



## Examining factors associated with postintervention recidivism in DUI repeat offenders after alcohol treatment: One-year follow-up study

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### ABSTRACT

Taiwan has deemed driving under the influence of alcohol (DUI) to be criminal, and offenders are subjected to fines and jail penalties without being offered alcohol-related treatment, although alcohol use problems are prevalent in this population. We followed the recidivism records of DUI repeat offenders for one year after they had received a newly established legal-medical joint intervention program for alcohol treatment and examined factors related to postintervention recidivism. In this study, 231 DUI repeat offenders with alcohol use problems screened out by the Alcohol Use Disorder Identification Test were referred from the prosecutors' office to one psychiatric hospital for SBIRT-based alcohol treatment. We divided the participants into two groups based on the official recidivism records within the year following the end of treatment. The study used a Cox proportional hazards model to examine the hazard ratio of the baseline clinical characteristics and intervention duration for post-treatment recidivism. The study used generalized estimation equation models to examine changes in psychological symptoms and drinking behaviors over time. We found that participants who recidivated in the next year after intervention did not differ from those without recidivism records in all measurements except for the length of duration they stayed in treatment. Survival analysis determined that participants who had received the intervention for >4 months showed significantly lower rates of one-year postintervention recidivism rates. The study participants showed improved psychological symptoms and drinking behaviors during the follow-up period. In conclusion, adequate duration of alcohol treatment is a significant factor associated with a lower risk of postintervention recidivism. The results provide some insight into the design of a collaborative program between legal and medical systems to reduce DUI recidivism and improve mental health of DUI repeat offenders.

### 1. Introduction

Driving under the influence of alcohol (DUI) is a major traffic safety and public health concern worldwide. An estimated 5%–35% of road deaths are related to DUI (World Health Organization, 2018). According to the Ministry of the Interior of Taiwan, the rate of DUI was 245 per 100,000 people and 5% of road injuries involved DUI, with nearly 20%

of deaths attributed to alcohol-related crashes (Ministry of the Interior of Taiwan, 2015). DUI recidivism rates within 5 years are high, ranging from 21% to 47% (Fell et al., 2009; Nochajski & Stasiewicz, 2006). Compared to first-time offenders, repeat offenders are more likely to be involved in fatal motor-vehicle crashes (Dickson et al., 2013). These observations highlight a need to identify pertinent factors related to DUI recidivism, and which measures could be optimally effective to

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counteract DUI and DUI recidivism.

Alcohol use problems, which are common among DUI offenders (Nochajski & Stasiewicz, 2006), can be a major risk factor for DUI recidivism (Cavaola et al., 2007). The prevalence and severity of alcohol use problems among offenders increases with a higher frequency of prior DUI convictions. McCutcheon found that 78.9%, 89.2%, and 97.5% of first-time, second-time, and third-time DUI offenders, respectively, had alcohol use disorder (AUD) (McCutcheon et al., 2009). Compared with first-time offenders, repeat offenders presented a heightened alcohol attentional bias toward cues and greater preoccupation with alcohol, and thus had more difficulty refraining from drinking before driving despite a history of DUI offense (Miller & Fillmore, 2014). Given the severe drinking problems in repeat offenders, interventions incorporating alcohol treatment that aim to manage the drinking problems may be beneficial for reducing the recurrences of DUI (Karasov & Ostacher, 2014). One recent study examining policies aimed at reducing DUIs across 194 countries found that offering medical treatment for offenders with drinking problems was effective (Cheng & Pien, 2018).

