

## Research Article

# Factors Affecting Recidivism of Drunk Driving for Car and Motorbike Users

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This study explored the important factors affecting the recidivism rate of drunk driving for car and motorbike users. The respondents were students of Taiwan's road safety training course, which was required for all drunk drivers who were suspended from driving due to the violation of regulations. The characteristics of the drunk car and motorbike drivers, such as socioeconomic variables, alcohol consumption changes, family life cycle, and changes in the number of trips, were investigated. This study estimated the models affecting the recidivism rate of drunk driving for car and motorbike users with the logistic regression model. The main variables included drivers with a university degree or above who tend not to be recidivists compared to the drivers without one. Such respondents are more willing to avoid the risk of becoming drunk driving recidivists. Moreover, the variables of alcohol use disorders' identification test (AUDIT), breath alcohol concentration, and frequency of drunk driving all significantly affect the possibility of recidivism. In terms of family life cycle, married respondents with children aged between 1 and 5 are less likely to become drunk driving recidivists. Those who take motorbikes as an alternative vehicle after being suspended from driving cars are more likely to become drunk driving recidivists. This study suggests the measures of suspending or withdrawing car and motorbike driver's licenses at the same time, using alcolocks to restrict the right to drive, and increasing the frequency of drunk driving crackdowns. In addition, in terms of alcohol consumption behaviors, drinkers with high risks and drunk drivers with high breath alcohol concentrations should be regarded as the key targets for future tracking in order to avoid drunk driving recidivism.

## 1. Introduction

Drunk driving accidents have long been a serious threat to traffic safety, as drunk drivers have a higher risk of being involved in traffic accidents than sober drivers, and the risk sharply increases with increasing blood alcohol concentrations [1]. Drunk driving not only causes enormous social costs but also leads to many broken families [2]. Therefore, in road traffic safety, drunk driving prevention has become a focus, and related agencies have enforced stricter measures through various approaches.

In 2016, a road traffic accident was the eighth leading cause of death, resulting in 1.35 million fatalities globally, at a rate of 18.2% per 100,000 inhabitants [3]. It has been widely reported that drunk drivers increase both the risk of traffic accidents and the probability of severe injury or death [4–6].

Specifically, 21.8% of all deaths from vehicular accidents are related to alcohol, resulting in approximately 306,002 deaths [7]. In Taiwan, there are more than 0.12 million drunk driving violation incidents per year, and one person dies per day on average due to drunk driving; that is, approximately one-sixth of deaths are due to drunk driving traffic crashes [8].

According to the National Police Agency (Taiwan), among A1 class traffic accidents (that is, someone is killed instantly or dies within 24 hours of when the accident occurred regardless of hospitalization or not) in Taiwan in the past 10 years, the top three causes of accidents due to drivers' negligence are related to drunk driving. While the proportion of drunk driving accidents has declined in recent years, the number of people prohibited from driving due to drunk driving still accounts for a certain proportion [9]. As

one of the main causes of road traffic accidents globally [10, 11], drunk driving increases the risk of injury or death for drunk drivers and puts other road users at risk.

In order to prevent drunk driving accidents, Taiwan has strengthened various prevention measures in terms of policies, legal institutions, safety promotion, and crackdown, and toughened the regulations and penalties for drunk driving. For example, the Ministry of Transportation and Communications implemented a new policy on drunk driving in July 2020. Anyone with a breath alcohol concentration over 0.15 mg/L or a blood alcohol concentration over 0.03% is considered a drunk driver, and fines vary by vehicle, ranging from NT\$ (US\$ = 30 NT\$) 30,000 to NT\$ 120,000 for cars and NT\$ 30,000 to NT\$ 90,000 for motorbikes. In order to reduce the rate of drunk driving recidivism, the fines for cars and motorbikes are progressive, with NT\$ 90,000 added to the previous amount for a third drunk driving offense within five years. In order to incite passengers to warn drivers not to drink and drive, fellow passengers over 18 and under 70 are subject to a fine of NT\$ 600–3000. Fines and years of driver's license suspension are increased for those who refuse to take the alcohol concentration test. First-time offenders are fined NT\$ 180,000, and those who refuse to take the alcohol test a second time are fined NT\$ 360,000 in addition to the previous amount. Moreover, the driver's licenses will be suspended for 3 years for first-time offenders and 5 years for recidivists. Drunk driving recidivists, those who cause injuries and deaths due to drunk driving, and those whose driver's licenses are suspended due to refusal to take the alcohol test are required to complete a 12-hour drunk driving prevention and control education program. Those who drive drunk more than three times are subject to treatment for alcohol addiction. After that, the supervision authority will issue one-year restricted driver's licenses. Drivers with restricted driver's licenses are only allowed to use restricted vehicles that are equipped with alcohol alcolocks (In Taiwan, a large number of applicants had participated in the driver's license examination from March 2020 to December 2020 after their driver's licenses were suspended. However, according to the news report (TVBS, 2020), only one installed the qualified alcolock and registered with the supervision authority, indicating the insignificant effect of the alcolock policy) and are required to return to the supervision authority regularly for alcolock maintenance and inspection every month [12].

As drunk driving is a significant threat to road safety and social stability, this study attempts to explore the important factors leading to drunk driving recidivism. In addition, in order to further understand the similarities and differences between drunk driving recidivists of cars and motorbikes, this study constructs drunk driving recidivism models for cars and motorbikes, respectively, which are intended to collect the characteristics of the drunk car and motorbike drivers, such as socioeconomic characteristics, alcohol consumption changes, family life cycle, and changes in the number of trips, to analyze the relationship between these characteristics and drunk driving recidivism. Finally, the significant variables affecting the drunk driving recidivism of cars and motorbikes are estimated by the logistic model. The

effects of significant variables on drunk driving recidivism are studied by calculating the odds ratios.

In addition to socioeconomic characteristics and alcohol consumption changes, the difference between this study and other studies is that the family life cycle stages of drunk drivers and the AUDIT at-risk drinker classification criteria (Many studies have shown that AUDIT at-risk drinker classification is highly associated with drunk driving, such as [13–16] are considered. Drivers who drink often suffer from alcohol use disorder. AUDIT is used for assessments of alcohol misuse [14, 16], and previous reports showed the relationship between AUDIT scores and DUIA prevalence [13, 15].

AUDIT consists of two parts. In the first part, the respondents' daily drinking habits are enquired, including amount, drinking frequency, and times of excessive drinking. In the second part, the effects of drinking on respondents' daily lives are investigated, including sleep quality, alcohol dependence, sense of guilt, frequency of alcoholic abstinence advice from relatives, and diagnosis of alcohol addiction.

In addition, this study considered the relationship between trip purpose and transport choice, as well as the relationship between changes in the number of trips and drunk driving recidivism before and after prohibition. Finally, the models for drunk car and motorbike drivers are, respectively, estimated by the logistic model, and policies are further developed for the significant variables in the models to reduce drunk driving recidivism.

The remainder of this paper is organized as follows: Section 2 offers the literature review, Section 3 provides the theoretical derivation of the models, Section 4 conducts data analysis, Section 5 shows the model estimation results, and Section 6 offers conclusions and suggestions.

## 2. Literature Review

*2.1. Drunk Driving.* Kaplan and Prato [17] researched the reduction of the legal blood alcohol concentration and extended the suspension or withdrawal of driver's licenses in order to reduce the casualties caused by drunk driving. The significant variables affecting the number of drunk driving accidents and deaths were estimated by a Poisson regression model. They found that the BAC reduction policy is more effective in reducing casualties than in reducing accidents; the elderly and women are more law-abiding than men and adults; drivers with passengers are more likely to reduce drunk driving with the policy change.

Hels et al. [18] researched the effects of alcohol and other psychoactive substances on serious injury accidents. According to the calculation of the logistic model, the risk of blood alcohol concentration (BAC) increases exponentially, and high alcohol concentrations ( $BAC \geq 0.8$  g/L) are related to serious injuries of drivers. Young drivers are at a higher risk of serious injuries than older drivers, and men seriously injured while driving under the influence of alcohol are 1.65 times the occurrences of women. That study proved that drunk driving with increased blood alcohol concentration would increase serious injuries.

Møller et al. [19] investigated the differences in demographic and socioeconomic characteristics of nondrunk driving, first-time drunk driving offenses, and drunk driving recidivism in Denmark. According to the ANOVA results, the rate of drunk driving recidivism was 17%, and first-time offenders were closely related to recidivists in terms of gender, age, income, educational level, early retirement pension, family type, and residence type. In particular, the degree of participation in crimes unrelated to drunk driving has a positive effect on the probability of drunk driving recidivism.

Chen and Jou [20] analyzed the personal characteristics and regional attributes of recidivists with the multilevel random logistic model and found that men are more likely to become drunk driving recidivists than women. Moreover, motorbike drivers are 1.6 times more likely to become recidivists than car drivers, and the probability of becoming recidivists is 6 times greater than that of first-time offenders with the increase of BAC. According to the results, strengthening community security and the development of public transport by governments can effectively reduce drunk driving recidivism and improve the safety of public roads.

