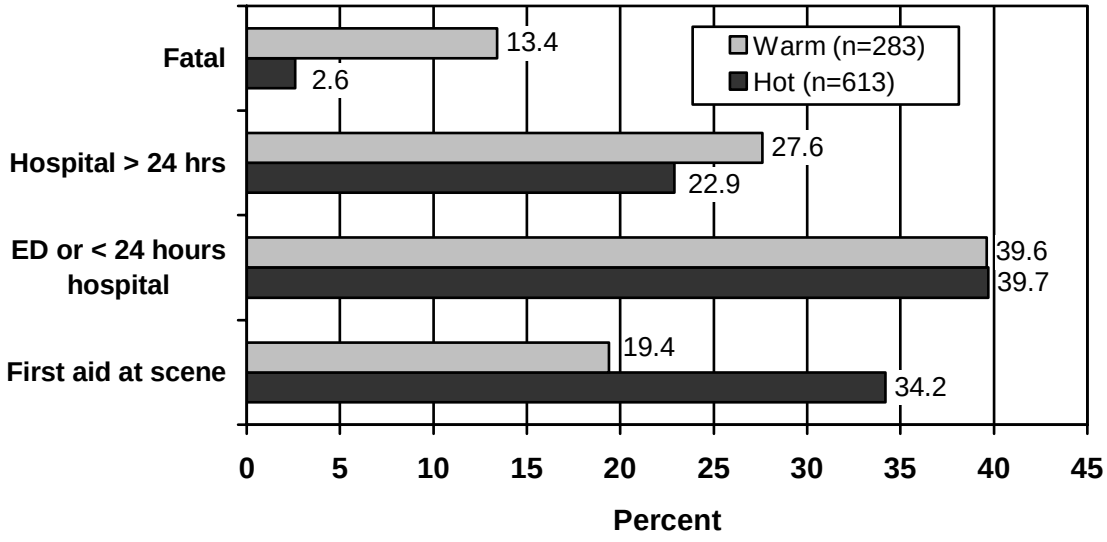
3. Results

3.1 Los Angeles and Thailand

In the Hurt study in Los Angeles study, 617 of the 900 crashes (69%) were "hot" investigations; the remaining 283 were classified as "warm."

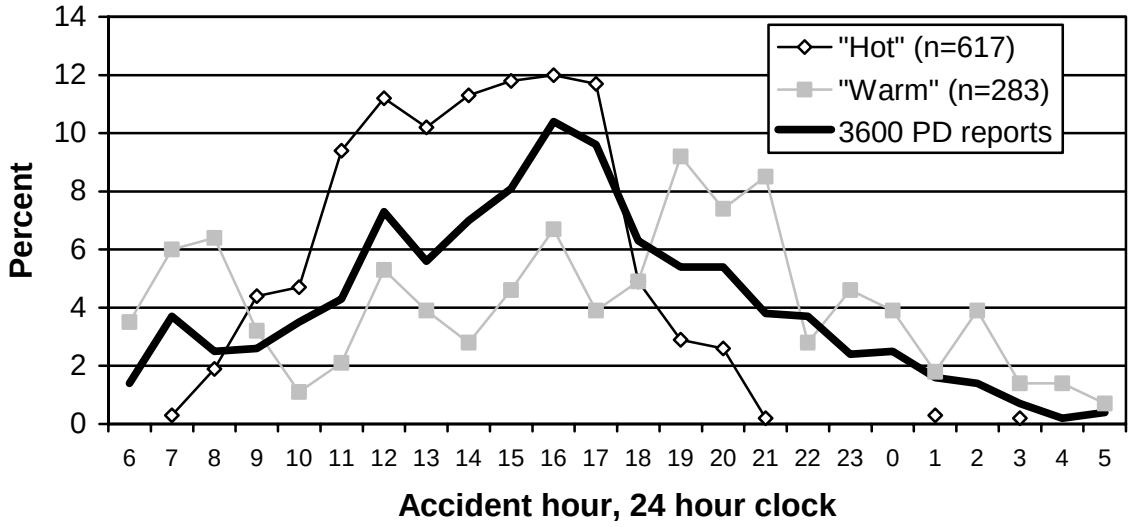
First, riders in "warm" accidents were significantly more likely to be hospitalized or killed and less likely to need only on-scene first aid than riders in "hot" accidents ($\chi^2 = 53.89$, $p < .001$, $df = 3$). The distribution of injury status is shown in Figure 1.

Figure 1. Rider medical treatment in hot and warm crashes in the USC study



In Los Angeles, the time of day for “hot” and “warm” investigations both differed from the larger accident population. Hurt study researchers collected police reports of all motorcycle accidents during the first 18 months of the study period, a total of 3600 reports. Figure 2 compares the accident hour of the 3600 police reports to the time of the “hot” and “warm” investigations. Generally, motorcycle crashes – as represented by the 3600 police-reported crashes – increased as the day progressed, coming to a peak between 4 – 6 p.m., during the afternoon rush hour, with smaller peaks during the morning rush hour and lunch hour. By comparison, the “hot” investigations were daytime events that over-sampled (relative to police reported crashes) the hours from 9 a.m. to 5 p.m. and under-sampled other hours. “Warm” investigations were distributed more evenly around the clock, but under-sampled (relative to police-reported crashes) between 10 a.m. and 6 p.m. and over-sampled at night. This difference in sampling is important because alcohol-involved crashes (which tend to be very different than non-alcohol crashes) occur mostly from late afternoon until about 2 a.m. and thus were more likely to be investigated “warm.”

