

## Exploring the age discrepancy in death rates from motorcycle injury in the United States of America: the decomposition method

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**Introduction** Motorcyclist deaths accounted for 13% of all traffic deaths in 2009 in the United States of America. Previous research has suggested age discrepancy among motorcycle drivers. We examined the various factors that contribute to this age discrepancy.

**Methods** The decomposition methodology separates the individual components contributing to overall rates. It has been used to explore differences in injury death rates across population groups, time periods, and geographic regions. The populationbased motorcycle driver fatality rate (A: # motorcycle driver fatalities / # personyears) can be expressed as the product of the driving exposure (B: # miles driven / # personyears), crash risk (C: # crashes / # miles driven) and crash fatality rate (D: # motorcycle driver fatalities / # crashes). Using ages 4049 as the referent group. We expressed the comparison of fatal crash involvement rates between the referent group and those aged 2029 years as a ratio:

$$\frac{A_{2029}}{A_{4049}} = \frac{B_{2029}}{B_{4049}} \times \frac{C_{2029}}{C_{4049}} \times \frac{D_{2029}}{D_{4049}}$$

The relative contribution (RC) of each component (B, C, or D) to the difference in motorcycle driver fatality rate is:

$$RC_i = \frac{|\ln(RC_i)|}{\{|\ln(RC_b)| + |\ln(RC_c)| + |\ln(RC_d)|\}} \times 100\%, \text{ where } i = b, c \text{ or } d; \ln: \text{ natural logarithm}$$

Data sources included the 20082009 Fatality Analysis Reporting System (FARS), General Estimates System (GES), National Household Travel Survey (NHTS), and resident population estimates. FARS is a census of fatal crashes in the United States. GES is a nationally representative sample of policereported crashes. Respondents in the NHTS were instructed to keep a written diary of all the trips made during a randomly assigned 24hour travel day: information included trip purpose,

transportation means, and trip length. The estimates of miles driven were obtained on the day trip diary.

**Results** Relative to ages 4049 years, the ratio of populationbased fatality rate was 0.39, 1.14, 0.93, 0.95, and 0.40 for ages of 1619, 2029, 3039, 5059, and 60 and over. Compared with persons aged 4049 years, the ratio of average annual miles driven was 0.13, 0.32, 0.41, 0.80, and 0.27 for ages 1619, 2029, 3039, 5059, and 60 and over; the ratio of crash risk was 4.81, 3.72, 2.40, 1.22 and 1.08 for ages 1619, 2029, 3039, 5059, and 60 and over; the ratio of crash fatality rate was 0.64, 0.96, 0.96, 0.97, 1.37 for ages 1619, 2029, 3039, 5059, and 60 and over. The relative contribution of driving exposure and crash risk was equally important for ages 2029, 3039, and 5059, while the relative contribution of crash fatality rate was 19% for age 60 and over.

**Conclusions** Motorcycle drivers aged 4049 years had the highest average annual miles driven and the lowest crash risk. For 2029 and 3039 year olds, reduced driving offset their high crash risk, making their fatality rate comparable to that for ages 4059. Prevention practice should focus on safety training and crash avoidance for motorcycle drivers aged 1619, 2029, and 3039 years to reduce their elevated crash risk. ■

## Exploring the relationship between the driving behavior questionnaire and hiway driving behavior

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The Driver Behavior Questionnaire (DBQ) is a well documented instrument for obtaining selfreport information on aberrant driving behaviors. The DBQ is comprised of three subscales: (a) errors – the failure of planned actions, which could result in unsafe driving; (b) violations – deliberate contravention of behaviors which are considered necessary for safe operation, and; (c) lapses – absentminded behaviors which are assumed unlikely to impact driving safety. A substantive body of research has demonstrated a relationship between DBQ scores and both retrospective and prospective

accident involvement. In addition, DBQ subscale scores have been shown to have relationships with drivers' attitudes, personality characteristics, psychological wellbeing, demographics, etc. However, to the best of our knowledge, there is little or no published information on the relationship between DBQ scores and driving performance variables under actual driving conditions that may bear some relationship to accident risk.

The present study focuses on the relationship between DBQ subscales and highway driving behaviors. A sample of 108 drivers in selfreported good health and having a safe recent driving history (no accidents in the previous year) was balanced by gender and across three age groups (2029, 4049, 6069). Prior to driving, participants completed a 24item U.S. version of the DBQ. After approximately 30 minutes of driving an instrumented Volvo XC90, driving behaviors were assessed over an 18 minute period. During this time, participants were engaged in both periods of single task driving and driving while engaged in a structured working memory task requiring a division of attention. A dichotomous breakdown of subscales of the DBQ (above or below the median) were independently examined as predictors of driving behavior (average velocity, standard deviation of velocity, standard deviation of steering wheel position, hard braking, rapid throttle acceleration, and sudden unidirectional acceleration (the vector sum of longitudinal and lateral acceleration)).

