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ORIGINAL ARTICLE

Factors affecting the likelihood of reporting road crashes resulting in medical treatment to the police

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Objective: This paper aims to determine the percentage of road crashes resulting in injuries requiring hospital care that are reported to the police and to identify factors associated with reporting such crashes to the police.

Design: The data of one of two hospitals in the Road Casualty Information System were matched with the police's Traffic Accident Database System. Factors affecting the police-reporting rate were examined at two levels: the different reporting rates among subgroups examined and tested with χ^2 tests; and multiple explanatory factors were scrutinised with a logistic regression model to arrive at the odds ratios to reflect the probability of police-reporting among subgroups.

Results: The police-reporting rate was estimated to be 57.5–59.9%. In particular, under-reporting among children (reporting rate = 33.6%) and cyclists (reporting rate = 33.0%) was notable.

Discussion: Accurate and reliable road crash data are essential for unveiling the full-scale and nature of the road safety problem. The police crash database needs to be supplemented by other data. In particular, any estimation about the social costs of road crashes must recognise the under-reporting problem. The large number of injuries not reflected in the police crash database represents a major public health issue that should be carefully examined.

Worldwide, police crash data represent the main source of crash data for road safety research. The comprehensiveness, accuracy, reliability and compatibility of these data are of great interest to road safety researchers and public health authorities. Although the guidelines for reporting crashes to the police vary substantially in different parts of the world,^{1–5} not all reportable road crashes are reported. Under-reporting can have significant implications on the correct estimation of the medical and other social costs of road crashes, the identification of vulnerable road user groups, the prioritisation of public health issues and the formulation and evaluation of road safety strategies.^{6–7}

Early studies using hospital statistics to estimate under-reporting in police crash database and eventual crash outcomes can be traced to the late 1960s.^{8–11} Notably, police-reporting rates differed significantly by road user group, gender, age, journey purpose, source of referral and employment status. Moreover, patient statistics from hospitals gave valuable additional information about the epidemiology of road injury. The usefulness of hospital statistics in supplementing police crash data continued to receive substantial attention throughout the 1990s^{2, 3, 12–15} and 2000s.^{1, 4, 5, 16–18} However, none of these recent reports came from Asia or highly urbanised cities. In other words, little is known about reporting of road crashes in Asian cities, where the socioeconomic circumstances are different from the European or American cities. There is a traditional Chinese saying: "do not enter the police station when you are alive, do not enter hell when you die". Although this traditional mentality might have lowered the police-reporting rates in Chinese societies, the highly urbanised environment could have made police reporting easier. The results of this study can, therefore, shed additional light on the issue of reporting in China and other such countries.

In Hong Kong, the police crash database (consisting of the crash-based, vehicle-based and casualty-based data), collectively known as the Traffic Accident Database System (TRADS), represents the sole source of road-crash information. According to the Road Traffic Ordinance, any road crash that involves

injury to any person (including the driver) must be reported to the police. If two vehicles are involved, the drivers are obliged to obtain each other's personal particulars. Hence, if a few hours later, one driver develops symptoms, the injury-inflicting collision should be reported to the police not later than 24 h after the crash. Bicycle-object collisions on the road are no exceptions to the above regulations. In other words, all road-crash casualties should have matching police crash records. Yet, the lack of supplementary data sources means that it is often not possible to determine the percentage of road crashes resulting in injuries requiring hospital medical care that are reported to the police, let alone the factors associated with reporting such crashes to the police.

The situation only changed with the formation of a working group in 2003 by a group of medical professionals at the Departments of Accident and Emergency Medicine, Tuen Mun Hospital, Tuen Mun, Hong Kong and the Queen Mary Hospital, Pokfulam, Hong Kong, along with representatives from the Hong Kong Police Force and the Transport Department. The aim was to establish a new pooled database on road casualties based on police data and data from the two hospitals.

