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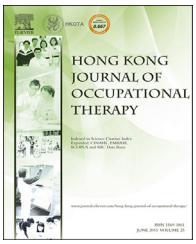

ORIGINAL ARTICLE

Relationship Between Driving-violation Behaviours and Risk Perception in Motorcycle Accidents

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Summary *Objective/Background:* Riding motorcycles is a popular means of community mobility in many Asian and developing countries. However, the potential harm associated with accidents is greater for motorcyclists and their passengers than for other vehicle users. The primary aims of this study were to explore the relationship between driving-violation behaviours and perceptions of the risk associated with potential accident causes, and to assess the contribution of these factors to active involvement in accidents among Chinese motorcyclists.
Methods: A total of 621 Chinese motorcyclists were recruited. All were asked to fill in a specially developed questionnaire to assess their driving-violation behaviours and perceptions of potential causes of motorcycle accidents.
Results: A relationship was identified between driving-violation behaviours and risk perceptions. Furthermore, both were significant predictors of involvement in motorcycle accidents. The motorcyclists involved in accidents demonstrated more aggressive and ordinary driving-violation behaviours. In addition, these motorcyclists exhibited lower perceptions of risk from both driving and environmental factors. Instead, these motorcyclists were more likely to identify risk in terms of belief-related causes.
Conclusion: This study could assist occupational-therapy practitioners involved in driving rehabilitation and training to identify strategies to deal with drivers' violation behaviours and risk perception. It could also provide evidence-based recommendations for drivers' education, driving-safety campaigns, or even licensing policies.

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Introduction

Community mobility, an instrumental activity of daily living, is defined as "moving [one]self in the community and using public or private transportation" (American Occupational Therapy Association, 2002). It is an essential element of ensuring independence and engaging in other everyday activities and occupations. Community mobility also refers to the extent to which an individual is able to travel within the community in accordance with his or her needs, and preferences (Di Stefano, Stuckey, & Lovell, 2012). Occupational-therapy practitioners have an important role in supporting community mobility by evaluating who is at higher risk of having an accident when driving (American Occupational Therapy Association, 2005). This role is likely to become much more prominent following the *Global Status Report on Road Safety* published by the World Health Organization in 2009. In this report, the World Health Organization states that road traffic accidents will become the fifth leading cause of death worldwide by 2030 if preventive measures are not taken immediately (World Health Organization, 2009). It has been predicted that between 2000 and 2020, the total number of road traffic deaths and injuries worldwide could rise by 65% in high-income countries, and by as much as 80% in low- and middle-income countries (Kopits & Cropper, 2003). On May 11, 2011, the United Nations launched its Decade of Action for Road Safety (World Health Organization, 2011), with the aim of firstly stabilising, and then reducing, the number of global road deaths by 2020.

Motorcyclists are more at risk of being killed or injured in accidents than any other road user. Riding motorcycles, however, is one of the most popular means of ensuring community mobility in many Asian countries. In developing countries, the popularity of motorcycle riding is on the increase, such as in Australia and New Zealand (Australian Bureau of Statistics, 2006; Bambach, Grzebieta, & McIntosh, 2012; White et al., 2013). In the crowded and congested city of Hong Kong, where over seven million people live on an island of just 1,100 km^2, the number of registered motorcycles increased from 34,085 in 2000 to 57,314 in 2012 (Transport Department of Hong Kong, 2013). In mainland China and Taiwan, the figures currently exceed 100 million and 25 million, respectively (National Police Agency, 2012; Traffic Administration Bureau, 2012).

The potential harm associated with any given traffic accident is usually greater for motorcyclists and their passengers, since they are not protected by the vehicle structure. For this reason, motorcyclists account for >50% of traffic deaths in mainland China and Taiwan (National Police Agency, 2005; Wang et al., 2003). In Hong Kong, the accident rate involving motorcycles is 3.4 times greater than that for private cars, and the proportion of motorcyclists sustaining severe or fatal injuries is 5% greater than for car drivers (Transport Department of Hong Kong, 2011). In Australia, motorcyclists are 30 times more likely to be killed and 37 times more likely to be seriously injured than car occupants per distance travelled (Department of Infrastructure, Transport, Regional Development and Local Government, 2008).

