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Different demographic and drinking profiles of motorcyclists and car drivers with the first-time offense of driving/riding under the influence of alcohol

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ABSTRACT

Background: Driving/riding under the influence (DUI) of alcohol is a major public concern worldwide. Only a few studies have distinguished DUI-related variables between motorcyclists and car drivers. This study examined the differences in demographic characteristics and drinking behaviors among first-time DUI offenders operating different transportation vehicles, and risk factors for frequent DUI (fDUI) among them.

Methods: We conducted an anonymous survey for 561 first-time DUI offenders who attended a mandatory educational program. Participants self-administered questionnaires concerning alcohol drinking behaviors and DUI. We defined fDUI as at least two DUI behaviors per month based on self-reported information. Demographic and drinking characteristics were compared between DUI offenders, car drivers and motorcyclists. Logistic regression analysis was used to examine risk factors for fDUI.

Results: Two-thirds of first-time DUI offenders were motorcyclists. Compared with car drivers, motorcyclists were younger and less educated, with a higher percentage of them being women and unmarried. Car drivers reported a higher rate of fDUI than motorcyclists (16.5% vs. 9.7%). Regression analysis revealed that binge drinkers had a higher fDUI risk in both groups. Regarding the drinking place prior to DUI behavior, workplace was significantly associated with fDUI in car drivers.

Conclusions: Distinct strategies may be required for motorcyclists and car drivers for DUI recidivism prevention, and drinking place interventions should also be considered.

1. Introduction

Driving/riding under the influence (DUI) of alcohol is a major public health concern worldwide. According to the 2004 World Health Organization report, approximately 20% of fatally injured drivers in high-income countries had excess alcohol in their blood, and the percentage was as high as 33%–69% in low- and middle-income countries (Margie Peden et al., 2004). In Taiwan, a high-income country, traffic accidents secondary to alcohol-impaired driving accounted for 18.8%–22% of all the traffic-related deaths between 2008 and 2012 (National Police Agency, 2019). Although the alcohol-related traffic fatalities decreased in the past 3 years in Taiwan, drunk driving remains a major public health problem. The number of DUI arrests increased from 5447 in 2013 to 7341 in 2016 in the northern city of Taiwan, Taipei, which has a population of 2.7 million (Taipei City Police Department, 2019).

Several countries in Asia such as China, Indonesia, Malaysia, Taiwan, Thailand, and Vietnam are listed among the top ranking countries in the world where people rely on motorcycles as the main transportation vehicles. According to the Ministry of Transportation and Communications of Taiwan, the major means of road transport were motorcycles and cars, which accounted for 45% and 23%, respectively (Ministry of Transportation and Communication, 2017). To date, only a few studies have investigated the pattern of DUI offense

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among different transportation vehicles.

Motorcyclists have a higher risk of injury and fatality than car drivers (Zambon and Hasselberg, 2006); injury rates and fatality rates of motorcyclists are estimated to be 8 times and 35 times higher than those of car drivers (per vehicle mile traveled), respectively (NHTSA, 2007; Ranney et al., 2010). In addition, motorcyclists are more likely to sustain serious injury than car drivers (Mannering and Grodsky, 1995; Plasència et al., 1995). Fatalities due to motorcycle accidents have been associated with alcohol consumption before driving. Approximately 24%–27% of fatalities of motorcyclist in France and the United States were due to motorcyclists being under the influence of alcohol (Department of Transportation of the United States, 2017; Papadimitriou et al., 2014). Nearly 60% of all driving fatalities involve motorcycles, and riding after drinking is a significant risk factor for the fatalities in Taiwan (Jou et al., 2012). The percentage of fatalities secondary to DUI was high, 40% of the fatalities of motorcyclists in single-vehicle crashes were associated with alcohol consumption (Huang and Lai, 2011). Furthermore, motorcyclists involved in fatal crashes had lower blood alcohol levels than car drivers (Holubowycz et al., 1994; Watson and Garriott, 1992), suggesting higher vulnerability of motorcyclists than that of car drivers to traffic accidents after alcohol consumption. However, differences in DUI attributes such as demographic characteristics, drinking behaviors, drinking places prior to DUI, and the involvement of repeat DUI incidents between car drivers and motorcyclists have been less studied. A distinct and appropriate policy may be required for motorcyclists to reduce the risk of fatalities caused by drunk driving.