DESIGN

This study matched the Tuen Mun Hospital's Road Casualty Information System (RoCIS) data with the police's crash records in TRADS during 2004. During this time, there were 15 026 police-reported road crashes, resulting in 19 402 casualties. We used the Hong Kong Identity Card number of the road crash victims as the linkage variable and matched the RoCIS and TRADS' casualty databases. To protect privacy, the Hong Kong Identity Card information was removed after the matching. Matched road casualty records were then linked to the crash-based and vehicle-based data in TRADS through the police-assigned Accident Report Booklet number.

Abbreviations: ISS, Injury Severity Score; RoCIS, Road Casualty Information System; TRADS, Traffic Accident Database System

The key variable of interest is whether a road crash victim reported the crash to the police. Three categories of factors—demographic, road user and injury severity factors—are analysed to identify those associated with reporting injury-related road crashes. The demographic factors include age and gender; road user factors refer to the classification of road user groups like drivers, passengers and pedestrians; injury severity is based on Injury Severity Score (ISS)¹⁹ and length of hospital stay. In the following section, descriptive statistics are used to summarise the percentage of RoCIS road-crash casualties that matched, did not match or partially match the police casualty database. We then present cross-tabulations and χ^2 tests to compare the relationships based on different medically treated groups. A logistic regression model is used to examine the impact of various selected factors on reporting rates.

RESULTS

Based on the hospital records, the total road-crash reporting rate in Hong Kong was estimated to be 57.5–59.9%. From 1st January to 31st December 2004, 3034 road-crash casualties sought medical treatment at the Emergency and Accident Department of Tuen Mun Hospital. Among them, 1818 (59.9%) patient records were successfully matched with police crash data, 73 (2.4%) cases had inconsistencies in relation to crash details or victims' information and were removed from the analysis. The remaining patients (1216) did not report the road crashes to the police.

Table 1 gives the summary results of the χ^2 tests and the different reporting rates. Notably, the police-reporting rate for road-crash casualties for <16-year olds was remarkably low at 33.6%. The corresponding figure for all other ages was 64.5%. A statistical test confirms that the difference is highly significant ($p = 0.000$). Furthermore, the police-reporting rates were 58.2% and 60.1% for males and females, respectively, which is not statistically significant at the 0.05 level ($p = 0.321$).

As noted, the police-reporting rate was the highest among drivers (80.6%) whereas for back-seat passengers, public

transport passengers, motorcyclists and pedestrians they were 52.7%, 61.3%, 71.5% and 64.6%, respectively.

The last category of factors is related to injury severity. In RoCIS, the injury severity is primarily measured by ISS. The reporting rate was 58.2% for ISS <10 and 75.2% for ISS \geq 10 ($p = 0.000$). Among the 1216 unreported road-crash casualties, 31 (2.5%) had an ISS of \geq 10. These road-crash victims could be considered as seriously injured in medical terms. Among them, 29.0% were children aged <16 years, 16.1% were the elderly aged >55 years. At the time of the road crash, 25.8% were pedestrians, 22.6% were cyclists and 16.1% were motorcyclists. Table 2 shows that 10.8% of the casualties who had not reported to the police required hospitalisation.

Table 3 shows the results of the logistic regression analysis to take into account the effects of confounding factors. Even after adjustment, children aged <16 years have a significantly lower likelihood of police reporting, the odds ratio (OR) was 0.43 (95% CI 0.34 to 0.53). Conversely, female casualties were about 1.20 times (95% CI 1.00 to 1.44) more likely than their male counterparts to report. Cyclists injured in a road crash report to the police at a rate that is lower than that of a driver (OR = 0.15; 95% CI 0.11 to 0.19) and the same is true for the others listed in the table. When other confounding factors are taken into account, casualties with an ISS of \geq 10 were about twice more likely to report than casualties with less serious injuries.