Evidence indicates that educational courses or psychosocial interventions are only marginal effective in lowering DUI recidivism rates (Elder et al., 2005; Timko et al., 2011; Vaucher et al., 2016; Williams et al., 2007). Research has suggested that interventions that combine legal sanctions with alcohol treatment that adopts a multicomponent approach, integrating, for example, education, cognitive behavioral therapy, or a brief motivational intervention, are some of the best strategies (DeYoung, 1997; Dill & Wells-Parker, 2006). However, few studies have examined the factors associated with DUI recidivism following different intervention strategies and findings have been inconclusive. For example, while younger repeat offenders showed a better outcome in recidivism than older repeat offenders in one study (Ouimet et al., 2013), another study reported that this group was less adherent to an intervention and thus more likely to recidivate (Robertson et al., 2016). Although drinking severity was associated with higher recidivism rates (Robertson et al., 2009), some evidence instead showed that DUI offenders with heavier previous drinking displayed more favorable behavior changes (Beadnell et al., 2012). Furthermore, in contrast to mandatory interventions that usually take more than one year for illicit drug abusers referred from the legal system (Sloan et al., 2016), intervention durations for DUI offenders in previous studies were less than 3 months (Beadnell et al., 2015; Ma et al., 2015; Mills et al., 2008; Robertson et al., 2013). DUI recidivists with AUD may warrant a longer intervention; but whether the duration of an intervention influences the risk of recidivism remains unclear.

In Taiwan, DUI is deemed criminal and offenders are subjected to fines and/or jail penalties when arrested. Taiwan has not incorporated alcohol treatment in interventions for DUI offenders despite that alcohol use is prevalent in the country and research has shown that it can be a contributing factor to recurrence of DUIs (Chang et al., 2019). Since 2015, Taiwan Taipei District Prosecutors Office (TTDPO) has first collaborated with Taipei City Hospital (TCH) to establish an alcohol treatment program that lasts for more than three months for DUI repeat offenders with alcohol use problems. In this study, we followed recidivism records for one year after the end of treatment and examined factors that were associated with postintervention recidivism. In addition, as treatment engagement is an important factor for recidivism (Robertson et al., 2009; Robertson et al., 2016) and the participants stayed in treatment for various lengths of time, we also evaluated the association of the length of time in treatment with recidivism risks. Finally, we examined participants' changes in psychological symptoms and drinking behaviors during the follow-up period.

## 2. Methods

### 2.1. Study participants

The Research Ethics Committee of Taipei City Hospital approved this observational study (IRB No: TCHIRB-1080510). In Taiwan, according to the Road Traffic Management and Penalty Act, DUI offense is defined as having a breath alcohol concentration (BrAC) of  $\geq 0.15$  mg/L at the time of offense. Drivers with BrAC  $\geq 0.15$  violate road traffic security rules and face license suspension or revocation, or a financial penalty, whereas drivers with a BrAC of  $\geq 0.25$  mg/L are prosecuted by the district prosecutors office and subject to criminal charges and imprisonment, criminal detention, or a high fine. In this pilot project, repeat offenders referred to those with two or more DUI convictions (i.e. BrAC  $\geq 0.25$  mg/L). Randomized trials have demonstrated that Screening, Brief intervention, and Referral to Treatment (SBIRT) is effective in minimizing alcohol use and alcohol-related consequences including DUI (Babor et al., 2017), therefore, we adopted the SBIRT model in this TCH-TDPO collaborative project based on the guidelines of the World Health Organization.<sup>1</sup>

TTDPO prosecutors screened DUI repeat offenders using the self-administered Chinese version of the Alcohol Use Disorder Identification Test (AUDIT) and those with an AUDIT score of  $\geq 8$ , a cutoff point validated to detect AUD (Chen et al., 2004), and who were willing to receive the collaborative intervention program for alcohol treatment were referred to Department of Addiction Sciences, Taipei City Psychiatric Center (TCPC). Other inclusion criteria were (1)  $\geq 18$  years of age; (2) residing in Taipei City or New Taipei City where public transport to TCPC is available; (3) without other types of criminal records other than DUI; and (4) currently not involved in any other DUI intervention programs.