C'de Baca et al. [21] estimated the recidivism probability of drunk drivers within four years by a logistic model. According to the variables, such as age, educational level, blood alcohol concentration, AUDIT, and the MacAndrews scale, most offenders with high BACs are alcohol addicts but can be improved by alcohol addiction treatment. Although the probability of being arrested cannot be accurately predicted, the method can be used to classify the drunk drivers who are most likely to become future recidivists.

Ferrante et al. [22] explored the time relationship between known drunk driving incidents and crashes. According to the multivariate survival analysis, if a driver's first drunk driving offense is the result of a road traffic accident, especially at a young age, he/she will be more likely to drive after drinking again and to have more car crashes. Similar to many studies, first-time offenders with high blood alcohol concentrations are more likely to drive after drinking again. Drunk drivers who have violated the criminal code are also more likely to become drunk driving recidivists and cause accidents.

Wang et al. [23] researched the differences between driving under the influence of alcohol (DUI) and driving while intoxicated (DWI) in China. The results showed that the blood alcohol concentration was between 0.02 mg/l and 0.08 mg/l for DUI offenders and higher than 0.08 mg/l for DWI offenders. According to the chi-squared test, drivers' age, time, casualties, and accident area are closely related to drunk driving. The results of the logistic model showed that DWI offenders are more likely to cause fatal accidents than DUI offenders and have a higher death rate.

García-Echalar and Rau [24] analyzed Chile's drunk driving law and its effects on car accidents, injuries, and deaths and used the blood alcohol test data to assess whether the law affects drivers' alcohol consumption. According to the results, the measures of suspending or withdrawing drivers' licenses, reducing the legal blood alcohol

concentration, and adding a year to the prison sentence for drunk drivers who cause injuries or deaths reduced alcohol consumption failed to decrease the deaths from drunk driving. The first two methods only affected men, and the third one affected both men and women, and none of the three affected heavy drinkers.

The literature on drunk driving is summarized in Table 1.

**2.2. Family Life Cycle.** WHO [25] researched the relationship between leisure barriers and the family life cycle stage and found that constraints on time, money, knowledge, attitude, and motivation affect risks or personal interests at a specific family life cycle stage. Their study took 5 stages of a family life cycle for investigation: the first stage (childless), the second stage (the youngest child aged between 1 and 5), the third stage (the youngest child aged between 6 and 12), the fourth stage (the youngest child aged between 13 and 18), and the fifth stage (the youngest child aged above 19).

Liang [26] divided the family life cycle into the expansion period and contraction period according to the changes in the number of family members, which are often used as the main factors to observe the transition of family life cycle stages. There are 2 stages according to the age of the oldest children: the first stage (childless - the eldest child aged 18) and the second stage (the eldest child aged above 19).

Saxton et al. [27] divided the family life cycle into 4 stages according to the age of the oldest children: the first stage (married and childless), the second stage is young family (the eldest child aged between 1 and 18), the third stage is middle-aged couples or after children leave home (the eldest child aged between 19 and 44), and the fourth stage is elderly couples or after retirement (the eldest child aged above 45). The literature on the family life cycle is summarized in Table 2.

Shen and Chen [28] explored the correlation between different backgrounds and marital satisfaction and the correlation between couples' communication and marital satisfaction. According to the descriptive analysis, linear regression analysis, and path analysis, the number of children and couples' communication are important variables affecting marital satisfaction, families with no children or four or more children have high marital satisfaction, and family variables, such as men, general and vocational high school or college degree or above, an age gap of couples between 0–4 years, and the first family life cycle stage, all have indirect effects on marital satisfaction through couples' communication.

### 3. Model

This study explored the important factors affecting drunk driving recidivists to construct the behavior models by the logistic model and estimated the coefficients of the models with STATA. We use SPSS as a statistical model to verify residual values. The principles of the models are explained as follows.

Assuming that the dependent variable  $Y$  is a binary variable, then  $P$  is the probability of recidivism ( $0 \leq p \leq 1$ , the

TABLE 1: Review of literature on drunk driving.

Author	Method	Dependent variables	Significant factors
Kaplan and Prato [17]	Poisson	Alcohol-related accidents and the number of deaths	BAC, male, adult (+), and passenger (-)
Hels et al. [18]	Logistic	Risk of alcohol-related accidents	BAC and male (+)
[19]	ANOVA	Nondrunk driversFirst-time drunk driving offendersDrunk driving recidivists	Gender, age, income, education level, early retirement pension, family type, and residence type
Møller et al. [20]	Multilevel random effects logistic	Drunk driving recidivists	Individual: male, age, motorcycle, BAC, Friday, Saturday (+)Area: report, alcohol consumption, Divorce rate (+) Education level, number of bus trips, and community security patrol teams (-)
C’de Baca et al. [21]	Logistic	Drunk driving recidivists	Age, BAC, AUDIT, MacAndrews test (+), and education level (-)
Ferrante et al. [22]	Multivariate survival analysis	Drunk driving recidivists	Age, male, first offense BAC, criminal arrest, and drink driving arrest (+)
Wang et al. [23]	(1) Chi-squared test(2) Logistic	DWI offenders	(1) Age, time, casualties, and accident area(2) Casualties, death, and injury (+)
García-Echalar and Rau [24]	Poisson-gamma	Drunk driving accidents, deaths and injuries	Suspending or withdrawing drivers’ licenses, reducing legal BAC, and adding a year to the prison sentence for drunk drivers who cause injuries or deaths (-)

TABLE 2: Analysis of socioeconomic characteristics of the first-time offenders and recidivists who drive cars and motorbikes.

Basic information	A			M			
	First time Sample (%)	Recidivists Sample (%)	Total Sample (%)	First time Sample (%)	Recidivists Sample (%)	Total Sample (%)	
<i>Gender</i>	Female	19 (9.7)	7 (6.4)	26 (8.5)	56 (14.4)	9 (6.3)	65 (12.2)
	Male	176 (90.3)	103 (93.6)	279 (91.5)	334 (85.6)	134 (93.7)	468 (87.8)
<i>Age</i>	18~25	16 (8.2)	3 (2.7)	19 (6.2)	53 (13.6)	1 (0.7)	54 (10.1)
	26~35	38 (19.5)	13 (11.8)	51 (16.7)	75 (19.2)	20 (14)	95 (17.8)
	36~45	59 (30.3)	40 (36.4)	99 (32.5)	101 (25.9)	44 (30.8)	145 (27.2)
	46~55	52 (26.7)	34 (30.9)	86 (28.2)	101 (25.9)	53 (37.1)	154 (28.9)
	56 up	30 (15.4)	20 (18.2)	50 (16.4)	60 (15.4)	25 (17.5)	85 (16)
<i>Marital status</i>	Married	86 (44.1)	55 (50)	141 (46.2)	163 (41.8)	56 (39.2)	219 (41.1)
	Single	109 (56)	55 (50)	164 (54)	227 (58)	87 (60.8)	314 (58.9)
<i>Education level</i>	Primary school	5 (2.6)	2 (1.8)	7 (2.3)	8 (2.1)	4 (2.8)	12 (2.3)
	Junior high school	40 (20.5)	31 (28.2)	71 (23.3)	62 (15.9)	33 (23.1)	95 (17.8)
	Senior high school	84 (43.1)	46 (41.8)	130 (42.6)	175 (44.9)	85 (59.4)	260 (48.8)
	5-year college	14 (7.2)	11 (10)	25 (8.2)	33 (8.5)	10 (7)	43 (8.1)
	University	52 (26.7)	20 (18.2)	72 (23.6)	112 (28.7)	11 (7.7)	123 (23.1)
<i>The number of courses</i>	1 class	187 (95.9)	56 (50.9)	243 (79.7)	379 (97.2)	77 (53.9)	456 (85.6)
	2 classes	7 (3.6)	31 (28.2)	38 (12.5)	9 (2.3)	33 (23.1)	42 (7.9)
	More than 3 classes	1 (0.5)	23 (20.9)	24 (7.9)	2 (0.5)	34 (23.8)	36 (6.8)
<i>Reasons for violation</i>	Slight	67 (34.4)	29 (26.4)	96 (31.5)	141 (36.2)	38 (26.6)	179 (33.6)
	Strict	116 (59.5)	77 (70)	193 (63.3)	230 (59)	94 (65.7)	324 (60.8)
	Refusal to the test	12 (6.2)	4 (3.6)	16 (5.3)	19 (4.9)	11 (7.7)	30 (5.6)
Total	195 (100)	110 (100)	305 (100)	390 (100)	143 (100)	533 (100)	

\*, the average number of vehicles per person.