DISCUSSION

This study finds that the police-reporting rate was about 57.5–59.9% in Hong Kong. Almost without exception, the police crash records represent the key (sometimes, the sole) source of road-crash data in an area. When a hospital road-crash database is available, a road safety researcher needs to know the extent to which it matches with what is in a police database. Although the data used in this study came from Tuen Mun Hospital only, and are therefore not representative of all Hong Kong residents, there is no reason to suggest that patients seeking medical treatment at this hospital have systematically different police-reporting rates than the rest of the territory. The estimated police-reporting rate of about 58% in Hong Kong was higher than what was found in two studies in France (37.7%),^{1,2} in Ohio (55%)¹¹ and in Western Australia (45%).¹⁷ Apparently, the traditional Chinese mentality of avoiding the police does not apply to the modern Hong Kong society.

Although it is recognised that the hospital database is not error free, it is not possible to determine the number of police-reported road-crash casualties who "should" be treated at the Tuen Mun Hospital. Even for police-recorded crashes happening in Tuen Mun district, some might have been treated elsewhere. Conversely, road-crash casualties not injured in the local district were also treated at the Tuen Mun Hospital. Since crash-location information was not collected in RoCIS, it is not possible to calculate the potential positive mismatch between

Table 1 Relationship between reporting rates and demographic, road user and injury severity factors

Factors	Reporting rate (%)
Demographic factors	
Age ($\chi^2 = 171.224$, $df = 1$, $p = 0.000$)	
<16 years	33.6
\geq 16 years	64.5
Gender ($\chi^2 = 0.983$, $df = 1$, $p = 0.321$)	
Male	58.2
Female	60.1
Road user factors	
Role of casualty ($\chi^2 = 367.774$, $df = 7$, $p = 0.000$)	
Driver	80.6
Front-seat passenger	76.4
Back-seat passenger	52.7
Public transport passenger	61.3
Motorcyclist	71.5
Cyclist	33.0
Pedestrian	64.6
Unknown	68.8
Injury severity factors	
ISS ($\chi^2 = 13.854$, $df = 1$, $p = 0.000$)	
<10	58.2
\geq 10	75.2
Hospital stay ($\chi^2 = 16.622$, $df = 1$, $p = 0.000$)	
<1 week	58.1
\geq 1 week	75.0

Table 2 Medical information related to unreported road-crash casualties

Days	Hospitalisation	Sick leave
	n (%)	n (%)
0	1085 (89.2)	677 (55.7)
1–2	74 (6.1)	118 (9.7)
3–7	23 (1.9)	285 (23.4)
8–14	15 (1.2)	56 (4.6)
>14	19 (1.6)	80 (6.6)
Total	1216 (100.0)	1216 (100.0)

Table 3 Logistic regression analysis of police reporting and non-reporting by road-crash casualties

	Logistic regression coefficient	SE	p Value	OR	95% CI	
					Lower	Upper
Constant	1.192	0.146	0.000	3.29*		
Age						
<16 years	-0.855	0.110	0.000	0.43*	0.34	0.53
Gender, female	0.184	0.092	0.045	1.20*	1.00	1.44
Role of victim						
Driver (reference)				1.00		
Front-seat passenger	-0.263	0.216	0.223	0.77	0.50	1.17
Back-seat passenger	-1.214	0.158	0.000	0.30*	0.22	0.40
Public transport passenger	-0.938	0.162	0.000	0.39*	0.28	0.54
Motorcyclist	-0.537	0.192	0.005	0.58*	0.40	0.85
Cyclist	-1.919	0.136	0.000	0.15*	0.11	0.19
Pedestrian	-0.713	0.149	0.000	0.49*	0.37	0.66
Others	-0.324	0.556	0.560	0.72	0.24	2.15
ISS \geq 10	0.541	0.256	0.034	1.72*	1.04	2.84
Hospital stay (in days)	0.019	0.010	0.065	1.02	1.00	1.04

ISS, Injury Severity Score.

*Statistically significant at $p=0.05$.

police and hospital crash databases. Furthermore, an estimation of under-reporting at one particular hospital is not meaningful.

In the foreseeable future, road safety research worldwide will continue to rely primarily on police crash databases because they represent the most systematic and comprehensive single source of road crash data. In many administrations, police crash records will remain the only available source of crash data. For these locations, this study highlights the potential limitations of relying on police data alone.