### 2.2. Intervention

We provided alcohol treatment in the outpatient department of TCPC. At the first visit, the study screened all participants with routine biochemical tests for physical illnesses. Internal medicine consultation was scheduled for those with possible physical problems. Psychiatrists (HMC and MCH) translated the brief intervention manual introduced by WHO into traditional Chinese. The study trained three case managers who had majored in counseling psychology to provide the brief intervention. By following the SBIRT protocol, we offered each participant an individualized intervention according to AUDIT scores at baseline. In brief, the study provided feedback and brief interventions (10–15 min) for hazardous drinkers ( $8 \leq \text{AUDIT} \leq 15$ ), feedback and support including brief interventions for harmful drinkers ( $16 \leq \text{AUDIT} \leq 19$ ), and intensive medical treatment for those with AUD ( $\text{AUDIT} \geq 20$ ). In addition, addiction psychiatrists interviewed participants with an AUDIT score of  $\geq 16$  to evaluate the psychiatric comorbidities and withdrawal syndrome, and these psychiatrists offered treatment if indicated. The program required all participants to receive at least one session of the brief intervention and one medical visit per month during their time in treatment. The frequency of the intervention or visits could be increased according to each patient's level of drinking. During each treatment session, the case managers enhanced offenders' motivation to change their drinking behaviors, explore ambivalence, correct faulty normative beliefs, identify high-risk situations, and plan ahead to arrange a designated driver or alternate transportation. If the participants failed to attend the scheduled intervention sessions, study staff made telephone calls to arrange another appointment. Research staff made a maximum of three contact attempts before the study terminated the intervention. The study calculated duration of the intervention as

<sup>1</sup> [http://www.euro.who.int/\\_data/assets/pdf\\_file/0006/351294/Alcohol-treatment-manual-final-edit-LSJB-290917-new-cover.pdf](http://www.euro.who.int/_data/assets/pdf_file/0006/351294/Alcohol-treatment-manual-final-edit-LSJB-290917-new-cover.pdf).

months between the first session and the last attended session.

### 2.3. Measurement

Participants self-reported demographic characteristics, including age, sex, educational years, employment, and marital status. The study used timeline follow-back methods to measure participants' drinking behaviors, namely average drinks (1 drink = 10 g of pure ethanol) of alcohol per drinking day, drinking days per week, and heavy drinking ( $\geq 6$  drinks) days per week at baseline and each intervention session. Additionally, the study administered at baseline the craving, annoyance, guilty feeling, and eye-opener (CAGE) questionnaire that screens for potential alcohol problems over one's lifetime (Ewing, 1984). The study measured alcohol craving using a self-rated visual analog scale (VAS) with a 10-point Likert scale ranging from 0 (no craving) to 9 (so severe that the individual was unable to resist a drink if available). We assessed psychological symptoms using the self-administered 21-item Beck Depression Inventory (BDI) (Lu et al., 2002) and the 21-item Beck Anxiety Inventory (BAI) (Che et al., 2006). The study used the Barratt Impulsive Scale (BIS) to assess impulsivity (Patton et al., 1995). The study evaluated drinking behavior variables, BDI, BAI, and BIS at baseline and 3, 6, and 12 months during the intervention.

The primary outcome was DUI recidivism event (BrAC  $\geq 0.15$  mg/L) in the one year after the last intervention session. One main reason that we observed the DUI event after, instead of during, the intervention was that we wanted to follow the maintenance of behavior change after treatment. In the written informed consent form, each participant provided the investigators access to their recidivism records (BrAC of  $\geq 0.15$  mg/L) from the Taipei City Traffic Adjudication Office (TCTAO) for one year after the last intervention session.

### 2.4. Statistical analysis

We compared the demographic characteristics, baseline drinking behaviors, and psychological symptoms, and intervention duration between the participants who recidivated (recidivism group) and who did not (nonrecidivism group) in the year after the last intervention session. The study tested the differences using Student's *t*-test for continuous variables and the chi-square test or Fisher's exact test (if observations  $< 5$ ) for categorical variables.

The study used Cox proportional hazards model to examine the hazard ratio (HR) of the baseline clinical characteristics and intervention duration for DUI recidivism in the next year. The study examined independently adjusted HR for each of the characteristics and the intervention duration in crude models and in full models adjusted for all other variables. We tested the validity of the proportional hazards assumption for each variable using a Kolmogorov-type supremum test based on 1000 simulated residual patterns (Austin, 2018). All variables have met the proportional hazards assumption ( $p > 0.05$ ). The study examined changes in drinking behaviors and psychological symptoms between baseline and 3-, 6-, and 12-month follow-ups using generalized estimation equation (GEE) models. We imputed missing observations by carrying forward the last observations.