Motorcyclists are frequently perceived as "speed rebels" and "risk takers". It is not uncommon to see a motorcyclist travelling faster than cars, overtaking more often, and pulling into smaller gaps in traffic. Risk taking is socially acceptable when the danger is recognised, such as with some competitive sports and activities, such as skydiving. Such a risky behaviour is directly related to driving violations (Parker, Reason, Manstead, & Stradling, 1995), which can be defined as deliberate deviation from those practices believed necessary to maintain the safe operation of a potentially hazardous system. Studies indicate that there is a relationship between driving violations and accidents (Lucidi et al., 2010). Driving violations can be categorised into two distinct types based on the underlying reason for the behaviour. In the first type, labelled ordinary violations, people deliberately break the law, but do not have an aggressive motivation for doing so. In the second type, called aggressive violations, the perpetrator is interpersonally aggressive (Lajunen, Parker, & Summala, 2004).

Traffic accidents are also related to how the motorcyclist perceives risk (Njå & Nesvåg, 2007). Traffic-risk perception is a subjective interpretation of the risk involved in various situations, and depends on the driver's ability to perceive such risks correctly (Kanellaidis, Zervas, & Karagioules, 2000). For example, it is well known that younger and novice motorcyclists are overrepresented in terms of the number of traffic accidents (Jama, Grzebieta, Friswell, & McIntosh, 2011). They characteristically underestimate the risk of an accident and are prone to optimistic bias, that is, they tend to perceive situations as relatively low risk compared with other drivers.

The primary aims of this study, therefore, were to explore the relationship between driving-violation behaviours and the perceived causes of motorcycle accidents, and then to assess the contributions of each factor to the risk of active involvement in accidents among Chinese motorcyclists. It was hypothesised that there would be a relationship between driving-violation behaviours and risk perception, and that these factors would be significant predictors of the incidence of motorcycle accidents.

Methods

Participants

We conducted a cross-sectional questionnaire of Chinese motorcyclists in Hong Kong, all of whom rode motorcycles with an engine capacity >50 cc. All respondents were recruited using a snowball-sampling technique, with the initial referrals made by companies involved in hiring motorcyclists for domestic deliveries. The inclusion criteria were (a) having at least 3 years of postlicence driving experience, (b) having an annual mileage of at least 8,000 km, (c) being literate enough to read and understand simple questions, and (d) being prepared to give an informed consent (and signing a form to that effect). Respondents were excluded from the study if they (a) were unable to read Chinese or (b) requested that their participation be terminated.

Procedure

A questionnaire was developed to assess the participants' perceptions of the causes of motorcycle accidents and their driving-violation behaviours while operating their motorcycles. The questionnaire consisted of three parts. Part 1 captured the demographic information as well as the respondent's "active" accident history during the previous 3 years. Active in this context means the motorcyclist was likely to be at fault for the crash. For example, if a vehicle hits another on the same carriageway from behind, its driver will be considered to have been involved in an active accident, whereas the driver of the vehicle that has been hit will not be regarded so. The driver involved in an active accident is usually held to be legally responsible for it.

Part 2 of the questionnaire consisted of an 18-item scale measuring the respondent's perceptions of the risks associated with a number of potential causes of motorcycle accidents (Appendix 1). These items have been validated and demonstrate high internal consistency among the subscales (Cronbach's alpha = .742—.898). The scale assesses the perceptions of Chinese motorcyclists (Cheng & Ng, 2012) of the risk associated with the potential causes of traffic accidents grouped along three dimensions (driving, environmental, and belief related). The participants were asked to indicate whether or not they thought each risk was a cause of accident using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Part 3 of the questionnaire consisted of a 19-item scale measuring self-reported driving-violation behaviours (Appendix 2). The measure yields a total score comprised of two subscales measuring ordinary and aggressive violations, respectively. The internal consistency (Cronbach's alpha) of these two subscales ranges from .876 to .914 (Cheng & Ng, 2010). The participants were asked to indicate how often they had committed each of the violations during the past 6 months using a 5-point Likert scale ranging from 1 (never) to 5 (very often). A high score indicates a greater degree of driving-violation behaviour.