For locations with supplementary crash databases, this report sheds light on the relative performance of police crash database in terms of under-reporting and biases. In the USA, a systematic attempt to trace road-crash casualties from the scene through the medical care system to the final disposition showed that safety seat belts and motorcycle helmets were effective in reducing fatalities and injuries.²⁰ The data linkage system used is the Crash Outcome Data Evaluation System. The Crash Outcome Data Evaluation System has enabled detailed crash studies,²¹ but the matching algorithm ignores all road-crash casualties who did not report to the police but who were treated in the medical care system. In light of the extent of under-reporting that we found, further efforts are warranted to examine the scale and nature of the under-reporting problem.¹¹⁻¹⁸

Specifically, worldwide, the research has shown that some subgroups of road users have systematically lower police-reporting rates. In the pioneering study of Thorson and Sande⁸ in Sweden, children aged <15 years had lower reporting rates and the same was found in Australia, The Netherlands and the USA.⁷⁻¹¹⁻¹⁷ This finding in Hong Kong raises important questions that deserve further exploration. Were those aged <16 years more likely to be cyclists or passengers? Were they likely to be less seriously injured? In Hong Kong, our data sets show that road-crash casualties aged <16 years were more likely to be cyclists (adjusted χ^2 residuals = 12.4), pedestrians (adjusted χ^2 residuals = 5.0) and back-seat passengers (adjusted χ^2 residuals = 3.5). The difference is statistically significant at the 0.05 level ($p=0.000$). Nonetheless, it is also obvious that children are less likely to be drivers and motorcyclists. Moreover, road-crash casualties involving children were less likely to have severe injury (adjusted χ^2 residual = -0.9) although the difference is not significant ($p=0.385$). Lastly, this study shows that females, if injured in a road crash, were more likely to report to the police than

their male counterparts. The finding is similar to the studies in Australia and the USA,⁵⁻¹⁵⁻¹⁸ though the opposite was found to be happening in France.¹

Earlier findings also suggest that vulnerable road users are underestimated in police-reported road crashes. In 1969, Thorson and Sande⁸ suggested that the reporting rates for cars, motorcycles, pedal cycles and others were 55%, 35%, 12% and 38%, respectively. Lopez *et al*⁵ also found that pedestrians were less likely to report than drivers. Sciortino *et al*¹⁸ in San Francisco noted that police records underestimated the number of injured pedestrians by 21%. In Hong Kong, the most serious under-reporting problem involved cyclists. Back-seat passengers might be less inclined to report because of worries that this may penalise drivers (who might be friends or colleagues). For young children and cyclists, the need for immediate medical treatment could have overridden any other concerns. For the teenagers, under-reporting might be attributable to their lack of awareness about the need to report or their fears of being rebuked by their parents. Many of these findings could be explained by relationships between the characteristics and severity of injury. The finding suggests, however, that the reasons for the cyclists to under-report could not be explained by injury severity alone.

This study challenges the common perception that road-crash casualties who had not reported to police only had minor injuries. Should the social costs of road crashes be calculated solely on the police-reported cases, it is obvious that there would be a serious underestimation of the medical expenses involved, the loss of productivity, and other related costs. Hence, any estimation about the social costs of road crashes must take account of under-reporting.

Governments should streamline police-reporting procedures and encourage the public to report road crashes to the police. In particular, there is a need for everyone to appreciate the needs and benefits of having accurate and reliable police crash records. At present, the large number of road-crash casualties (both in Hong Kong and elsewhere) not represented in police data represents a major public health issue that should be carefully examined.

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Key points

- This study matched the Tuen Mun Hospital's RoCIS data with the police's crash records in TRADS during 2004. About 57.5–59.9% of the road-crash casualties reported the road crashes to the police. This share was generally higher than similar studies (37.3–45%) conducted elsewhere
- All three categories of factors—demographic, road user and injury severity factors—were significantly associated with reporting injury-related road crashes
- Under-reporting among children (reporting rate = 33.6%) and the cyclists (reporting rate = 33.0%) was particularly serious
- The large number of injuries not reflected in the police crash database represents a public health issue that should be carefully examined

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