Several studies have examined the features associated with first-time offenders (Cavaiola et al., 2007; Dickson et al., 2013; Hunter et al., 2006) to develop cost-effective interventions for preventing DUI reoccurrence. The potential predictors of DUI recidivism include alcohol drinking, poor driving records, substance use, and a criminal history. However, information on DUI recidivism in articles is derived from official arrest records, which may not reflect the “true” history of the DUI behavior of offenders. It has been estimated that DUI incidents that occur prior to an arrest range from one arrest in 50–200 trips (Beitel et al., 2000). Given that self-reported information may aid in identifying DUI incidents without arrest (Nochajski and Stasiewicz, 2006), it would be interesting to use the self-reported information to investigate risk factors for repeated DUI behaviors without arrest. In addition, the drinking characteristics and contexts of DUI offenders have been scarcely examined (Andreuccetti et al., 2014). For example, one study from the United States reported that among first-time DUI offenders, drinking on social occasions was more common than drinking alone (Beck et al., 2011). Prevention strategies tailored for the distinct characteristics of first-time DUI offenders, including drinking context and transportation vehicles, will reduce DUI recidivism more precisely.

In this study, we examined the differences in demographic characteristics and alcohol drinking behaviors between motorcyclists and car drivers with first-time DUI offences using chi-squared test and *t* test. Multiple logistic regression models were used to examine risk factors for frequent DUI behavior (fDUI) in both vehicle groups. In the present study, first-time DUI offenders refer to those with first-time DUI arrest, and fDUI was defined as having ≥2 DUI incidents without arrests per month in the past year according to self-reported information.

2. Methods

2.1. Study design and participants

According to the Article 185-3 of the Criminal Law of Taiwan, DUI is defined as a breath alcohol concentration (BrAC) of ≥0.25 mg per liter or a blood alcohol concentration (BAC) of ≥0.05%. Drivers violating the law are imprisoned as well as fined if arrested. Prosecutors have the right to mandate those with first-time DUI arrest to attend educational programs for enhancing the knowledge and awareness of driving regulations and the consequences of unhealthy drinking. Each offender received a 3-h educational session that is provided by the Taiwan Taipei prosecutors office once per month. During the study period from November 2016 to November 2017, a total of 13 sessions had been held, and we invited all the 1152 offenders who attended one of the 13 sessions to join the study. To again confirm their legal status, participants who identified themselves in the verification item of first-time DUI offenders on the questionnaire were included in the analysis. Individuals who did not complete the questionnaire because of language barriers, cognitive disability, and visual problems and those who were repeat DUI offenders were excluded. All the eligible participants were ≥18 years old and spoke Mandarin. The authors thoroughly explained the study aims and the details of survey before the participants filled out the questionnaire. A total of 666 offenders were eligible, and among them, 597 completed the self-administered questionnaire anonymously. The participants categorized themselves for the vehicle group in the questionnaire based on the vehicles operated by them at the time of DUI offense: car group (including, cars, vans, sport utility vehicles, light trucks, and buses), motorcycle group, and others (such as, trailer trucks, tow trucks, and tractors). After excluding those with incomplete or unidentifiable answers (N = 31) or operating vehicles other than cars or motorcycles (N = 5), 372 motorcyclists and 189 car drivers (n = 561) were included in our analysis. This study was approved by the Institutional Review Board of Taipei City Hospital (TCHIRB-10509105-E).