closer  $p$  is to 0, the smaller the success probability of  $Y$ , and vice versa), which is affected by independent variable  $x$ , and the relationship between  $p$  and  $x$  can be expressed as follows:

$$p(Y = 1 | X = x) = \frac{e^{f(x)}}{1 + e^{f(x)}} = \frac{e^{x'\beta}}{1 + e^{x'\beta}}, \quad (1)$$

$$1 - p(Y = 1 | X = x) = \frac{1}{1 + e^{f(x)}} = \frac{1}{1 + e^{x'\beta}},$$

where the odds ratio is defined as the ratio of the success probability to the failure probability of an event and is expressed as follows:

$$\frac{P}{1 - P} = e^{f(x)}. \quad (2)$$

The logistic regression can be expressed as follows:  $\beta_0$  is the intercept of the regression model,  $x_m$  is the independent variable of the sample,  $\beta_m$  is the corresponding vector coefficient, and  $m$  indicates the number of independent variables:

$$\ln \frac{P}{1 - P} = f(x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots + \beta_m x_m. \quad (3)$$

The logistic regression is estimated by the maximum likelihood estimation (MLE), and its likelihood function is expressed as follows (when  $y_i = 1$ , the sample  $i$  is a recidivist; when  $y_i = 0$ , the sample  $i$  is a first-time offender):

$$L(\beta) = \prod_{i=1}^n p_i^{y_i} (1 - p_i)^{1 - y_i}. \quad (4)$$

#### 4. Data Analysis

This study distributed questionnaires (Questionnaire was designed mostly based on the study done by [8] to the students (All drunk drivers who are suspended from driving for violation of regulations are required to take the road safety training course, which meets the sampling requirements. This method is choice-based sampling) of the road safety training course at the supervision stations in central Taiwan from August 17 to October 26, 2020, for a total of 71 days. Supervision stations were taken as the investigation sites; questionnaires were distributed in the road safety training course. Each student received a copy of the questionnaire. An investigator explained the questions on the platform and instructed the students to answer the questions in order, and collected the questionnaires after checking for completeness. A total of 846 questionnaires were collected, and 838 questionnaires were valid after screening. The criterion for the invalid questionnaires was that the violation was due to drunk driving of bicycles or electric bicycles.

This study divided the respondents into two groups according to the type of vehicles they used during the violation: cars (A) and motorbikes (M), with a total of 305 samples and 533 samples, respectively. In the following sections, the differences between first-time offenders and

recidivists in the two groups are statistically analyzed by focusing on the socioeconomic characteristics, family life cycle, alcohol consumption changes, and changes in the number of trips by the respondents.

**4.1. Socioeconomic Characteristics.** According to Table 2, in terms of gender, the proportion of male offenders is about 90% (motorbikes: 86%; cars: 94%), and the result was the same in ([19, 22]. Generally, drunk driving is more prevalent among male drivers than among female drivers because of higher compliance with the law among females [17].

Drunk drivers were mostly aged between 36 and 55, and the proportion of male recidivists is greater than that of first-time offenders in both groups of cars and motorbikes. The result was the same in [20]. Regarding marital status, the proportion of single drivers is greater than that of married drivers, and the result was the same in [19]. Besides, single recidivists in the motorbike group are the most. Regarding the educational level, first-time offenders with junior, senior high school, or vocational school are the most in the two groups, and most first-time offenders in Group A have a university degree or above.

More than 90% of the first-time offenders who drive cars and motorbikes after drinking were taking the road safety training course for the first time, and recidivists participated in the road safety training course more often than first-time offenders. In terms of the reasons for violation, the breath alcohol concentrations of most drunk drivers were above 0.25 mg/L, and recidivists had high breath alcohol concentrations, accounting for 70% and 65% in the two groups, respectively.

Regarding occupation, the largest proportion of offenders who drive cars and motorbikes after drinking work in service and in industry. The result was the same in [8]. It is probably because of the greater opportunity of drinking due to social culture in Taiwan. Regarding incomes, most offenders who drive cars and motorbikes after drinking earned NT\$ 20,000 to NT\$ 40,000. The reason behind this result could be a reflection of the occupation described above.

Families in Group A owned more cars than those in Group M, but the families of first-time offenders owned more cars than the families of recidivists in Group M. Families in Group M owned more motorbikes than those in Group A, and 50% of families of first-time offenders owned more than two motorbikes in Group M. There were few bicycle owners in either group, and 20% recidivists in Group A owned bicycles.

**4.2. Family Life Cycle.** The number of children raised in families of drunk drivers is shown in Table 3, and most drunk drivers in both groups had no children. The result was the same in [19]. With the exception of the families of recidivists in Group M, the proportion of families raising 2 children was greater than that of families raising 1 child. Overall, families with no children were in the majority, followed by families with two children.

At different stages of the family life cycle, people face different responsibilities and face different obstacles and

TABLE 3: The number of children raised in families of the first-time offenders and recidivists who drive cars and motorbikes.

Basic information	A			M		
	First time Sample (%)	Recidivists Sample (%)	Total Sample (%)	First time Sample (%)	Recidivists Sample (%)	Total Sample (%)
Child = 0	81 (41.5)	41 (37.3)	122 (40)	203 (52.1)	69 (48.3)	272 (51)
Child = 1	31 (15.9)	21 (19.1)	52 (17.1)	44 (11.3)	27 (18.9)	71 (13.3)
Children = 2	55 (28.2)	27 (24.6)	82 (26.9)	102 (26.2)	23 (16.1)	125 (23.5)
Children $\geq 3$	28 (14.4)	21 (19.1)	49 (16.1)	41 (10.5)	24 (16.8)	65 (12.2)
Total	195 (100)	110 (100)	305 (100)	390 (100)	143 (100)	533 (100)

moral and economic pressures. Thus, to understand the high-risk groups causing drunk driving recidivism, this study explored the first-time drunk driving offenders and recidivists in the two groups at different family life cycle stages (according to the relationship between family life cycle and marital satisfaction by Shen and Chen [28], the family life cycles of married couples [26], the classification by the age of the eldest children [27], and the classification by the age of the youngest children [25]). The family life cycle statistics by [26] are shown in Table 4. As seen, the proportion of car and motorbike recidivists is greater than that of first-time offenders at the second stage, but the proportions of first-time offenders and recidivists who drive cars and motorbikes are similar at the two stages. According to the family life cycle statistics by Saxton [27], as shown in Table 4, the proportion of first-time offenders and recidivists who drive cars and motorbikes is the greatest at the third stage (except for first-time offenders driving motorbikes), followed by the second stage. The samples are insufficient at the fourth stage. According to the family life cycle statistics by [25], as shown in Table 4, the first-time offenders and recidivists who drive cars and motorbikes are mainly at the fifth stage, followed by the fourth stage, and recidivists are more concentrated than first-time offenders. The classification of [26] is too general, while the classification of Saxton [27] fails to conform to sample characteristics. In order to understand the family life cycle changes, this study adopted the family life cycle classification of [25] by considering two principles, namely, the sample size in each layer and indicative layering stage.

#### 4.3. Drinking Habits, Alcohol Problems, and Treatment.

Table 5 shows the drunk driving habits and alcohol addiction diagnosis and treatment. Before the drunk driving crackdown, most people drive 0 times after drinking per week, and the proportion of recidivists with a high frequency of drunk driving is greater than that of first-time offenders. Overall, the frequency of drunk driving in Group A is higher than that in Group M. The majority of respondents do not receive a diagnosis of alcohol addiction and do not need treatment for alcohol addiction.

Table 6 shows respondents' drinking preferences, among which beer is the most common in Taiwan, followed by whiskey. It should be noted that the result cannot explain the relationship between the level of alcohol consumption and the risk of collisions in Taiwan.

Figures 1 and 2 show the changes in the percentage of alcohol consumed by first-time offenders and recidivists of drunk driving in groups A and M before and after drunk driving crackdown. Recidivists who drink too much (seven or more drinks every time) were reduced by a larger percentage than first-time offenders ( $T$ -test shows that these two groups are significantly different, with  $p < 0.05$ ). Interestingly, recidivists were more willing to abstain from alcohol (0 drinks) than first-time offenders.

Overall, in Group A, the average amount of drinks consumed by first-time offenders dropped from 1.5 to 1.1, and that consumed by recidivists dropped from 2.5 to 1.8. In Group M, the average amount of drinks consumed by first-time offenders dropped from 3.1 to 2.3, and that consumed by recidivists dropped from 3.3 to 2.5. The average alcohol consumption of Group A was lower than that of Group M, and the alcohol consumption of Group M was more related to drunk driving than that of Group A.

Figures 3 and 4 show the changes in the drinking frequency of first-time offenders and recidivists in Group A and Group M before and after the drunk driving crackdown. After the crackdown, while both first-time offenders and recidivists reduced the drinking frequency in their daily lives, there was an obvious reduction in frequent drinkers ( $>7$  times).  $T$ -test shows that these two groups are significantly different with  $p < 0.05$ . Overall, in Group A and Group M, the distribution of drinking frequency before and after the crackdown and the proportion of people changing drinking frequency was different. The average drinking frequency of first-time offenders decreased from 2.1 times to 1.6 times in both groups, and the average drinking frequency of recidivists decreased from 2.8 times to 2.2 times in Group A and from 3 times to 2.2 times in Group M.