A total of 774 questionnaires were sent out, of which 621 were returned fully completed. This resulted in a response rate of 80.23%. All participants replied to the questionnaire anonymously and voluntarily.

Data analysis

Descriptive statistics were used to describe the demographic characteristics of all the respondents. A bivariate-correlation analysis was then carried out to evaluate any correlation between the three dimensions of perceived causes of motorcycle accidents and the driving violations carried out while riding a motorcycle. This was followed by an independent t test to evaluate any significant differences between motorcyclists who were involved in accidents and motorcyclists who were accident free, in terms of these dimensions and behaviours. For the prediction of a motorcycle accident, univariate logistic regressions were first performed to examine the effect of different demographic variables, alignment with the different dimensions of perceived accident causes, and the extent of driving-violation behaviours. Variables reaching $p > .05$ were then eliminated. The remaining variables (that is, with $p < .05$) were then entered into a multivariate backward stepwise logistic regression to determine their contribution to predicting active involvement in accidents amongst these motorcyclists. All statistical analyses were performed using the IBM SPSS programme version 20.0 for Windows (IBM SPSS Inc., Chicago, IL, USA); the significance level was set at $p < .05$.

Results

Demographic characteristics of respondents

Of the 621 participants, the mean postlicence driving experience was 10.09 years (standard deviation [SD]: 6.618) and the mean annual mileage is 12,115.3 km (SD: 747.821). They were mainly male (96%), with a mean age of 33.67 (SD: 7.204). A total of 281 had been involved in at least one active motorcycle accident in the last 3 years. Table 1 summarises these descriptive characteristics.

Correlation analysis

There was a statistically significant relationship between the two types of driving-violation behaviours and the perception of motorcycle accidents as having belief-related causes. Both ordinary ($r = .153$, $p < .001$) and aggressive ($r = .174$, $p < .001$) violation behaviours were positively correlated with selecting belief-related causes. There was also a significant positive correlation between ordinary and aggressive driving-violation behaviours ($r = .593$, $p < .001$). In terms of the three dimensions of the perceived causes of accidents, the selection of driving-related causes was positively related to choosing environment-related causes ($r = .277$, $p < .001$), but inversely related to a

Table 1 Demographic Characteristics of the Participants

	Accident-involved motorcyclists ($n = 281$)	Accident-free motorcyclists ($n = 340$)
Sex (%)	Male: 93.59 Female: 6.41	Male: 96.47 Female: 3.53
Mean age (SD)	33.26 (8.24)	34.01 (6.21)
Education level (%)	Primary: 13.52 Secondary: 50.89 Technical school: 31.32 Tertiary: 4.27	Primary: 15.29 Secondary: 47.06 Technical school: 34.12 Tertiary: 3.53
Mean years since licensure (SD)	9.83 (6.93)	10.31 (6.35)
Mean annual mileage, km (SD)	11,074.35 (860.24)	10,618.02 (912.34)

Note. SD = standard deviation.

Table 2 Correlation Analysis of Driving-violation Behaviours and Perceived Causes of Accident When Driving a Motorcycle ($n = 621$)

Variable	(1)	(2)	(3)	(4)	(5)
Ordinary driving-violation behaviours (1)	—	.593*	.015	.030	.153*
Aggressive driving-violation behaviours (2)		—	.006	.076	.174*
Driving-related causes (3)			—	.277*	−.285*
Environment-related causes (4)				—	−.204*
Belief-related causes (5)					—

*$p < .001$.

strong perception of belief-related causes ($r = -.285$, $p < .001$). Furthermore, the selections of the environment- and belief-related-accident causes were negatively correlated ($r = -.204$, $p < .001$; Table 2).