2.2. Measurements

The demographic characteristics of the participants were collected, including age, sex, educational level, and marital status. For drinking behavior measurements, the participants self-reported the operated vehicle and their drinking locations prior to DUI arrest. The participants chose a drinking location from a list: their own or friend’s house; restaurant, bar, nightclub, or karaoke bar; convenience stores, supermarkets, or grocery stores; workplaces; and other places. All the participants were asked the following question: “During the past year, how often have you driven after drinking alcoholic beverages with the frequency of DUI incidents for two or more times per month?.”

For alcohol drinking behaviors, the types of alcohol beverages the participants usually drank were recorded based on alcohol concentration as follows: (1) < 10% (e.g., beer and caffeinated alcoholic drinks); (2) 10%–39% (e.g., wine, rice liquor, and herb wine); and (3) 40% or more (e.g., Whisky and Gaoliang that are rather common in the Taiwanese society). In addition, the participants responded to questions regarding the age of their first drink and how many drinks of alcohol they usually drank per drinking episode in the past year. We also screened them for binge drinking, which is defined by World Health Organization (WHO) as drinking at least ≥60 g of pure alcohol on at least one occasion in the past 30 days (World Health Organization, 2010). Binge drinking or heavy episodic drinking is one of the most important indicators for acute consequences of alcohol use, such as accidents or injuries (Kuntsche et al., 2017), and is considered a hazardous drinking pattern in Taiwan (Wu et al., 2008). In accordance with WHO, one drink was defined as being equivalent to 10 g of pure alcohol in this study. We recorded whether the participant was engaged in regular binge drinking, which was defined as drinking ≥6 drinks per drinking episode at least once per month in the past year.

2.3. Statistical analysis

We compared the differences between motorcyclists and car drivers for demographic characteristics and drinking behaviors using chi-squared tests for categorical variables and *t* tests for continuous variables (Table 1). Logistic regression models are widely used to estimate the parameters of a regression model with binary outcome. It converts log-odds to probabilities, where an odds ratio > 1 represents an

Table 1
Comparison of demographic characteristics and drinking behaviors of DUI offenders operating different motor vehicles.

	All participants (n = 561)	Motorcycle (n = 372)	Car (n = 189)	*p*
Age, years ± SD	37.1 ± 12.3	34.4 ± 11.9	42.6 ± 11.5	< 0.001
Sex (female), n (%)(missing = 5)	105 (18.9%)	84 (22.8%)	21(11.2%)	0.001
Marital status (Married), n (%)	196 (34.9%)	97(26.1%)	99 (52.4%)	< 0.001
Educational years (missing = 5)				0.002
≤ 12 years, n (%)	225 (40.5%)	166 (45.0%)	(31.7%)	
> 12 years, n (%)	331 (59.5%)	203 (55.0%)	128 (68.5%)	
Age of first drink, years ± SD	18.5 ± 5.1	18.4 ± 5.4	18.8 ± 4.7	0.380
Regular binge drinking (missing = 7), n(%)	250 (45.1%)	173 (47.1%)	77 (41.2%)	0.180
Usual Alcohol strength (missing = 1)				< 0.001
< 10%	260 (46.4%)	190 (51.2%)	70 (37.0%)	
10-40%	63 (11.3%)	30 (8.1%)	33 (17.5%)	
> 40%	237 (42.3%)	151 (40.7%)	86 (45.5%)	
Drinking place (missing = 2)				0.190
Home	116 (20.7%)	80 (21.6%)	36 (19.1%)	
Restaurant or bars	361 (64.4%)	237 (64.1%)	123 (65.1%)	
Stores	26 (4.6%)	20 (5.4%)	5 (2.7%)	
Workplace	58 (10.3%)	33 (8.9%)	25 (13.2%)	
fDUI (missing = 2)	67 (12.0%)	36 (9.7%)	31 (16.5%)	0.020

DUI: driving/riding under the influence of alcohol; fDUI: frequent DUI (DUI ≥ 2 times/month).

increase in the odds of the dependent variable. We used multiple logistic regression models to examine the associations between drinking behaviors and self-reported fDUI (reference: < 2 DUI/month in the past year) in the two transportation vehicle groups after adjustment for demographic variables. Model goodness-of-fit was examined by likelihood ratio. SAS 9.4 (SAS Institute, Cary, NC, USA) was used for all analyses. Significance level was set at $p < 0.05$.