4.4. Changes in the Number of Trips. According to the trip purposes, the changes in the number of car trips by first-time offenders and recidivists before and after the crackdown are organized in Table 7. Regarding the number of trips, both first-time offenders and recidivists reduced the number of trips before and after the crackdown, with the exception of recidivists attending school and picking up relatives. Regarding the average number of trips per person per week, except for first-time offenders shopping, purchasing, and picking up relatives, as well as recidivists attending school, going to work, and picking up relatives, trips for other purposes were reduced after the crackdown (but

TABLE 4: Family life cycles of the first-time offenders and recidivists who drive cars and motorbikes.

Family life cycle	A		M	
	First-time offenders	Recidivists	First-time offenders	Recidivists
Liang [26]				
The first stage (childless-the eldest child aged 18)	44 (51.16%)	26 (47.27%)	92 (56.44%)	31 (46.27%)
The second stage (the eldest child aged 19 or above)	42 (48.84%)	29 (52.73%)	71 (43.56%)	36 (53.73%)
Saxton [27]				
The first stage (childless)	8 (9.30%)	9 (16.36%)	19 (11.66%)	6 (8.96%)
The second stage (the eldest child aged between 1 and 18)	36 (41.86%)	17 (30.91%)	73 (44.79%)	25 (37.31%)
The third stage (the eldest child aged between 19 and 44)	42 (48.84%)	29 (52.73%)	69 (42.33%)	35 (52.24%)
The fourth stage (the eldest child aged 45 or above)	0 (0.00%)	0 (0.00%)	2 (1.23%)	1 (1.49%)
Witt and Goodale [25]				
The first stage (childless)	8 (9.30%)	9 (16.36%)	19 (11.66%)	6 (8.96%)
The second stage (the youngest child aged between 1 and 5)	16 (18.60%)	4 (7.27%)	20 (12.27%)	3 (4.48%)
The third stage (the youngest child aged between 6 and 12)	16 (18.60%)	6 (10.91%)	34 (20.86%)	11 (16.42%)
The fourth stage (the youngest child aged between 13 and 18)	18 (20.93%)	13 (23.64%)	33 (20.25%)	20 (29.85%)
The fifth stage (the youngest child aged 19 or above)	28 (32.56%)	23 (41.82%)	57 (34.97%)	27 (40.30%)
Total	86 (100%)	55 (100%)	163 (100%)	67 (100%)

TABLE 5: Drunk drinking habits, alcohol problems, and treatment of the first-time offenders and recidivists who drive cars and motorbikes.

Basic information	A			M			
	First time Sample (%)	Recidivists Sample (%)	Total Sample (%)	First time Sample (%)	Recidivists Sample (%)	Total Sample (%)	
<i>Frequency of drunk driving</i>	0 times	128 (65.6)	47 (42.7)	175 (57.4)	266 (68.2)	65 (45.5)	331 (62.1)
	1 time	32 (16.4)	22 (20)	54 (17.7)	67 (17.2)	27 (18.9)	94 (17.6)
	2 times	12 (6.2)	15 (13.6)	27 (8.9)	22 (5.6)	21 (14.7)	43 (8.1)
	3~4	11 (5.6)	12 (10.9)	23 (7.5)	16 (4.1)	13 (9.1)	29 (5.4)
	5~7	12 (6.2)	14 (12.7)	26 (8.5)	19 (4.9)	17 (11.9)	36 (6.8)
<i>Diagnosis of alcohol addiction</i>	Before prohibition	4 (2.1)	1 (0.9)	5 (1.6)	3 (0.8)	12 (8.4)	15 (2.8)
	None	177 (90.8)	95 (86.4)	272 (89.2)	360 (92.3)	107 (74.8)	467 (87.6)
	After prohibition	4 (2.1)	4 (3.6)	8 (2.6)	4 (1)	4 (2.8)	8 (1.5)
<i>Treatment for alcohol addiction</i>	Diagnosed as not addicted to alcohol	10 (5.1)	10 (9.1)	20 (6.6)	23 (6)	20 (14)	43 (8.1)
	Treatment before drunk driving	1 (0.5)	3 (2.7)	4 (1.3)	2 (0.5)	8 (5.6)	10 (1.9)
	Treatment after drunk driving	4 (2.1)	3 (2.7)	7 (2.3)	5 (1.3)	5 (3.5)	10 (1.9)
	No treatment is required	190 (97.4)	104 (94.6)	294 (96.4)	383 (98.2)	130 (90.9)	513 (96.3)
Total	195(100)	110 (100)	305 (100)	390 (100)	143 (100)	533 (100)	

TABLE 6: Types of alcohol consumed by the first-time offenders and recidivists who drive cars and motorbikes.

Basic information	A			M			
	First time Sample (%)	Recidivists Sample (%)	Total Sample (%)	First time Sample (%)	Recidivists Sample (%)	Total Sample (%)	
<i>Types of alcohol</i>	Beer	135 (44)	80 (46.2)	215 (44.8)	295 (50.5)	102 (47.9)	397 (49.8)
	Whiskey	62 (20.2)	34 (19.7)	96 (20)	106 (18.2)	30 (14.1)	136 (17.1)
	Red wine	22 (7.2)	8 (4.6)	30 (6.3)	33 (5.7)	8 (3.8)	41 (5.1)
	Sorghum liquor	31 (10.1)	29 (16.8)	60 (12.5)	61 (10.5)	42 (19.7)	103 (12.9)
	Vodka	11 (3.6)	6 (3.5)	17 (3.5)	27 (4.6)	6 (2.8)	33 (4.1)
	Brandy	12 (3.9)	7 (4.1)	19 (4)	9 (1.5)	6 (2.8)	15 (1.9)
	Sake	11 (3.6)	2 (1.2)	13 (2.7)	11 (1.9)	4 (1.9)	15 (1.9)
	Others	23 (7.5)	7 (4.1)	30 (6.3)	42 (7.2)	15 (7)	57 (7.2)
Total	307(100)	173 (100)	480 (100)	584 (100)	213 (100)	797 (100)	

insignificantly). According to such results, the average number of trips per person per week did not decrease significantly before or after the crackdown, meaning it was

difficult to reduce trips with high levels of purpose dependence. In other words, people with low dependence were more likely to decrease their trip purposes.

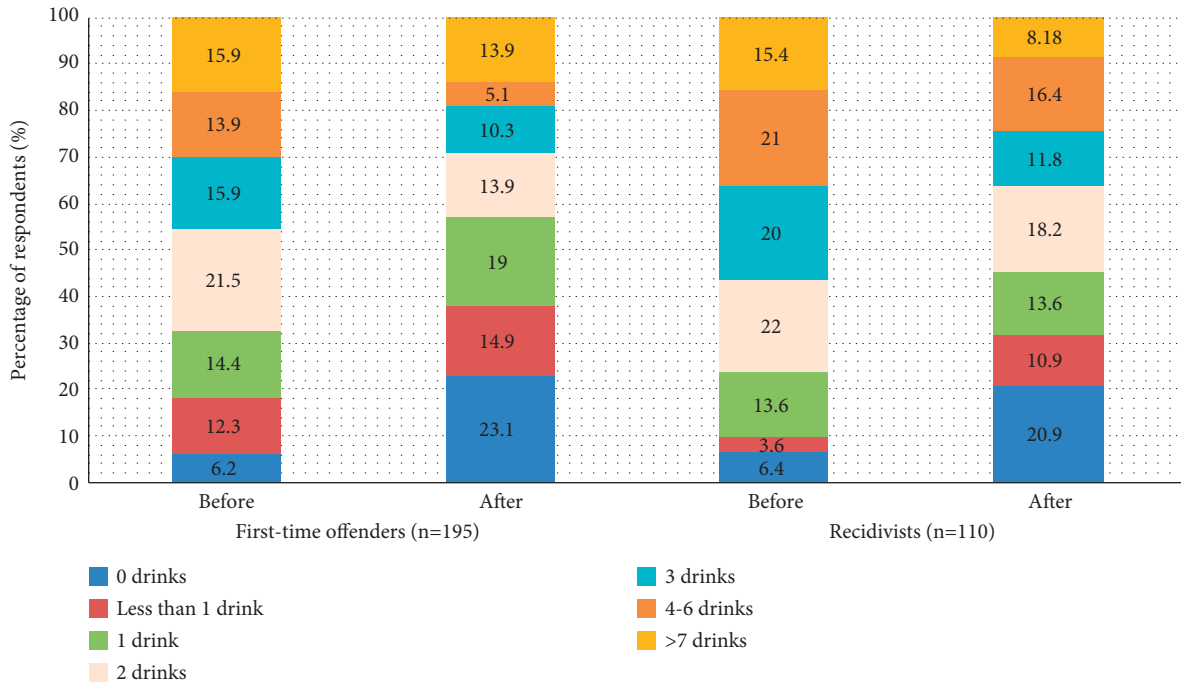


FIGURE 1: Changes in alcohol consumption of group A before and after drunk driving prohibition.