To further examine the effect of intervention duration on recidivism, we devised a multivariable Cox model with a restricted cubic spline (RCS). Research has widely used RCS to analyze the relationship between survival and intervention while adjusting for other covariates (Desquilbet & Mariotti, 2010). The study defined spline using four knots at the 5th, 25th, 50th, and 95th percentiles. We used one-month as the reference and plotted the HR for recidivism against the intervention duration (months), adjusting for baseline psychological symptom scores and drinking behaviors. We performed regression models using the log-transformed HR as a sensitivity analysis. The statistical trends were similar; neither of the trends violated the proportional hazards assumption. Therefore, the study used an untransformed HR. The study determined a threshold for the length of intervention duration, which

was associated with a reduced adjusted HR for recidivism, by examining the maximum change in the slope of the RCS curve (Molinari et al., 2001). The study subsequently used the threshold to divide our participants into two groups: those who stayed in the intervention longer than the threshold duration (SL group) and those who did not (non-SL group). We compared the survival curve of recidivism between the SL group and non-SL group. Research staff used SAS 9.4 (SAS Institute, Cary, NC, USA) for the analyses.

### 3. Results

A total of 279 DUI repeat offenders were referred from TTDPO; among them 231 agreed to participate in this study (participants). The study found no differences in the demographic or clinical characteristics between nonparticipants ( $N = 48$ ) and participants (shown in Supplementary Table A). Table 1 shows that the participants were middle-aged and predominantly employed men. Among the total 231 participants, 27 (11.7%) recidivated in the year following the last intervention session. According to the CAGE questionnaire responses, 63.2% of the participants had potential problems with alcohol dependence (score  $\geq 2$ ). We did not observe differences in demographic characteristics, baseline

**Table 1**  
Baseline demographic characteristics, drinking behaviors, psychological symptoms, and intervention duration of study participants.

	Overall ( <i>N</i> = 231)	Recidivism group ( <i>n</i> = 27)	Non- recidivism group ( <i>n</i> = 204)	<i>p</i>
Age (year), mean (SD)	45.7 (9.4)	47.5 (7.7)	45.5 (9.6)	0.297
Sex (n, %)*				1.000
Male	226 (91.8)	27 (100)	199 (97.5)	
Female	5 (2.2)	0 (0.0)	5 (2.5)	
Education (years), mean (SD)	11 (3.4)	10.7 (2.8)	11 (3.4)	0.669
Marriage (n, %)**				0.130
Unmarried	142 (61.5)	13 (48.2)	129 (63.2)	
Married	89 (38.5)	14 (51.8)	75 (36.8)	
Occupation (n, %)*				1.000
Unemployed	10 (4.3)	1 (3.7)	9 (4.4)	
Employed	221 (95.7)	26 (96.3)	195 (95.6)	
Alcohol drinking variables				
CAGE (n, %)**				0.411
$< 2$	85 (37.8)	8 (29.6)	77 (37.7)	
$\geq 2$	146 (63.2)	19 (70.4)	127 (62.3)	
VAS*** for craving, mean (SD)	2.7 (2.4)	2.5 (2.8)	2.7 (2.3)	0.685
Heavy drinking days/week, mean (SD)	1 (1.9)	0.9 (1.7)	1 (1.9)	0.712
Drinking days/week, mean (SD)	2.4 (2.3)	2 (2.2)	2.5 (2.3)	0.333
Drinks/drinking day, mean (SD)	4.1 (4.5)	3.8 (4.1)	4.2 (4.6)	0.711
BIS scores, mean (SD)***	64.4 (9.3)	63.4 (8.6)	64.5 (9.4)	0.614
BDI scores, mean (SD)***	8.5 (7.9)	9.3 (7.1)	8.4 (8)	0.558
BAI scores, mean (SD)***	5.3 (6.8)	7.3 (9.4)	5.1 (6.3)	0.235
Duration of stay on intervention (month), mean (SD)	7.2 (4.2)	5.5 (3.1)	7.4 (4.2)	<b>0.024</b>

\* Fisher's exact test.

\*\* Chi-square test.