Figure 2. Accident hour of hot and warm crashes in the USC study, compared to all police-reported crashes



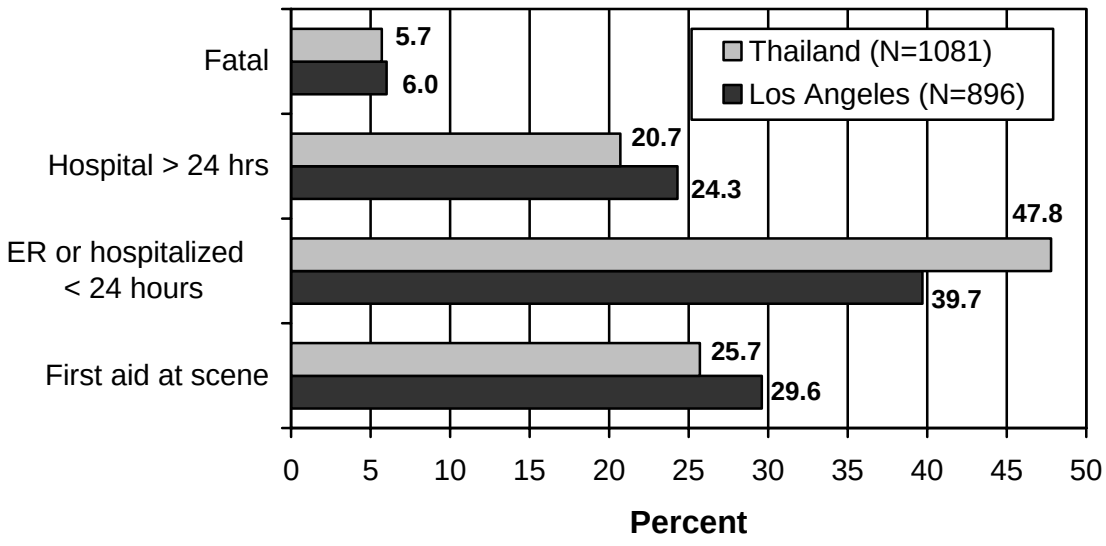
In fact, because alcohol use is so frequent at night when fewer “hot” investigations occurred, alcohol use was significantly more common in crashes investigated “warm” than in those investigated “hot.” Some of the factors regularly associated with alcohol – such as more crashes caused by rider error, more single vehicle crashes and more fatalities – were found in warm crashes. However, other factors usually associated with alcohol crashes – loss of control (usually by running off the road) and less helmet use– were **not** found in the “warm” investigations. In spite of nearly equal levels of helmet use in hot and warm cases, the warm cases had significantly more fatal crashes, brain injuries and severe (AIS $\geq$ 3) brain injuries. This is shown in Table 1.

Table 1. Typical alcohol-related factors in "hot" and "warm" investigations in Los Angeles

Factor	Hot cases		Warm cases		χ^2	p (df = 1)
	n / N	%	n / N	%		
Alcohol use	55 / 607	9.1	48 / 269	17.8	13.86	< .001
Single vehicle crash	108 / 617	17.5	73 / 283	25.8	8.30	< .004
Ran off road	52 / 615	8.5	25 / 281	8.9	0.02	
Loss of control	242 / 615	39.3	119 / 283	42.0	0.59	
Rider error caused crash	237 / 615	38.5	130 / 283	45.9	4.39	< .05
Helmet use	241 / 613	39.3	114 / 279	40.9	.191	< .662
Fatal	16 / 617	2.6	38 / 283	13.4	40.38	< .001
Brain injury, any severity	64 / 617	10.4	70 / 283	24.7	31.58	< .001
Brain injury, AIS $\geq$ 3	26 / 617	4.2	43 / 283	15.2	33.05	< .001

Overall fatality rates in Los Angeles and Thailand were nearly identical and rates of hospitalization for longer than 24 hours were very similar. In less severe crashes, Thailand riders were more likely to go to the hospital emergency department or to be admitted briefly (48% vs. 40%) than those in Los Angeles.

Figure 3. Comparison of medical treatment status in Los Angeles and Thailand



3.2 The MAIDS study in Europe

The recent Final Report of the Motorcycle Accident In-Depth Study (MAIDS) in Europe does not say how many cases were investigated immediately on-scene and how many by later follow-up. European researchers reported fewer minor injury collisions and a larger proportion of serious injury and fatal cases than the Thailand and Los Angeles studies.