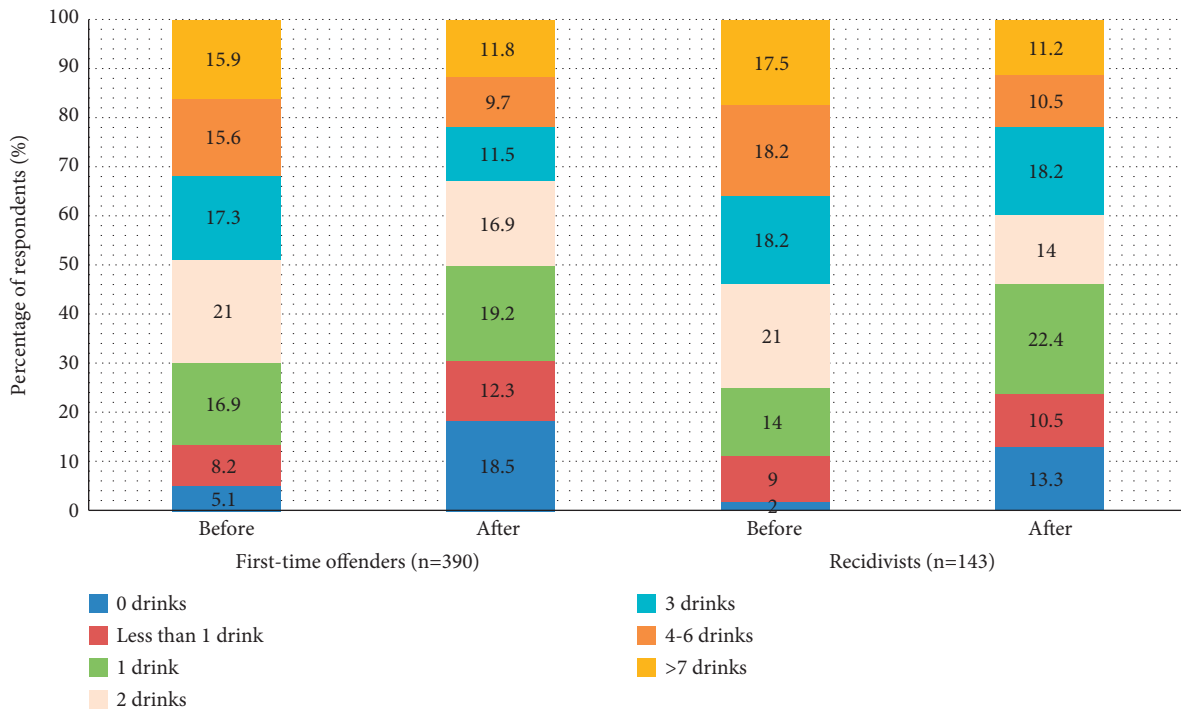


FIGURE 2: Changes in alcohol consumption of group M before and after drunk driving prohibition.

As the majority of vehicles used by the respondents when being suspended from driving were cars and motorcycles, the number of trips by alternative vehicles, such as passenger cars, public transports, and bicycles, are combined in this study. Table 8 shows the changes in the number of car trips by first-time offenders and recidivists before and after crackdown according to the vehicle choice. In the car group

affected by suspensions or withdrawal of driver’s licenses, the number of trips by first-time offenders and recidivists was significantly reduced, but the number of trips per person per week was not significantly reduced. The number of motorbikes used by first-time offenders and recidivists increased, which was probably because car driver’s licenses were suspended or withdrawn. Thus, motorbikes were taken



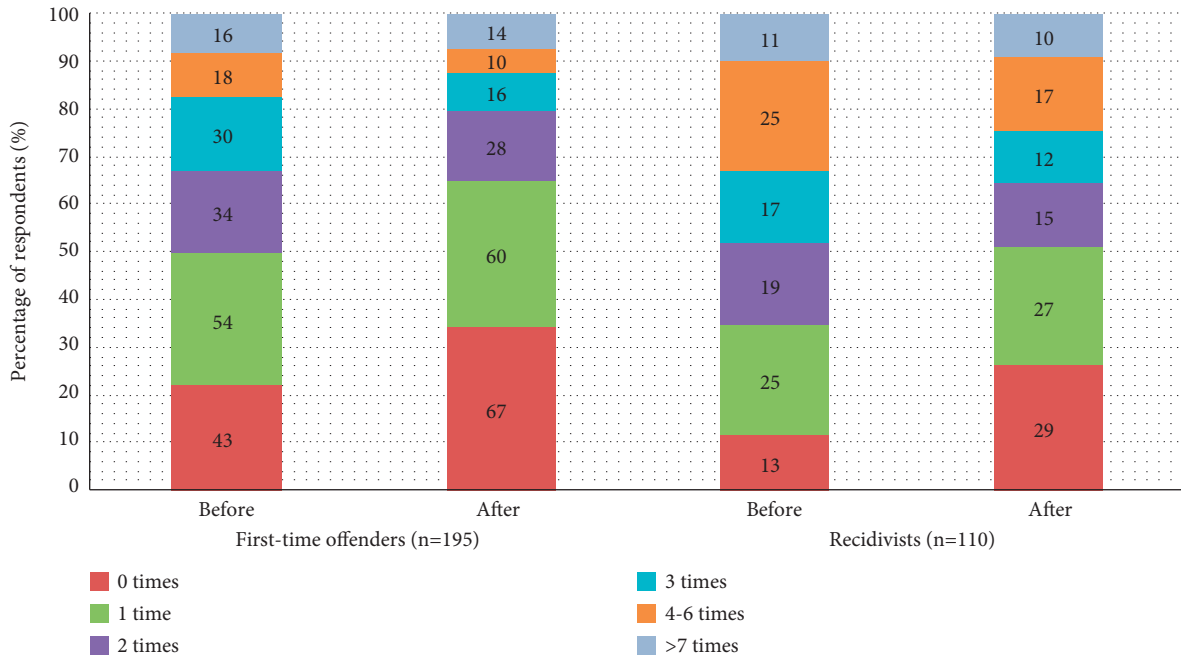


FIGURE 3: Changes in drinking frequency of group A before and after drunk driving prohibition.

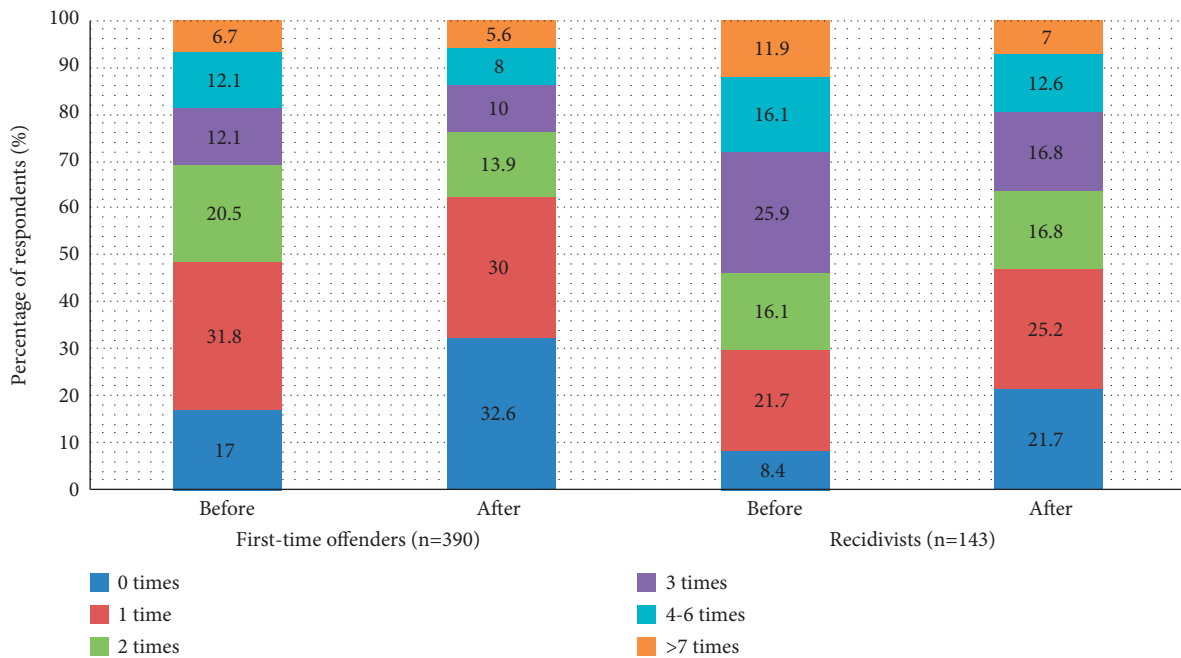


FIGURE 4: Changes in drinking frequency of group M before and after drunk driving prohibition.

as alternative vehicles in order to meet the transportation needs of daily life.