3. Results

The participants were aged 37.1 ± 12.3 years old. Among them, 451 (81.1%) participants were male, 331 (59.5%) participants finished high school education, and 196 (34.9%) were married. In the past 1 year, 310 (55.5%) participants reported that they were involved in DUI for more than once per month, whereas 67 (12.0%) participants were involved in fDUI (i.e., at least twice per month). Regarding the drinking context prior to the DUI offense, 361 (64.4%) of the offenders consumed alcohol in a restaurant or a pub, 116 (20.7%) at their own or friends' house, and 58 (10.3%) at their workplace. A total of 372 (66.3%) DUI offenders were riding a motorcycle, whereas 189 (33.7%) offenders were driving a car (Table 1).

Compared with car drivers, motorcyclist offenders were younger, less educated, and unmarried, with a higher percentage of them being females. fDUI was more common in car drivers than in motorcyclists (16.5% vs. 9.7%). Car drivers drank stronger alcoholic beverages than motorcyclists. In logistic regression analyses for the whole sample, car driving, drinking at workplace, and regular binge drinking were significantly associated with fDUI (Table 2). Further regression analysis for determining goodness-of-fit models for car drivers and motorcyclists revealed that regular binge drinking was associated with a higher fDUI risk in both groups, whereas drinking at workplace was significantly associated with a higher fDUI risk only in car drivers.

4. Discussion

This is the first study to examine differences in drinking behaviors and their association with fDUI in motorcyclists and car drivers. Two-thirds of first DUI offenders rode a motorcycle at the time of offense. Compared with motorcyclists, a higher percentage of car drivers reported fDUI. Regular binge drinking and drinking at the workplace prior to DUI offenses were associated with a higher fDUI risk in car drivers.

In our participants, the number of motorcyclists was twice the number of car divers. However, so far, the majority of preventive measures and advocacy activities against DUI have targeted car drivers, with minimal attention on motorcyclists. Car-driving DUI offenders usually cause more severe casualty and entail higher social cost, whereas motorcyclist offenders cause more harm to themselves. Motorcyclists had more disadvantaged sociodemographic profiles than car-driving offenders in this study. A nationwide cohort study reported that people with a low socioeconomic status had a higher risk of road-traffic injury than those with the highest socioeconomic status, suggesting that those with a disadvantaged socioeconomic status might be more involved in DUI (Zambon and Hasselberg, 2006). In line with this observation, another study also reported higher proportions of impaired driving among youth with a low socioeconomic status (Vaez and Laflamme, 2005). Motorcyclists constitute a substantial proportion of DUI offenders and are susceptible to severe injury, leading to heavy health and financial burden (Preusser et al., 1995); therefore, we suggest that distinct and appropriate preventive strategies against DUI motorcyclist offenders should be established. For instance, it has been observed that compared with unimpaired riders, alcohol-impaired motorcycle riding was associated with younger age, weekend and nighttime riding, and riding without valid license (Karl Kim and Eric Yamashita, 2000). Several motorcycle-specific policies, including night traffic regulation, use of helmets and reflective jackets, and alcohol restriction policies, have reduced traffic-injury deaths of motorcycle riders (Mena et al., 2014; Tsai et al., 2019).

Previous studies have demonstrated that DUI offenders are more likely to have alcohol drinking problems and other psychiatric disorders (Baley and Hoffman, 2015; Lapham et al., 2001; Lapham et al., 2011; Osilla et al., 2015). In our survey, 45% of the entire population are regular binge drinkers. Given that binge drinking has been implicated as a reliable indication of the likelihood of alcohol use disorders (Wu et al., 2008), our results support the association between alcohol use problems and DUI. In particular, in the regression analysis, regular binge drinking significantly increased the risk of fDUI, further suggesting that alcohol use problem enhances the possibility to repetitive occurrences of DUI. A routine screening of alcohol use problems and implementing intervention programs as well as treatment for alcohol use disorder are warranted for high-risk DUI offenders to reduce the recidivism rate.