\*\*\* Abbreviations: BDI, Beck Depression Inventory; BAI, Beck Anxiety Inventory; VAS: visual analog scale; BIS: Barratt Impulsivity Scale.

psychological symptoms, and drinking behaviors between the recidivism group and nonrecidivism group (Table 1). The mean duration that participants stayed in treatment was 7.2 months (SD = 4.2), and the duration was significantly longer in the nonrecidivism group than in the recidivism group ( $p = 0.024$ ). The length of stay in treatment or the recidivism rate did not differ between participants with different severity of alcohol use, i.e.,  $8 \leq \text{AUDIT score} \leq 15$ ,  $16 \leq \text{AUDIT score} \leq 19$ , and AUDIT score  $\geq 20$  (Supplementary Table B).

Table 2 shows results for the Cox proportional hazard models. The duration of intervention was negatively associated with recidivism after adjusting for all the other baseline characteristics (HR = 0.87, 95% CI = 0.77–0.98). Due to the small case number (27 recidivists), we confirmed the model stability through bootstrapping with the number of resampling that was set as 10,000. The results remained significant for intervention duration (HR = 0.870, 95% CI = 0.869–0.872). The BAI score was significantly associated with recidivism in the adjusted model (HR = 1.06, 95% CI = 1.00–1.13). Table 3 shows a significant time effect for all drinking behavior parameters and psychological symptoms over time by GEE models, with significant improvements in all variables.

The Cox model with RCS yielded a threshold in the risk function (Fig. 1) through a maximum change in slope (Supplementary material Table C) between the 4th and 5th month, after adjusting for all the baseline characteristics. Using 4 months as a cutoff point, the study divided participants into SL (>4 months group,  $N = 173$ ) and non-SL ( $\leq 4$  months group,  $N = 58$ ) groups. The two groups were comparable on all clinical characteristics (Supplementary Table D). The recidivism rate in the postintervention year was 8.6% for the SL group and 20.7% for the non-SL group. Fig. 2 illustrates survival curves for the SL group and non-SL group. The HR for recidivism was significantly lower (HR = 0.48,  $p = 0.01$ ) in the SL group than in the non-SL group.

**Table 2**

Hazard ratio (HR) of baseline characteristics and intervention duration for recidivism (reference: no recidivism).

	Crude HR (95% CI)*	P	Adjusted HR (95% CI)**	P
Age (year)	1.03 (0.99–1.07)	0.188	1.00 (0.96–1.05)	0.842
Education (year)	0.98 (0.87–1.10)	0.769	0.95 (0.82–1.09)	0.460
Marriage state (ref: married)	0.47 (0.21–1.03)	0.057	0.56 (0.25–1.24)	0.155
Occupation (ref: employed)	0.91 (0.12–6.69)	0.922	1.02 (0.13–8.12)	0.983
Alcohol drinking variables				
CAGE (ref < 2)	1.25 (0.54–2.91)	0.597	1.44 (0.6–3.46)	0.408
VAS*** for craving	0.97 (0.83–1.14)	0.715	1.01 (0.83–1.24)	0.910
Heavy drinking days/week	0.95 (0.76–1.17)	0.611	1.03 (0.74–1.41)	0.877
Drinking days/week	0.90 (0.75–1.08)	0.249	0.86 (0.67–1.11)	0.257
Drinks/drinking day	0.99 (0.90–1.08)	0.759	1.01 (0.9–1.13)	0.903
BIS scores***	0.99 (0.95–1.03)	0.548	0.98 (0.93–1.03)	0.376
BDI scores***	1.01 (0.96–1.05)	0.733	0.98 (0.93–1.04)	0.596
BAI scores***	1.04 (0.99–1.09)	0.813	<b>1.06</b> (1.00–1.13)	<b>0.046</b> <sup>†</sup>
Duration of stay on intervention (month)	<b>0.88</b> (0.78–0.99)	<b>0.031</b>	<b>0.87</b> (0.77–0.98)	<b>0.026</b>

\* Crude models: each independent variable was included in separate models.

\*\* Adjusted models: adjusted for all the other variables listed in this table.

\*\*\* Abbreviations: BDI, Beck Depression Inventory; BAI, Beck Anxiety Inventory; BIS: Barratt Impulsivity Scale; VAS: visual analog scale.

<sup>†</sup> Boldface indicates statistical significance ( $p < 0.05$ ).