In order to understand the changes in vehicle choice of drunk car drivers whose driver’s licenses were suspended or withdrawn, Table 9 analyzes the samples of changes in the number of trips by various vehicles before and after crackdown when the number of vehicles in use is not 0. There was a decrease in the samples of car trips and an increase in the samples of motorbike trips, suggesting that

drivers switched from cars to motorbikes after the penalty for drunk driving. The samples of decreased car trips and increased motorbike trips were small, which was possibly because the drunk drivers who were willing to reduce their car trips were less likely to reduce motorbike trips at the same time in order to maintain normal daily trips. The number of car trips by most respondents remained the same. That is, they still used cars for transportation after their driver’s licenses were suspended or withdrawn. This was

TABLE 7: Changes in the number of car trips by first-time offenders and recidivists before and after crackdown (by trip purpose).

Trip purposes (trips/person perweek)	First-time offenders		Recidivists	
	Before	After	Before	After
Commuting	1803 (1.45)	1546 (1.43)	912 (1.21)	782 (1.24)
Attending school	222 (0.81)	126 (0.75)	98 (1.27)	104 (1.65)
Working	1147 (1.34)	689 (1.22)	424 (0.93)	364 (1.63)
Shopping and purchasing	943 (0.86)	716 (1.09)	384 (1.28)	317 (0.92)
Socializing and entertaining	852 (1.15)	610 (1.08)	365 (1.27)	341 (1.22)
Picking up relatives	424 (0.45)	312 (0.89)	115 (0.21)	123 (0.92)
Others	306 (1.18)	206 (1.18)	59 (0.70)	20 (0.41)
Total number of trips	5697 trips	4205 trips	2357 trips	2051 trips

Note: the figures in brackets are the average number of trips per person per week.

TABLE 8: Changes in the number of car trips by first-time offenders and recidivists before and after crackdown (by vehicle).

Vehicle choice (trips/person perweek)	First-time offenders		Recidivists	
	Before	After	Before	After
Cars	3447 (1.41)	1865 (1.33)	1346 (1.19)	739 (1.10)
Motorbikes	1524 (1.13)	1848 (1.22)	870 (1.28)	1054 (1.43)
Passenger cars/public transports/bicycles	726 (2.76)	492 (2.15)	141 (1.60)	258 (2.49)
Total number of trips	5697 trips	4205 trips	2357 trips	2051 trips

Note: the figures in brackets are the average number of trips per person per week.

TABLE 9: Analysis of vehicle changes before and after the crackdown of the first-time offenders and recidivists who drive cars.

Changes in the number of trips	Vehicles	First-time offenders			Recidivists		
		Samples	Before	After	Samples	Before	After
Cars and motorbikes	Cars↓	32	1024 (4.57)	123 (0.55)	17	486 (4.08)	56 (0.47)
Decrease and increase	Motorbikes↑		155 (0.69)	1033 (4.61)		62 (0.52)	463 (3.89)
Cars and motorbikes	Cars↓	7	248 (5.06)	25 (0.51)	10	134 (1.91)	30 (0.43)
Decrease and decrease	Motorbikes↓		240 (4.90)	82 (1.67)		242 (3.46)	131 (1.87)
Cars and motorbikes	Cars-	61	1476 (3.46)		29	462 (2.28)	
Unchanged and decrease	Motorbikes↓		199 (0.47)	199 (0.47)		147 (0.72)	117 (0.58)
Cars and motorbikes	Cars↓	37	222 (0.86)	190 (0.73)	22	137 (0.89)	140 (0.91)
Decrease and unchanged	Motorbikes-		426 (1.64)			321 (2.08)	

Note: the figures in brackets are the average number of trips per person per week.

possibly because they still used cars upon expiration of their suspension or withdrawal of driver's licenses. In other words, suspension or withdrawal of driver's licenses had only temporary effects on the vehicle use restrictions of drunk drivers. Drunk drivers were willing to take the risk of driving without a license, regardless of the suspension or withdrawal of their driver's licenses, and such drivers are potential hazards to road safety. The respondents with the same number of motorbike trips take second place in the total. The changes in the average number of car trips per person per week were insignificant, which indicates that the number of car trips did not change greatly when the number of motorbike trips was not affected, which further verifies the changes from cars to motorbikes.

According to trip purposes, the analysis results of the changes in the number of motorbike trips by first-time offenders and recidivists before and after crackdown are shown in Table 10. Although the number of trips decreased before and after the drunk driving crackdown, the average number of trips per person per week was not significantly reduced. Perhaps when the drivers had more trips for certain

purposes, they became more relied on those trips. Therefore, it is difficult to change their trip behaviors, especially for first-time offenders who commute to work. In contrast, respondents that did not consider trip purposes were more likely to reduce the number of trips for certain purposes, such as picking up relatives.

According to vehicle choice, the analysis results of the changes in the number of motorbike trips by first-time offenders and recidivists before and after crackdown are shown in Table 11. Although the number of motorbike trips significantly decreased, the number of trips per person per week was not significantly reduced. Perhaps the respondents who were willing to change their vehicles no longer used motorbikes for transportation, and those who continued to use motorbikes for transportation did not reduce their daily trips due to the suspension or withdrawal of their driver's licenses. According to the results, before and after the drunk driving crackdown, the average number of trips by each first-time offender per week increased, and first-time offenders were more dependent on motorbikes than recidivists. As the driver's licenses of first-time offenders were suspended or

TABLE 10: Changes in the number of motorbike trips by first-time offenders and recidivists before and after crackdown (by trip purpose).

Trip purposes (trips/person per week)	First-time offenders		Recidivists	
	Before	After	Before	After
Commuting	3654 (1.35)	3386 (1.41)	988 (1.08)	818 (1.04)
Attending school	432 (1.29)	413 (1.64)	89 (0.79)	64 (0.76)
Working	922 (1.11)	763 (1.08)	409 (1.08)	263 (0.99)
Shopping, purchasing	1425 (0.93)	1196 (0.94)	473 (0.90)	301 (0.84)
Socializing and entertaining	1175 (0.97)	988 (0.93)	295 (0.74)	216 (0.69)
Picking up relatives	493 (0.81)	403 (0.83)	170 (0.81)	109 (0.78)
Others	338 (1.05)	295 (1.05)	130 (1.03)	101 (1.03)
Total number of trips	8439 trips	7444 trips	2554 trips	1872 trips

Note: the figures in brackets are the average number of trips per person per week.

TABLE 11: Changes in the number of motorbike trips by first-time offenders and recidivists before and after crackdown (by vehicle).

Vehicle choice (trips/person per week)	First-time offenders		Recidivists	
	Before	After	Before	After
Cars	1498 (0.92)	2035 (1.07)	631 (1.09)	397 (0.93)
Motorbikes	6332 (1.26)	4076 (1.37)	1706 (0.93)	1016 (0.91)
Passenger cars/public transports/bicycles	609 (1.98)	1333 (2.53)	217 (2.62)	459 (2.65)
Total number of trips	8439 trips	7444 trips	2554 trips	1872 trips

Note: the figures in brackets are the average number of trips per person per week.

withdrawn, the number of their trips by other vehicles was increased.

In order to understand the changes in vehicle choice of drunk motorbike drivers whose driver’s licenses were suspended or withdrawn, Table 12 analyzes the samples of changes in the number of trips by various vehicles before and after crackdown when the number of vehicles in use is not 0. The results show that there was an increase in the samples of car trips and a decrease in the samples of motorbike trips. Different from the vehicle changes shown in Table 12, after the punishment for drunk driving, the number of trips made by car instead of by motorbike is not exactly equal. It may cost more for drunk motorbike drivers to use cars as alternative vehicles, which affects the vehicle changes. The samples of decreased car trips and increased motorbike trips are small, which was possibly because the drunk drivers who are willing to reduce car trips are less likely to reduce motorbike trips at the same time, in order to maintain normal daily trips. The respondents with the same number of car trips take second place in the total, and the number of trips and the average number of trips per person per week is both lower than the car drivers under violation. This proves that motorbikes remained to be the main vehicle for most drunk drivers who were suspended from driving motorbikes after the violation. The number of motorbike trips by most respondents also remained the same. The changes in the average number of car trips per person per week were insignificant. This indicates that the number of car trips does not change greatly if the number of motorbike trips is not affected, which further verifies the changes from cars to motorbikes.