The MAIDS study hospitalization data is difficult to compare directly comparison to the Los Angeles and Thailand studies. That is, the Los Angeles and Thailand studies both separated into three discrete groups those riders who were 1) treated in the emergency department and released, 2) hospitalized for less than one day and 3) hospitalized longer than one day. The MAIDS report grouped many of these riders together: riders treated briefly in the emergency department and released the day of the crash were combined with riders hospitalized for as long as eight days. Table 2 compares rider medical treatment in the Los Angeles, Thailand and European studies.

Table 2. Rider medical treatment in Los Angeles (L.A.), Thailand and MAIDS studies.

Study	Rider medical treatment					
	First aid on scene	ER only or Hospital <24 hours	Hospitalized ≥ 24 hours	Hospitalized ≤ 8 days	Hospitalized > 8 days	Fatal
L.A. on-scene (n=613)	34.2%	39.7%	22.9%	Not reported	Not reported	2.6%
L.A. follow-up (n=283)	19.4%	39.6%	28.3%	Not reported	Not reported	13.4%
Thailand (n=1081)	25.7%	47.8%	20.3%*	11.0%	9.3%	5.8%
MAIDS (n=914)	2.7%	Not reported	Not reported	56.8%	13.1%	10.9%

* Includes all riders hospitalized ≥ 24 hours, whether 2-8 days or >8 days

The Final Report of the MAIDS study notes that the team in Hannover, Germany focused its efforts on severe injury and fatal crashes, so it would be expected that the German data would have a higher fatality rate. The fatality rates by region from the MAIDS study are reported in Table 3.

Table 3. Fatality rates by region in the MAIDS study

Country	Germany	France	Netherlands	Spain	Italy	Total
Fatalities	49	16	15	12	11	103
Cases	250	150	200	121	200	921
Fatality rate	19.6%	10.7%	7.5%	9.9%	5.5%	11.2%

4. Discussion

An accurate picture of the overall motorcycle accident population depends on sampling crashes in a way that minimizes biases. The difference between "hot" and "warm" investigations in Los Angeles suggests that follow-up investigations tend to increase the proportion of fatal and serious injury crashes. This is due at least in part to simple logistics: in warm investigations, it is more difficult to locate and obtain data about the motorcycle and rider if everybody left the scene with their vehicles and easier if the rider has been taken to the hospital and his motorcycle has been impounded by the police. "Warm" investigations are easiest to complete in fatal cases, where evidence, including helmets and other vehicles involved in the crash, are especially likely to be impounded by the police.

Therefore, if the desire is to collect data that reflects the overall motorcycle accident population, researchers can reduce or eliminate at least one source of bias by collecting as many crashes as possible immediately after the collision, during the police on-scene investigation. At the very least, "hot" investigations should be distinguished from "warm" investigations so that the data can be analyzed for differences between the two methods.

On the other hand, if specific sub-populations are the focus of research, sampling can be altered to better target those populations. For example, a number of researchers have reported that alcohol-involved motorcycle crashes are more common during evening and late night hours (Ouellet et al., 1987; Peek-Asa & Kraus, 1996; Haworth et al., 1997; Kim et al., 2000; Kim & Boski, 2001). Thus, a strategy to maximize the percentage of alcohol-involved crashes would be to increase the amount of sampling done in early evening and late night hours. Sampling fatal crashes is easily done by getting all notifications through the coroner's office (e.g., Hurt et al., 1986.)

In Los Angeles and Thailand, about 70-75% of riders were in relatively minor crashes in which the rider went home after on-scene first aid or a brief visit to the hospital emergency department. It is fair to ask whether such a large proportion of relatively minor crashes is really needed in a motorcycle accident study, or whether more emphasis should be given to the serious injury and fatal crashes. If a larger sample of serious injury crashes is desired, more follow-up investigations or more night crashes may be warranted.

It is unclear at this point how the MAIDS data compare to the data from Thailand and Los Angeles. Differences in the distribution of rider injury status could reflect genuine differences between the various study areas or they could reflect differences in sampling methods or both. It is worth keeping in mind that considerable variation can occur from one study area to another. For example, 36% of riders in Thailand had been drinking before they crashed (Kasantikul et al., 2005), compared to 12% in Los Angeles and 4% reported in the MAIDS study in Europe. Similarly, serious leg injuries occurred in Thailand about 60% as often as in Los Angeles, for reasons that were only partially explained (Ouellet & Kasantikul, 2004).

5. Conclusion

Follow-up ("warm") investigations present researchers with two problems. The first is that they are much more difficult and far more time-consuming to complete because of the difficulties in locating people and vehicles. They are likely to have more missing data (such as car driver interviews or inspection of the driver's car.) These difficulties help create to the second problem: that "warm" investigations may generate somewhat different data than "hot" investigations. Limitations on research funding may make around-the-clock coverage 24 hours a day, 7 days a week unfeasible and "warm" investigations inevitable. In that case, researchers should at least distinguish "hot" from "warm" investigations as one more variable that needs to be taken into account in analyzing crash data.

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