#### 4. Discussion

To the best of our knowledge, this is the first report in Taiwan to evaluate the factors associated with DUI recidivism among repeat offenders participating in a newly developed joint program between legal and medical systems that provides SBIRT-based alcohol treatment. In this observational cohort study, we found that the participants exhibited significant improvements in drinking behaviors and psychological symptoms over time, with only 11.7% of them recidivating within the next year following the end of intervention. The study did not observe any differences in clinical factors between the recidivism group and nonrecidivism group, except the duration of their stay in the program. Participants who stayed in the program for >4 months were significantly associated with a lower rate of recidivism.

Some studies that examined the risk factors for DUI recidivism have reported that having alcohol use problems and certain sociodemographic characteristics, including male sex, middle age, living alone, and low education, were predictive of later recidivism (Cavaiaola et al., 2007; Dickson et al., 2013). However, in our study after adjusting for the length of stay in the intervention, demographic characteristics and psychological symptoms displayed no association with recidivism. To paraphrase, among recidivists, intervention duration is the strongest predictor for a decreased risk of recidivism. In two review studies that examined all types of interventions (e.g. behavioral treatment, pharmacotherapy, monitoring, and counseling) for individuals with alcohol or drug use disorders, McKay found that interventions with longer periods produce better outcomes during the intervention or post-intervention follow-up, compared to interventions based on an acute care model (McKay, 2005, 2009). These observations collectively suggest that maintaining therapeutic contact for longer periods of time with DUI individuals with alcohol use problem promotes behavioral changes. In line with these findings, some studies have also observed that a better adherence to intervention is a determining factor for recidivism risk reduction (Robertson et al., 2009; Robertson et al., 2016). In fact, considerable variability in individual factors may exist for the extent of intervention adherence or retention (McKay, 2009) and, as a result, influence the risk of recidivism. For example, factors like young age, higher drinking frequencies, and prior DUI conviction history were reported to be predictors of noncompletion in a remedial program for convicted drinking drivers, and these factors were also associated with higher recidivism risks (Rootman et al., 2005).

In the current study, we offered an average 10–15 min of brief interventions in each session and discussed participants' behavioral changes in successive sessions over several months. Based on our findings, we suggest that an intervention consisting of multiple brief sessions, given over a longer program duration, preferably longer than 5 months, helps to reduce DUI recidivism for repeat offenders. Although only limited reports have addressed the effect of intervention designs on the outcomes for DUI offenders, a prior study observed that 7-hour educational programs yielded worse recidivism outcomes than 2-hour programs (Vaucher et al., 2016), suggesting that the length of a treatment session should be taken into account when designing appropriate measures to change people's behavior. One study showed that criminal justice clients without postintervention arrest records had received a higher intensity of intervention than those with arrest records (Brown et al., 2004). These results pointed out the necessity for future studies to empirically examine the components of treatment (e.g., frequency, content, and length of each session) that may moderate the beneficial effects of interventions.

Although this study lacked a control group that included DUI repeat offenders who had not joined this program, we found that this collaborative program is helpful in improving drinking behaviors and psychological symptoms. We found that a high baseline anxiety score was associated with an increased recidivism risk. Previous studies have demonstrated that increased anxiety levels were associated with greater levels of dangerous driving (Dula et al., 2010), and a decrease in anxiety