Differences between accident-involved and accident-free motorcyclists

The results of an independent t test showed a statistically significant difference between accident-involved and accident-free motorcyclists with respect to ordinary and aggressive driving-violation behaviours, and the selection of driving- and belief-related causes. Accident-involved motorcyclists showed higher mean scores for both ordinary and aggressive driving-violation behaviours, and also for belief-related causes, but lower scores for driving-related causes, compared to their accident-free counterparts (Table 3). These findings indicate that the accident-involved motorcyclists committed certain driving violations more often. In addition, they considered driving-related causes of accidents to be less important and belief-related causes more important than motorcyclists without an active accident history.

Contributors to motorcycle accidents

The results of the univariate logistic regressions showed that only five variables had a statistically significant effect on prior involvement in an active accident, namely, ordinary (crude odds ratio [OR] 1.110, 95% confidence interval [CI] 1.074—1.147) and aggressive (crude OR 1.145, 95% CI 1.107—1.183) driving-violation behaviours, and the selection of driving- (crude OR .961, 95% CI .943—.980), environment- (crude OR .957, 95% CI .938—.985), and belief-related causes (crude OR 1.156, 95% CI 1.116—1.197). None of the demographic variables significantly predicted accident involvement for this sample. When these five significant variables were included in the multivariate logistic regression, four continued to predict accident involvement, namely, aggressive driving-violation behaviours (adjusted OR 1.115, 95% CI 1.068—1.164), and the selection of driving- (adjusted OR .916, 95% CI .888—.944), environment- (adjusted OR .924, 95% CI .891—.959), and belief-related causes (adjusted OR 1.296, 95% CI 1.205—1.336). All four variables significantly predicted involvement in active traffic accidents after controlling for concurrent demographic variables (Table 4). A one-point increase in total score on the aggressive driving violation and belief-related-cause subscales increased the likelihood of having an active accident history by 1.115 and 1.269 times, respectively. However, a one-point increase in total score for the driving- and environment-related-cause subscales decreased this likelihood by .916 and .924 times, respectively.

Discussion

These results support the hypotheses that there is a relationship between driving-violation behaviours and risk perception, and that both are significant predictors of motorcycle-accident involvement amongst Chinese motorcyclists. The accident-involved motorcyclists reported more aggressive and ordinary driving-violation behaviours than their accident-free counterparts, and were also less likely to perceive the risks of accident as being caused by driving- and environment-related factors, and more likely to consider such risks to be belief related.

Risk perception is influenced by cultural and contextual factors. It also depends upon what the news media choose to report, what people discuss, and what cultural norms are involved. The media can influence an individual's tendency to overestimate or underestimate risk (Berry, Wharf-Higgins, & Naylor, 2007). Lewis and Tyshenko (2009) describe this as the "social amplification" of risk, which focuses on the influence of public discourse and media reports on risk information. Lastly, contextual factors, in terms of the traffic environment and regulations,

Table 3 Comparison of Scores for Driving-violation Behaviours and Perceptions of the Causes of Motorcycle Accidents Between Accident-free and -involved Motorcyclists

	Accident-involved motorcyclists ($n = 281$)		Accident-free motorcyclists ($n = 340$)		t statistics	Two-tailed p
	Mean	SD	Mean	SD		
Ordinary driving-violation behaviours	19.091	6.043	15.972	5.172	−6.761	<.001
Aggressive driving-violation behaviours	22.061	6.011	17.823	5.481	−8.993	<.001
Driving-related causes	29.491	9.252	32.401	7.982	4.141	<.001
Environment-related causes	19.642	6.185	20.093	7.096	.845	.398
Belief-related causes	18.872	5.298	15.244	4.691	−.227	<.001

Note. SD = standard deviation.