Car drivers reported a higher likelihood to be involved in fDUI than motorcyclists. Experiences of DUI without accidents may strengthen the driver's sense of control over drinking and the driver may thereby overlook the potential danger, further reinforcing the DUI behavior

Table 2
Odds ratio of frequent DUI in offenders operating different transportation vehicles.

Variable	All (case = 66, n = 561))		Car (case = 31, n = 189)			Motorcycle (case = 35, n = 372)		
	OR	95% CI	OR	95% CI		OR	95% CI	
Age ≥ 40	0.87	(0.45, 1.66)	0.86	(0.35,	2.15)	0.87	(0.33,	2.31)
Male	1.08	(0.50, 2.33)	4.38	(0.45,	42.95)	0.73	(0.32,	1.71)
Education level (≥12 years)	0.63	(0.35, 1.15)	0.56	(0.19,	1.60)	0.75	(0.35,	1.62)
Marital status (Married)	1.24	(0.60, 2.11)	1.09	(0.43,	2.77)	0.88	(0.35,	2.21)
Regular binge drinking	**3.40**	**(1.82, 6.35)**	**4.23**	**(1.56,**	**11.46)**	**2.99**	**(1.27,**	**7.06)**
Drinking place							,	
Home	1		1			1		
Restaurant or bars	0.85	(0.41, 1.74)	1.59	(0.42,	6.00)	0.51	(0.20,	1.27)
Stores	1.49	(0.36, 6.08)	4.95	(0.32,	76.37)	0.84	(0.16,	4.50)
Workplace	**3.13**	**(1.33, 7.37)**	**8.43**	**(1.91,**	**37.15)**	1.51	(0.48,	4.76)
Usual Alcohol strength								
< 10%	1		1			1		
10-40%	1.37	(0.51, 3.70)	2.07	(0.50,	8.57)	0.98	(0.20,	4.79)
> 40%	1.62	(0.85, 3.09)	1.64	(0.55,	4.86)	1.66	(0.73,	3.77)
Car drivers (compared with motorcyclists)	**2.12**	**(1.15, 3.91)**						
Model Goodness of Fit (Log likelihood)								
Null Model	−200.91		−83.25			−114.82		
Full model	**−177.12**		**−69.32**			**−104.07**		

DUI: driving/riding under the influence of alcohol; fDUI: frequent DUI (DUI ≥ 2 times/month).

(Fuller, 1991). Although risk or safety perceptions between car-driving and motorcycle-riding DUI offenders were not examined in our study, we speculated that car drivers might perceive lower risks of accidents from DUI than motorcyclists because car driving is associated with higher protection levels.

One study revealed that social influence through peers' attitudes and behaviors may be associated with motorcyclists' engagement in drunk riding; in other words, those with friends that often drink and ride are more likely to be involved in the same behavior themselves (Papadimitriou et al., 2014). Our finding that drinking at workplaces was associated with a higher risk of fDUI among car drivers may also imply a result of social influence from the workplace, where coworkers tend to have the same attitude of neglecting the risk associated with DUI. Similarly, our previous study found that consuming beer and caffeinated alcoholic beverages is rather common in manual workers, and they are more likely to drink the beverages together with other workers at workplaces (Cheng and Cheng, 2016; Cheng et al., 2012). This further suggests that people might adopt the behavior norms of the peer group. However, the current countermeasures for DUI have only focused on restaurants, bars, or pubs that are generally believed to be the drinking locations prior to DUI events and have neglected the potential impact of alcohol drinking at workplaces. Our results highlight an urgent need for policy making to carefully consider countermeasures designed for workplaces to curtail DUI behaviors.