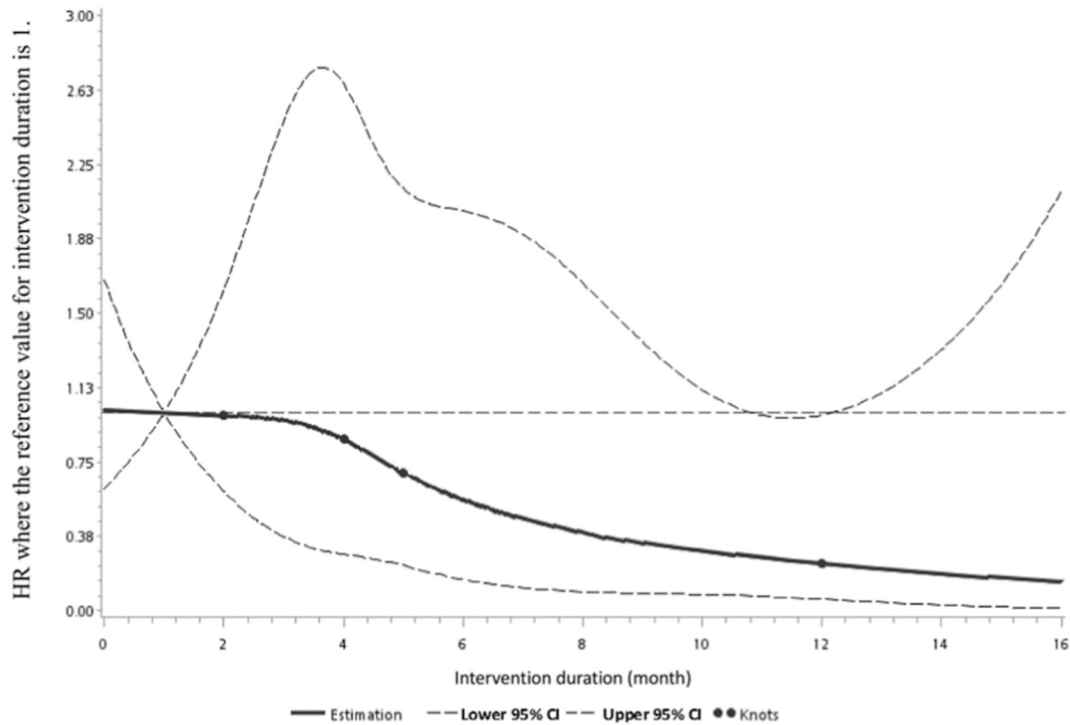
**Table 3**  
Changes in psychological symptoms and drinking behaviors at baseline, 3, 6, and 12 months.

Variables	Baseline		3 months		6 months		12 months		Difference from baseline			P**
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	3 months	6 months	12 months	
VAS* for craving	231	2.66 (2.39)	207	1.99 (2.07)	188	1.78 (1.99)	86	1.85 (2.12)	-0.32	-0.40	-0.27	<0.001***
Heavy drinking days/week	231	1.02 (1.86)	212	0.44 (1.25)	210	0.31 (0.98)	210	0.28 (0.85)	-0.58	-0.71	-0.74	<0.001
Drinking days/week	231	2.41 (2.3)	214	1.61 (1.93)	213	1.44 (1.82)	213	1.26 (1.7)	-0.80	-0.97	-1.15	<0.001
Drinks/drinking day	231	4.11 (4.52)	214	2.71 (3.49)	213	2.55 (2.83)	213	2.38 (3.09)	-1.40	-1.56	-1.73	<0.001
BDI scores*	231	8.49 (7.87)	208	6.4 (7.94)	188	5.31 (7.32)	85	5.19 (7.52)	-2.09	-3.18	-3.30	<0.001
BAI scores*	231	5.33 (6.76)	208	4.15 (5.75)	188	3.44 (4.75)	85	3.41 (5.12)	-1.01	-2.01	-1.64	<0.001

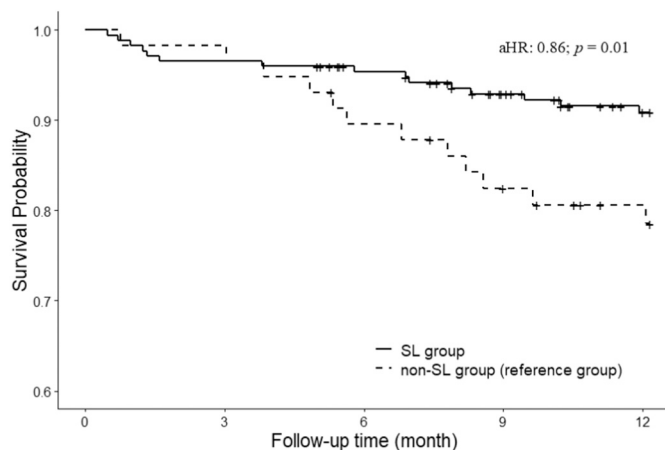
\* Abbreviations: BDI, Beck Depression Inventory; BAI, Beck Anxiety Inventory; VAS: visual analog scale.

\*\* p values for time effects in generalized estimation equation models.

\*\*\* Boldface indicates statistical significance (p < 0.05).