Table 4 Effect of Demographic Variables, Driving-violation Behaviours, and Perceived Causes of Motorcycle Accidents on the Involvement in Active Motorcycle Accidents ($n = 621$)

Predictor variable	Crude OR	95% CI	Adjusted OR	95% CI
Age	1.015	.993, 1.038		
Sex				
Female	1			
Male	1.326	.595, 2.954		
Education level				
Primary	1.368	.555, 3.376		
Secondary	1.119	.487, 2.569		
Technical school	1.318	.565, 3.074		
Tertiary	1			
Years post licensure	1.011	.987, 1.036		
Annual mileage (km)	.989	.967, 1.124		
Ordinary driving-violation behaviour	1.110	1.074, 1.147**	1.043	.998, 1.091
Aggressive driving-violation behaviour	1.145	1.107, 1.183**	1.115	1.068, 1.164**
Driving-related causes	.961	.943, .980**	.916	.888, .944**
Environment-related causes	.957	.938, .985*	.924	.891, .959**
Belief-related causes	1.156	1.116, 1.197**	1.269	1.205, 1.336**

Note. Model summary: −2 log likelihood, 605.921; Nagelkerke R^2, .410. CI = confidence interval; OR = odds ratio.
*$p < .05$. **$p < .001$.

could also influence the perceptions of traffic risk, and thus, driving behaviours (Goldenbeld & van Schagen, 2007).

The results of this study have particular implications for the profession of occupational therapy. Firstly, occupational-therapy practitioners involved in driver rehabilitation and training, whether by means of off- or on-road assessments, should be aware that drivers' perceptions of risk will affect their driving behaviours, which could consequently undermine their hazard-perception abilities. Hazard perception involves detecting stationary or moving objects on the road that have the potential to increase the risk of an accident (Haworth, Mulvihill, & Symmons, 2005). Therefore, it is recommended that a formal assessment of accident-risk perception and driving behaviours be included in both off- and on-road assessments to identify "at-risk" drivers or to predict driving performance. This is particularly important for drivers with superstitious and fatalistic attitudes about possible causes of accidents. Such drivers are more likely to attribute an accident to factors outside their control (an evil spirit, bad luck, and so on), implying that they consider those risk factors for which they could be personally responsible to be less significant. More importantly, because such fatalistic beliefs influence their perception of the causes of road accidents, this may lead them to take more risks on the road. This phenomenon deserves our attention, because fatalism can lead to a certain passivity or a tendency to seek help from mystical practices, resulting in an inclination to neglect rational security precautions and be less responsive to recommended preventive measures.

Secondly, occupational-therapy practitioners involved in providing advice to driver education, driving-safety campaigns, or even driver licensing policies should be aware that policymakers rely on experts to educate them about the issues, and to present solutions that address their concerns while being politically and financially acceptable. With the global trend towards primary prevention, an emerging practice area for our profession is the formulation of health promotion and prevention strategies to support policymakers to optimise the driving competency of people of different ages, both with or without disabilities. Parnell and Wilding (2010) indicate that occupational-therapy practitioners have a role in developing policies, systems, and community environments that promote mobility engagement. It is recommended that occupational-therapy practitioners provide evidence-based recommendations and make use of their occupational perspectives in this nontraditional role to give advice on topics, such as urban environmental design and how to use the media to promote safe driving.

Limitations of the study

Some limitations of the current study should be noted. Firstly, the participants in this study were Chinese motorcyclists in Hong Kong. As a result, the study results may not be fully generalizable to other Chinese motorcyclists living in mainland China, Taiwan, or other countries. Secondly, the classification of accident-free and accident-involved motorcyclists relied on self-reported data, which are known to be subject to response styles, demand characteristics, and imperfect recall of retrospective events. This also introduces the possibility of bias. Lastly, because the study data were cross sectional in nature, the direction of causality may not be reliably inferred from the significant relationships identified. Therefore, the present study provides only a foundation for future research employing longitudinal and experimental methodologies to explore further the relationships identified here.