### 5. Model Estimation Results

5.1. *Drunk Car Drivers.* This study explored the important influencing variables between first-time offenders (0) and

recidivists (1) by the logistic regression model. First, the respondents driving cars when stopped for drunk driving are taken as samples, and the important factors affecting drunk driving recidivists are estimated by the logistic regression model. The descriptions of the significant variables in model estimation and the estimation results are summarized in Tables 13 and 14. According to the tables, the daily drinking frequency and alcohol consumption of the respondents were estimated by WHO’s AUDIT. The respondents who were classified as high-risk drinkers before and after the drunk driving crackdown by AUDIT, and failed to change their daily alcohol consumption pattern after the drunk driving crackdown, were more likely to become drunk driving recidivists. The odds ratio of 1.59 suggests that their drinking patterns increased the probability of recidivism. Those with a breath alcohol concentration of more than 0.25 g when stopped for drunk driving are more likely to become recidivists. These results are consistent with previous findings, meaning that the likelihood of recidivism increases with the increase in blood alcohol concentration at the time of testing [21, 29]. The respondents who drink and drive more than 3 times within a month before crackdown frequently drive after drinking and are more likely to become recidivists, with an odds ratio of 2.18. For those who only made trips by car before the crackdown and used motorbikes as alternative vehicles to make trips after the crackdown. The punishment for drunk driving was ineffective on those drivers, and it may be difficult to change their awareness of drunk driving. The probability of recidivism is 2.28 times that of the first offense offenders. The respondents who only made trips by car before and after the crackdown are highly dependent on cars. The effect of punishment for drunk driving could be enhanced by not being able to use alternative vehicles, which reduces the likelihood of becoming recidivists.

TABLE 12: Analysis of vehicle changes before and after the crackdown of the first-time offenders and recidivists who drive motorbikes.

Changes in the number of trips (Decrease, increase)	Vehicles	First-time offenders			Recidivists		
		Samples	Before	Samples	Before	Samples	Before
(Cars, motorbikes)	Cars↑		159 (0.49)	906 (2.81)		4 (0.10)	80 (1.90)
(Decrease, increase)	Motorbikes↓	46	948 (2.94)	48 (0.15)	6	113 (2.69)	21 (0.50)
(Cars, motorbikes)	Cars↓		250 (1.88)	85 (0.64)		37 (0.88)	10 (0.24)
(Decrease, decrease)	Motorbikes↓	19	350 (2.63)	75 (0.56)	6	56 (1.33)	4 (0.10)
(Cars, motorbikes)	Cars–		885 (1.86)			218 (2.08)	
(Unchanged, decrease)	Motorbikes↓	68	816 (1.71)	658 (1.38)	15	125 (1.19)	113 (1.08)
(Cars, motorbikes)	Cars↓		422 (0.45)	406 (0.43)		188 (0.46)	180 (0.44)
(Decrease, unchanged)	Motorbikes–	134	2785 (2.97)		59	653 (1.58)	

\*The figures in brackets are the average number of trips per person per week.

TABLE 13: Description of variables in the drunk driving recidivism model for cars.

Variables	Meaning explanation	Min	Max	Mean	Standard deviation
AUDIT	High-risk drinkers before and after crackdown	0	1	0.5	0.5
RB2	A breath alcohol concentration of more than 0.25 g when tested	0	1	0.64	0.48
DDT34	Driving after drinking more than 3 times within a month	0	1	0.16	0.37
BCAM	Only driving cars before crackdown and only driving motorbikes after crackdown	0	1	0.16	0.23
BCAC	Only driving cars before and after crackdown	0	1	0.06	0.37
FCB2	The second stage of Witt (the youngest child aged between 1 and 5)	0	1	0.07	0.25
Age1	Aged between 18 and 25	0	1	0.06	0.24
CC1	Reduction of car trips to complete work tasks	0	1	0.14	0.35
Edu5	University degree or above	0	1	0.24	0.42

Being in the second stage family life cycle (married and the youngest children aged between 1 and 5) is the main turning point for a family, as couples tend to have moral and financial constraints due to their children [25, 28]. They may reduce their risk of drunk driving in order to avoid family stress and are more likely to become first-time offenders. Young respondents aged between 18 and 25 are less likely to become drunk driving recidivists; the odds ratio of 0.24 indicates that the likelihood of becoming recidivists is reduced because driver's licenses are not issued long enough. The respondents who make fewer car trips to complete working tasks tend to reduce the necessary number of business trips because they are being punished for drunk driving. This indicates that the suspension or withdrawal of driver's licenses affects their work, and they will pay more attention to future drunk driving; hence, they are less likely to become drunk driving recidivists. Those with a university degree or above have higher socioeconomic status and are more willing to spend money on designated driving services or taxis in order to avoid the risk of becoming drunk driving recidivists, as suggested by [8].

The results of Collinearity Diagnostics, as shown in Table 14, the VIF value of each variable is not greater than 10, so it is judged that the collinearity between the independent variables is not serious, and the regression model can effectively predict the dependent variables.

**5.2. Drunk Motorbike Drivers.** The motorbike drivers under violation are taken as samples, and the important factors affecting drunk driving recidivists are explored by the logistic regression model. The explanations of variables and

the estimation results are summarized in Tables 15 and 16, respectively. According to the estimation results, men are more likely to become drunk driving recidivists than women (with an odds ratio of 2.65), which is consistent with previous studies. [30] showed that a high proportion of men are classified as high-risk drinkers. [17] found that men are more likely to become recidivists, as women are more law-abiding. The respondents who drink and drive more than 3 times within a month before crackdown frequently drive after drinking and are considered high-risk drinkers and more likely to become recidivists, with an odds ratio of 2.56.

Similar to the car drivers under violation, those classified as high-risk drinkers by AUDIT are more likely to become recidivists due to their alcohol consumption patterns, especially the motorbike drivers under violation, with an odds ratio of 2.38. Drunk drivers who drank more frequently each week after crackdown are more likely to engage in risky alcohol consumption and are twice as likely to become recidivists as first-time offenders. Similar to the samples who use cars as vehicles when driving after drinking, young people are less likely to become drunk driving recidivists because their driver's licenses are not issued long enough and they are inexperienced in driving. The odds ratio of 0.05 indicates that because they hold licenses for a short time, they are less likely to become recidivists. Drinkers with a breath alcohol concentration between 0.15 g and 0.25 g when stopped for drunk driving are those who drove after drinking small amounts of alcohol, and they do not believe that alcohol affects their driving behaviors. They are subject to penalties (fine, suspension of driver's licenses) and mandated for traffic safety education (road safety training course) in order that

TABLE 14: Estimation results of the drunk driving recidivism model for cars.

Explanatory variables	$\beta$	Z	Odds ratio	VIF
Constant terms	-0.84	-2.9***	0.43	
AUDIT	0.46	1.81*	1.59	<b>1.046</b>
RB2	0.51	1.88*	1.67	<b>1.021</b>
DDT34	0.78	2.31**	2.18	<b>1.043</b>
BCAM	0.83	1.78*	2.28	<b>1.129</b>
BCAC	-0.55	-1.71*	0.58	<b>1.067</b>
FCB2	-1.04	-1.71*	0.35	<b>1.063</b>
Age1	-1.40	-2.11**	0.25	<b>1.016</b>
CC1	-0.95	-2.29**	0.39	<b>1.059</b>
Edu5	-0.65	-2.05**	0.52	<b>1.034</b>
Sample size		305		
Log likelihood		-182.27		
Pseudo R2		0.09		

\*\*\*,  $\alpha = 1\%$ ; \*\*,  $\alpha = 5\%$ ; \*,  $\alpha = 10\%$ .

TABLE 15: Description of variables in the drunk driving recidivism model for motorbikes.

Variables	Meaning explanation	Min	Max	Mean	Standard deviation
MALE	Male	0	1	0.88	0.33
DDT34	Driving after drinking more than 3 times within a month	0	1	0.13	0.34
AUDIT	High-risk drinkers before and after crackdown	0	1	0.53	0.5
F2	Increased drinking frequency after crackdown	0	1	0.05	0.22
HC0	Families own no cars	0	1	0.38	0.49
RB1	A breath alcohol concentration between 0.15 g and 0.25 g when tested	0	1	0.33	0.3
FCB2	The second stage of Witt (the youngest child aged between 1 and 5)	0	1	0.04	0.47
WC2	Increased car trips for commuting	0	1	0.09	0.2
N4	Same number of motorbike trips before and after crackdown	0	1	0.36	0.28
Edu5	University degree or above	0	1	0.23	0.22

TABLE 16: Estimation results of the drunk driving recidivism model for motorbikes.

Explanatory variables	$\beta$	Z	Odds Ratio	VIF
Constant terms	-2.24	-4.92	0.11	
MALE	0.97	2.41**	2.65	<b>1.048</b>
DDT34	0.94	3.25***	2.56	<b>1.037</b>
AUDIT	0.87	3.83***	2.38	<b>1.055</b>
F2	0.69	3.03***	2.00	<b>1.014</b>
HC0	0.49	2.28**	1.64	<b>1.111</b>
RB1	-3.10	-3.00***	0.05	<b>1.023</b>
FCB2	-0.65	-2.78***	0.52	<b>1.013</b>
WC2	-1.59	-2.06**	0.20	<b>1.122</b>
N4	-1.36	-2.87**	0.26	<b>1.113</b>
Edu5	-0.37	-1.68*	0.69	<b>1.076</b>
Sample size		550		
Log likelihood		-274.79		
Pseudo R2		0.15		

\*\*\*,  $\alpha = 1\%$ ; \*\*,  $\alpha = 5\%$ ; \*,  $\alpha = 10\%$ .

they may become more cautious about drunk driving and less likely to become recidivists.