**Fig. 1.** Adjusted dose-response association between length of intervention duration (months) and risk of recidivism (reference: intervention for less than one month) using the Cox model with a restricted cubic spline with four knots (5th, 25th, 50th, and 95th percentiles). Dashed lines are 95% confidence intervals. Knots are represented by dots.



**Fig. 2.** Survival curves and adjusted hazard ratios (aHR) estimating the post-intervention one-year recidivism risk associated with longer (>4 months, the SL group) relative to shorter (≤4 months, the non-SL group) intervention.

was associated with better outcomes in alcohol treatment (Sloan et al., 2003). Therefore, given that mental illnesses are often underdiagnosed among DUI offenders and possibly represent missed opportunities to improve outcomes (Freeman et al., 2011), assessing anxiety symptoms and providing pertinent treatment is also important in intervention programs.

There are several limitations of this study. First, we used the official records of recidivism, and, therefore, the study may have underestimated the true DUI occurrences. The number of DUI incidents that occur prior to an arrest range from one arrest in 50 to one in 200 (Beitel et al., 2000). Therefore, the association between recidivism and individual characteristics or intervention duration is subject to bias. Second, we cannot determine the causal relationship between intervention duration and DUI recidivism because the study did not randomly assign intervention duration to participants. Participants who exhibited more severe drinking problems or had higher motivation to change would probably stay in the program for longer, and, in turn, have a lower recidivism rate. A randomized controlled trial is needed to determine the effect of intervention duration on recidivism rates. The third limitation concerns the generalizability of the results. We provided a service

to repeat DUI offenders (with BrAC  $\geq 0.25$ ) who agreed to be transferred from the prosecutors' office to the hospital to manage their alcohol use problems. The selected study population does not allow us to generalize our findings to other individuals who were not included in our study, such as first-time offenders, those with  $0.15 \leq \text{BrAC} < 0.25$  (i.e. violating road traffic security rules for DUI offense but not prosecuted), with other criminal histories that might be associated with poorer impulse control or higher drinking severity, or who refused to participate in the intervention. Hence, our study sample might represent a group of participants who share similar clinical profiles. This perhaps helps to explain, at least in part, the insignificant differences in demographic or clinical characteristics between the recidivism and nonrecidivism groups or between SL and non-SL groups. The study may not have measured some factors affecting the outcome in our participants, such as the motivation level, readiness to change, personality trait, family's support, and so on. Furthermore, we tested a specific program design with multiple sessions of brief interventions integrated with alcohol treatment in DUI recidivists in a metropolitan area. Future research should examine whether the results will hold true in areas with lower levels of urbanization. Fourth, a longer follow-up period is required to further understand the intervention duration effect on long-term recidivism.

In conclusion, legal sanctions for DUI offenders have increasingly included rehabilitation approaches in the form of alcohol treatment to prevent the reoccurrence of DUIs (Voas et al., 2011). Our results highlight that those staying in the program for a longer time (>4 months) had a higher postintervention one-year recidivism rate. Our pragmatic applied approach reveals, then, that programs should take into consideration adequate duration of alcohol treatment when designing a feasible collaborative intervention program between the legal and medical systems for repeat offenders. Given that DUI convictions represent "a window of opportunity to encourage behavioral change" (Dill & Wells-Parker, 2006), we suggest that a joint legal-medical program can provide valuable opportunities for offenders to recognize and manage their drinking problems and consequences.

#### CRediT authorship contribution statement

Ming-Chyi Huang conceptualized the study, wrote the study protocol, and revised the manuscript. Wan-Ju Cheng reviewed the bulk of literature and wrote the first draft of the manuscript. Lian-Yu Chen assisted with the design of the analysis and provided statistical consultancy. Su-Chen Fang analyzed the data. Hu-Ming Chang and Ru-Chi Chang recruited the participants. Tien-Wen Yang supervised the implementation of the study. Tai-Chao Hsing provided the relevant legal expertise. All authors have read and approved the final manuscript.

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#### Data availability statements

The data underlying this article cannot be shared publicly due to the privacy of individuals that participated in the study. The data will be shared on reasonable request to the corresponding author.

#### Declaration of competing interest

None.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jsat.2021.108426>.

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