Conclusion

The results of this study show that there is a relationship between driving-violation behaviours and risk perception, both of which are significant predictors of motorcycle-accident involvement. This knowledge can help inform occupational-therapy practitioners involved in driving rehabilitation and training to look for strategies to deal with drivers' violation behaviours and risk perception. It could also provide evidence-based recommendations for driver education, driving-safety campaigns, or even licensing policies.

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References

American Occupational Therapy Association. (2002). Occupational therapy practice framework: domain and process. *American Journal of Occupational Therapy, 56*, 609—639.

American Occupational Therapy Association. (2005). Statement: driving and community mobility. *American Journal of Occupational Therapy, 59*, 666—670.

Australian Bureau of Statistics. (2006). *Motor vehicle census, Australia, Mar 2006*. Canberra: Australian Bureau of Statistics.

Bambach, M. R., Grzebieta, R. H., & McIntosh, A. S. (2012). Injury typology of fatal motorcycle collisions with roadside barriers in Australia and New Zealand. *Accident Analysis & Prevention, 49*, 253—260.

Berry, T. R., Wharf-Higgins, J., & Naylor, P. J. (2007). SARS wars: an examination of the quantity and construction of health information in the news media. *Health Communication, 21*(1), 35—44.

Cheng, A. S. K., & Ng, T. C. K. (2010). Development of a Chinese motorcycle rider driving violation questionnaire. *Accident Analysis & Prevention, 42*, 1250—1256.

Cheng, A. S. K., & Ng, T. C. K. (2012). Risky driving and the perception of motorcycle accident causes among Chinese motorcyclists in Hong Kong. *Traffic Injury Prevention, 13*, 485—492.

Department of Infrastructure, Transport, Regional Development and Local Government. (2008). *Fatal and serious road crashes involving motorcyclists. In Research and analysis report, road safety monograph 20* (pp. 1—26). Australia, Canberra: Department of Infrastructure, Transport, Regional Development and Local Government.

Di Stefano, M., Stuckey, R., & Lovell, R. (2012). Promotion of safe community mobility: Challenges and opportunities for occupational therapy practice. *Australian Occupational Therapy Journal, 59*, 98—102.

Goldenbeld, C., & van Schagen, I. (2007). The credibility of speed limits on 80 km/h rural roads: The effects of road and person(ality) characteristics. *Accident Analysis & Prevention, 39*, 1121—1130.

Haworth, N., Mulvihill, C., & Symmons, M. (2005). *Hazard perception and responding by motorcyclists: Background and literature review (report no. 235)*. Melbourne, Australia: Monash University Accident Research Centre.

Jama, H. H., Grzebieta, R. H., Friswell, R., & McIntosh, A. S. (2011). Characteristics of fatal motorcycle crashes into roadside safety barriers in Australia and New Zealand. *Accident Analysis & Prevention, 43*(3), 652—660.

Kanellaidis, G., Zervas, A., & Karagioules, V. (2000). Drivers' risk perception of road design elements. *Transportation Human Factors, 2*, 39—48.

Kopits, E., & Cropper, M. (2003). *Traffic fatalities and economic growth*. Washington, DC: World Bank, Policy Research Working Paper No. 3035.

Lajunen, T., Parker, D., & Summala, H. (2004). The Manchester driver behaviour questionnaire: a cross-cultural study. *Accident Analysis & Prevention, 36*, 231—238.

Lewis, R. E., & Tyshenko, M. G. (2009). The impact of social amplification and attenuation of risk and the public research to mad cow disease in Canada. *Risk Analysis, 29*(5), 714—728.

Lucidi, F., Giannini, A. M., Sgalla, R., Mallia, L., Devoto, A., & Reichmann, S. (2010). Young novice driver subtypes: relationship to driving violations, errors and lapses. *Accident Analysis & Prevention, 42*, 1689—1696.

National Police Agency. (2005). *Ministry of Interior of Taiwan, police policy report*. Taipei, Taiwan: Ministry of Interior of Taiwan.