Significant relationships were found to exist between subscales of the DBQ and actual driving behaviors. Drivers with high violations scores drove faster, had poorer lateral control (higher standard deviation of wheel position) and more sudden unidirectional accelerations. Among these factors, higher driving speed is known to influence the probability of accidents. The relationship between lateral control and sudden acceleration to accidents is less established but appears reasonable. High lapses scores were related to less consistent gas pedal control (larger standard deviation of velocity and more frequent periods of rapid throttle acceleration). It is interesting to speculate as to whether there is an attentional factor that links the lapses score and these consistency of control measures. There were no main effects observed between errors scores and any of the driving behavior measures. Significant interactions in errors×gender on rapid

throttle acceleration and violations×age on hard braking appeared. Male drivers with high errors scores speed up more abruptly than those with low scores while female drivers did not. High violations drivers in their 60s more frequently engaged in periods of hard braking than those with low violations scores. The relationships observed here are likely conservative since drivers having had accidents in the past year were excluded. ■

## **H**ow to consider the protection of the abdominal area of children: the CASPER's project contribution

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The European research project CASPER is dedicated to the improvement of the safety of restrained children in cars through improving the quality of use of the restraint systems and the development of new tools allowing the birth of a new generation of restraint systems. This paper shows the point of advancement of the work conducted in European research projects to improve the knowledge of injuries in the abdominal area sustained by restrained children in cars.

Field studies are conducted to have a good picture of the situation of traveling conditions of children in cars. In depth accident studies show that for children using the seatbelt of the car, with or without a booster system, severe or fatal abdominal injuries can be observed when they are involved in a severe frontal or side impact. An overview of the main abdominal injury mechanisms is proposed through a careful analysis of the detailed CASPER accident database. A comparison with the abdominal injuries and corresponding mechanisms sustained by adults under similar type of loadings has been performed and is reported in the

paper. These real world results were used to make steps in the area of the protection of the abdomen of children.

In dynamic tests, it is important that to approve child restraint systems or to evaluate their level of performance the child dummies used are able to reproduce abdominal injury mechanisms, to measure physical parameters linked to a corresponding injury criteria. In the current regulation tests, this risk is only covered by the use of pieces of clay that are deformed if the seatbelt intrudes the area.

For many years, research projects have been looking for solutions based on a more scientific basis. During previous European research projects, CREST and CHILD, a new set of dummies representing children of different ages were developed: called the Q family dummies. They are more biofidelic than the ones of the previous generation still used in the European regulation. At the beginning of the CASPER project, three prototype systems of abdominal sensors existed, all at the stage of being usable for research purposes. One main output of the project is to select the one that is best adapted to be widely used in crash test laboratories running intensive test campaigns, to modify it in order to make it easy to use in the Q dummies and that it can be industrialized. In addition to work on the sensor it has been necessary to improve the global kinematics of the child dummies to allow a better submarining behaviour. In the CASPER project, different proposals were made and tested. This paper describes the technical choices and the works carried out both on the dummies and on the selected sensor to improve the protection of the abdomen. The approaches taken to ensure that the abdominal protection is also considered on the child dummy models and child human models developed in the CASPER project are also explained. ■

## **M**ultinomial logit model of bicycle injury risk in Hong Kong

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**Background** More and more countries have been promoting bicycle transport mode, as one of the key strategies in sustainable transport development. In many European and American countries (e.g. Netherlands, Denmark and Canada), bicycle has been a popular commuter transport mode. In contrast, bicycle is mainly used for recreational purpose in Hong Kong. Well planned bicycle transport infrastructure was absent, except smallscale and isolated bicycle path network in suburban area. Unfavorably, proportion of bicycle crash to total road crash has been increasing, from 5.3% in 1997 to 12.7% in 2004. Therefore, factors contributing to bicycle injury risk are worth exploring.

**Study Design** An integrated database, Road Casualty Information System (RoCIS), was jointly developed by the Police, Transport Department and hospital, linking up the trauma records of casualties admitted to the accident and emergency department of hospital and the crash records maintained by the Police and Transport Department the advantage of RoCIS, information on bicyclist demographics, injury severity, injured body part, collision type, road design and vehicle attributes, of 682 bicycle casualties during the period 2004-2006 have been collected.

**Results** In this study, multinomial logit regression is applied to identify the significant factors contributing to the risk of severe and lifethreatening injury of bicycle casualties. Results indicate that middle age and elderly bicycle casualties are more likely to have severe injury. Besides, bicycle casualties with severe head injury and with motor vehicles involved are remarkably more likely to have lifethreatening injuries. Unfortunately, the helmet wearing rate is extremely low and at 2% only. Therefore, safety education, campaign and enforcement could be targeted to the middle age and elderly bicyclists. In particular, use of protective device and compliance to traffic rules should be promoted. Also, access of bicycle on the motorway should be scrutinized.

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