Evidence has revealed that younger people exhibit a higher tendency to drink and drive, but the same is not applicable in the case of motorcyclists (Papadimitriou et al., 2014). In our study, no significant associations between age and fDUI were found in car drivers. The potential age effect in car drivers may be attenuated because other drinking behavior measurements were adjusted in the regression models. In addition, sex, education level, and marital status were not associated with self-reported fDUI in both groups, which was consistent with previous findings (Bishop, 2011; Dickson et al., 2013), although an earlier study demonstrated that male sex might be a predictor of DUI recidivism (Marowitz, 1998). The measurement of fDUI in our study was based on self-reported information provided by the participants instead of their criminal offense records, which might more accurately reflect real-life DUI behavior.

This study has several limitations. The cross-sectional design did not allow us to determine the causal inference of fDUI behaviors of DUI car divers and workplace drinkers. Despite adjusting for demographic characteristics, other factors that were not measured in our study, such as criminal records, other substance use, and personality traits, may have confounded our results (Karjalainen et al., 2015; Lapham et al., 2001, 2011; Maxwell and Freeman, 2007; McCutcheon et al., 2009; Nelson et al., 2015; Shaffer et al., 2007). Participants who reported fDUI might choose to drive a car instead of riding a motorcycle when they have perceived high risks of being caught by policemen or having accidents after alcohol drinking (Syner and Vegega, 2001). This "adaptation" attempt might have resulted in an association between car driving and fDUI. Second, DUI offenders tend to underestimate their alcohol use behaviors or related-problems because of fear of ensuing legal problems (Lapham et al., 2004; McMillan et al., 2008). To reduce the effect of resistance or unreliable information, we adopted an anonymous survey and reassured the participants that the data they provide would not affect their legal state. Beitel et al. suggested that the probability of DUI arrest while driving at a BAC > 0.1% (approximately 0.5 mg/L of BrAC) was approximately 1 in 50–200 DUI incidents (Beitel et al., 2000). The criminal intoxication level for DUI in Taiwan is set at 0.25 mg/L for BrAC, which is lower than the 0.5 mg/L as examined in Beitel's report; thus, it is possibly associated with a higher probability than the estimation in Beitel's report. Nevertheless, our study data, which presented only 12% of the participants self-reported ≥2 DUI incidents per month in the past year, appeared to be an underestimation. Third, the participants in this study were aged ≥18 years; therefore, underage first-time offenders were neglected. The response rate for the questionnaire was slightly above 50% in this study, and a selection bias may exist because the included participants were probably better educated and motivated. It has also been reported that rural DUI offenders differ in their drinking behaviors from urban offenders (Malek-Ahmadi and Degiorgio, 2015). Therefore, the generalizability of our results is only limited to adult DUI offenders in urban areas.

5. Conclusions

Among first-time DUI offenders, sociodemographic characteristics and alcohol drinking severity differed between those who rode a motorcycle and those who drove a car. Car drivers are more likely to be involved in fDUI than motorcyclists. Regarding the risk factors accounting for fDUI, although sociodemographic characteristics were not associated with fDUI, a history of binge drinking presents a higher risk of fDUI for both groups. In particular, for car drivers, drinking at workplaces prior to the DUI event is associated with a higher likelihood of fDUI, which is not observed in motorcyclists. We suggest that distinct strategies may be required for motorcyclists and car drivers, and

drinking place interventions should also be considered for DUI recidivism prevention. For example, workplace intervention for employees with drinking problems may attenuate DUI recidivism, especially car drivers. In addition, employers should be responsible for the development and implementation of workplace drinking policies, particularly prohibition of driving after drinking. All drivers as well as motorcyclists should opt for public transport after drinking, and the accessibility of public transport is required to be ensured. Sobriety checkpoints and random breath testing should be set up near places where people are prone to binge drinking, such as restaurants and bars. Last but not least, the government and media should give more attention toward advocating the importance of avoiding drinking and riding to protect the motorcycle riders themselves as well as road users.

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Declaration of Competing Interest

The authors declare no conflict of interest.

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