National Police Agency. (2012). *Ministry of Interior of Taiwan, police policy report*. Taipei, Taiwan: Ministry of Interior of Taiwan.

Njå, O., & Nesvåg, S. M. (2007). Traffic behaviour among adolescents using mopeds and light motorcycles. *Journal of Safety Research, 28*, 481—492.

Parker, D., Reason, J. T., Manstead, A. S. R., & Stradling, S. G. (1995). Driving errors, driving violations, and accident involvement. *Ergonomics, 38*(5), 1036—1048.

Parnell, T., & Wilding, C. (2010). Where can an occupation-focussed philosophy take occupational therapy? *Australian Occupational Therapy Journal, 57*, 345—348.

Traffic Administration Bureau. (2012). *China road traffic accidents statistics 2011*. Beijing: Traffic Administration Bureau of China State Security Ministry.

Transport Department of Hong Kong. (2011). *Annual transport digest 2010*. Hong Kong: Transport Department (Hong Kong Special Administrative Region).

Transport Department of Hong Kong. (2013). *Annual transport digest 2012*. Hong Kong: Transport Department (Hong Kong Special Administrative Region).

Wang, S., Chi, G., Jing, C., Dong, X., Wu, C., & Li, L. (2003). Trends in road traffic crashes and associated injury and fatality in the People's Republic of China. *International Journal of Injury Control and Safety Promotion, 10*, 89—93.

White, D., Lang, J., Russell, G., Tetsworth, K., Harvey, K., & Bellamy, N. (2013). A comparison of injuries to moped/scooter and motorcycle riders in Queensland, Australia. *Injury, 44*, 855—862.

World Health Organization. (2009). *Global status report on road safety: Time for action*. Retrieved November 18, 2013, from http://www.who.int/violence_injury_prevention/road_safety_status/2009/en/.

World Health Organization. (2011). *Ensuring the decade is action: Decade of action for road safety 2011—2020*. Retrieved November 18, 2013, from http://www.makeroadssafe.org/publications/Documents/decade_is_action_booklet.pdf.

Appendix 1. Items in the questionnaire covering driving-violation behaviours (English translation of the original Chinese items)

Ordinary driving-violation behaviours; have you ...

1. sounded your horn to show your annoyance to another road user
2. made an illegal U-turn
3. driven above the speed limit in order not to be late for an appointment
4. driven as fast on a wet road surface as on a dry one
5. driven through an amber light when it was about to turn red
6. imitated the postures and movements used in a motorcycle race while driving on the public road, such as touching the ground with a knee when turning
7. moved abruptly from the right into the left lane to exit a roundabout
8. driven too close to the car in front
9. driven the wrong way down a one-way street

Aggressive driving-violation behaviours; have you ...

10. crossed double white lines to overtake on a sharp bend
11. participated in unofficial races
12. given chase to another driver who angered you
13. crossed double white lines to overtake even though there were vehicles approaching in the opposite lane a short distance away
14. driven on the pavement when caught in a traffic jam
15. exceeded the speed limit in an urban road (by $>$20 km/h)
16. overtaken even when close to turning
17. ignored a red light in an empty street at night
18. overtaken the driver in front when he/she was driving at the speed limit
19. driven after drinking alcohol

Appendix 2. Items in the questionnaire covering perceptions of the risk involved in the potential causes of motorcycle accidents (English translation of the original Chinese items)

Driving-related potential causes

1. Driving too close to the car in front
2. Speeding
3. Drink driving
4. Driving when tired
5. Not concentrating fully
6. Unsafe overtaking
7. Not signalling
8. Taking risks

Environment-related potential causes

9. Weather conditions
10. Type of road (such as urban, rural, highways, etc.)
11. Road-surface conditions
12. Other road users
13. Transport systems

Belief-related potential causes

14. Accidents are often unexplainable
15. Accidents are caused by an evil spirit
16. Improper driving attitudes
17. Lack of driving experience
18. Bad luck