In the second stage of the family life cycle, meaning being married and having the youngest children aged between 1 and 5, the drivers feel the changes in their marital relationship and tend to face moral and financial constraints due to their children [25, 28]. Those drivers may reduce their risk of drunk driving to avoid family stress and are more likely to

become first-time offenders. The respondents who make more car trips for commuting, namely, those who use cars instead of motorbikes, may try to prevent their driver's licenses from being suspended or withdrawn again and will avoid drunk driving recidivism. By reducing their drinking frequency and alcohol consumption, they are less likely to become recidivists, with an odds ratio of 0.26. Those with the same number of motorbike trips before and after the crackdown were not affected by the withdrawal or suspension of their driver's licenses, and they paid more attention to drunk driving, which may be due to their dependence on motorbikes.

The results of Collinearity Diagnostics are as shown in Table 16; the VIF value of each variable is not greater than 10, so it is judged that the collinearity between the independent variables is not serious, and the regression model can effectively predict the dependent variables.

5.3. Summary. This study explored drunk drivers using cars and motorbikes and estimated the relationship between first-time offenders and recidivists by the logistic regression model. The results of AUDIT indicate that the recidivism probability for high-risk drinkers is 1.59 times higher than for the first offense probability. The drunk drivers with a breath alcohol concentration greater than 0.25 g when tested have a higher recidivism probability [21, 29], with an odds ratio of 1.67; regarding the respondents who drink and drive

more than 3 times within a month before the crackdown, due to the poor concept of drunk driving prevention, the recidivism probability is 2.18 times higher than the first offense probability. Regarding those who used only cars before crackdown and motorbikes after the crackdown, the punishment for drunk driving is not very effective, and the recidivism probability is 2.28 times higher than the first offense probability. Regarding those who only make car trips before and after the crackdown, the penalties for drunk driving may reduce the recidivism probability, with an odds ratio of 0.58. Regarding married drivers with their youngest children aged between 1 and 5, they may reduce their drinking frequency or avoid drunk driving to avoid moral and economic pressures [25, 28], with an odds ratio of 0.35. Regarding young people aged 18 to 35 with insufficient driving experience, the recidivism probability is 0.25 times higher than the first offense probability. Regarding those making fewer car trips to complete work tasks, the recidivism probability is reduced, with an odds ratio of 0.39. Regarding respondents with a university degree or above, the recidivism probability is 0.52 times higher than the first offense probability. Drunk drivers make fewer car and motorbike trips before and after crackdown.

The test results of respondents driving motorbikes after drinking show that men are high-risk drunk drivers, which is consistent with Bisop et al. [30]. Kaplan and Prato [17] pointed out that the recidivism rate of women is 2.58 times higher than the first offense rate because they are more law-abiding. Regarding the respondents who drank and drove more than 3 times within a month before crackdown, due to the poor understanding of the concepts of drunk driving prevention and habits, their recidivism probability is 2.45 times higher than the first offense probability. According to AUDIT, high-risk drinkers have significant effects on the drunk driving recidivists of motorbikes, with an odds ratio of 2.31. Thus, arranging more drunk driving prevention and alcohol consumption improvement courses for such respondents can effectively solve the recidivism rate for driving motorbikes after drinking. Moreover, drunk drivers who drink more frequently each week after crackdown are more likely to engage in risky alcohol consumption. Thus, the recidivism probability is twice as high as the first offense probability. Married drivers with youngest children aged between 1 and 5 may reduce their drinking frequency or avoid drunk driving, in order to avoid moral and economic pressures, with an odds ratio of 0.2. Regarding those who make more car trips to commute to work to prevent their driver's licenses from being suspended or withdrawn, the recidivism probability is 0.26 times lower than the first offense probability. Those who make the same total number of motorbike trips before and after crackdown are highly dependent on motorbikes. In order to avoid being punished again for drunk driving, which would affect their daily trips, they tend to pay more attention to the losses caused by drunk driving, with an odds ratio of 0.69.

High-risk alcohol consumption and high-frequency drunk driving habits are both important factors affecting drunk driving recidivism, which is the same for car and motorbike drivers. Compared with motorbike drivers, car

drivers who use motorbikes as alternative vehicles are more likely to become recidivists. Motorbikes have lower costs than cars as alternative vehicles, and car drivers have an average of 1.5 motorbikes per family. This indicates that the prevalence of motorbikes in Taiwan reduces the penalty of suspension and withdrawal of driver's licenses. The recidivism rate of drunk car drivers increases with the increase of the breath alcohol concentration when tested. On the other hand, with the decrease of alcohol concentration when tested, the recidivism rate of drunk motorbike drivers is decreased. When the original vehicles are still used after crackdown, the results indicate that, due to their dependence on the vehicle, they are more likely to understand that they are being punished for drunk driving, and they will correct their drunk driving habits and reduce the possibility of future drunk driving. There are significant findings in drunk car and motorbike drivers. Regarding the respondents driving cars after drinking, childless drunk drivers are continuously tracked and the road safety training course focuses on moral and economic persuasions, which is intended to enhance their self-discipline abilities. In addition to fines of more than NT\$ 15,000 and less than NT\$ 80,000, as stated in Article 114 of Road Traffic Safety Regulations (Laws and Regulations Database) and Article 35 of the Road Traffic Management and Penalty Act, the government has strengthened punishments for those with high breath alcohol concentrations according to "the crime of dangerous driving" in Article 185 of the Criminal Code, which applies increased fines (more than NT\$ 30,000 and less than NT\$ 80,000) for every 0.15 g of alcohol concentration increase. Regardless of driving cars or motorbikes, AUDIT this variable shows that the recidivism probability of high-risk drinkers is higher. Since the respondents with drunk driving habits before crackdown are more likely to reoffend, the number of road safety training courses can be increased to improve the awareness of drunk driving, or alcolocks are required to be installed to prevent drunk drivers from recidivism.

## 6. Conclusion and Suggestions

**6.1. Conclusion.** In central Taiwan, most drunk drivers are first-time offenders and only 1/3 of them are recidivists, which is similar to the distribution proportion in the study of Fell and Hedlund [31]. While the penalty for drunk driving is to suspend or revoke driver's licenses, the use of motorbikes as alternative vehicles for daily trips will reduce the threat of legal punishment. Thus, the recidivism probability is high. The majority of respondents did not change their vehicles or the number of trips, and the model estimation results show that this behavior can reduce the probability of recidivism. In addition, drunk car drivers are more likely to use motorbikes as an alternative for their daily needs because the owners of cars are more likely to own motorbikes as well.

According to the estimation results, alcohol consumption patterns have significant effects on the recidivism rate of drunk driving. As dangerous alcohol consumption patterns are often the sign of a tendency to engage in drunk driving [30], various measures, such as advice and treatment, are

considered as an important part of correcting drunk driving offenses [32, 33]. As the breath alcohol concentration increases, the probability of drunk driving will increase significantly in the future. According to Allsop [34] and Borkenstein et al. [35], with the increase of the alcohol concentration test value, the accident rate increases. The Taiwan government has raised the fines on those with higher alcohol concentrations and enforced penalties according to the Criminal Code to reduce the harm of drunk driving caused by high alcohol concentration. The drunk driving habits before crackdown directly affect the recidivism rate of drunk drivers. For routine trip purposes (commuting and working), the respondents with high dependence on routine trips and are willing to use alternative vehicles or reduce the number of trips made by their original vehicles pay more attention to the punishment for drunk driving.

**6.2. Policy Implications.** This study offers suggestions according to the results to facilitate further research and policy revision.

- (1) The situation that drunk car drivers use motorbikes as alternative vehicles or that drunk motorbike drivers use cars as alternative vehicles will greatly affect the effectiveness of the penalties on drunk driving. Suspending and withdrawing driver's licenses for cars and motorbikes, using alcolocks to restrict the right to drive after drinking, and increasing the frequency of police taking crackdown measures have the effects of deterrence and supervision, and fewer people are driving after drinking without licenses.
- (2) In the road safety training course, in addition to the harms caused by drunk driving, the effects of alcohol consumption should be stressed. High-risk drinkers can be tracked in the future by AUDIT, in order to understand their habits and frequency of drunk driving and provide good concepts for drunk driving prevention, thereby reducing the probability of future recidivism.
- (3) Drivers with a high breath alcohol concentration when tested have a higher probability of recidivism. In addition to increasing the fines, penalties, and punishments, the government may reduce the future probability of recidivism by increasing the road safety training courses and making drivers receive a mandatory diagnosis of alcohol addiction.
- (4) Families in different stages have different tasks and pressures. According to our estimation results, the family at different stages might, to some extent, reduce the likelihood of drunk driving recidivism. For example, when children are between the ages of 1 and 5. That is, when they face the dual difficulties of childrens' education and economic burden, couples will tend to make themselves an example and improve their alcohol consumption habits. Reducing the divorce rate and increasing the fertility rate might

improve social development and reduce the likelihood of drunk driving recidivism.

## Data Availability

The data used to support the findings of the study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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