Current Medical Science
DOI https://doi.org/10.1007/s11596-019-2062-y
39(3):472-482,2019

Abstinence Following a Motivation-Skill-Desensitization-Mental Energy Intervention for Heroin Dependence: A Three-year Follow-up Result of a Randomized Controlled Trial*

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Summary: The high rate of relapse among heroin users remains a significant public concern in China. In the present study, we utilized a Motivation-Skill-Desensitization-Mental Energy (MSDE) intervention and evaluated its effects on abstinence and mental health. Eighty-nine male heroin users in a drug rehabilitation center were enrolled in the study. The participants in the MSDE intervention group (n=46) received MSDE intervention, which included motivational interviewing, coping skills training, eye movement desensitization and reprocessing, and mindfulness-based psychotherapy. The participants in the control group (n=43) received a series of lectures on skills training. A significant increase in Contemplation Ladder score (P<0.001) and decreases in scores on the Obsessive Compulsive Drug Use Scale (P<0.001), Beck Depression Inventory (P<0.001), and Aggression Questionnaire (P=0.033) were found immediately after intervention. Compared to the control group, the MSDE intervention group reported significantly higher abstinence rates (P=0.027) and retention rates (P<0.001) at follow-up. Overall, the MSDE intervention, which uses a combined strategy for relapse prevention, could be a promising approach for preventing relapse among heroin users in China.
Key words: heroin dependence; relapse prevention; motivational interviewing; cognitive therapy; eye movement desensitization and reprocessing

The prevalence of heroin dependence has been widespread in China during the past decades. Although the proportion of heroin users among registered drug users has dramatically decreased from 78.3% to 49.3% in the past ten years, there were still 1.458 million heroin users in China by the end of 2014[1, 2]. In contrast with the control of prevalence, researchers still face challenges in preventing heroin relapse. Although China's law requires individuals to receive addiction treatment at compulsory detoxification, voluntary detoxification, or community rehabilitation facilities[3], guidelines for implementation of the prevention and intervention strategies need to be elucidated. Psychological and behavioral interventions are still unavailable for most drug users in the detoxification or rehabilitation facilities. After addiction treatment in the facilities, relapse rates in heroin users were reported from 55% to over 90% within one year[4, 5]. From 2008–2010, 63.5% (276 349/435 195) of drug users had relapsed[6]. The situation has prompted researchers in China to introduce effective treatments for heroin relapse.

Over the past few decades, a number of psychological and behavioral interventions, such as motivation enhancement therapy[7, 8], cognitive behavioral therapy[8, 9], and contingency management[10], have been conducted in China. These interventions have been shown to assist heroin users in quitting. Nonetheless, as the high rates of relapse present a severe challenge to therapists, predictors of relapse should first be identified for application of interventions. Empirical studies and literature reviews have reported

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*This study was funded by the National Natural Science Foundation of China (No. 30872175, No. 81573236).

several risk factors associated with relapse, such as craving[11–13], low self-efficacy or motivation to change[14–17], and negative emotional states[18–20]. However, the risk determinants only reported medium or even small effects on predicting relapse, indicating that no single determinant can play a powerful role in predicting the relapse[21]. According to Witkiewitz and Marlatt's reformulated cognitive-behavioral model of relapse, the "synergistic effect" of various risk factors operated on an individual's relapse in a dynamic way[22]. Therefore, integrating psychological and behavioral interventions into a multi-component relapse prevention approach may address the multi-faceted challenges more efficiently and may be more effective in preventing relapse.

Marlatt's relapse prevention model provides a framework for understanding the risks of relapse[22]. Low levels of readiness to change, inadequate coping skills for high-risk situations, intense experiences of craving, and negative emotions were classified as primary intrapersonal determinants of relapse. Based on the classification of the determinants above, we developed a Motivation-Skill-Desensitization-Mental Energy (MSDE) intervention protocol. The MSDE intervention is a multi-component relapse prevention strategy that integrates effective psychological and behavioral interventions for addressing the multiple intrapersonal risks of relapse (i.e., low levels of readiness to change, inadequate coping skills for high-risk situations, intense experiences of craving, and negative emotions). Rather than targeting the risk factors independently, the MSDE intervention aims to provide a feasible combined approach to address the risks of relapse to drug use comprehensively and improve the abstinence rates of heroin users in China. Motivational interviewing, cognitive-based skills training, eye movement desensitization and reprocessing (EMDR), and mindfulness-based psychotherapy were incorporated in the MSDE intervention protocol. In 2010, we carried out a preliminary trial to test the feasibility of the MSDE intervention. In this pilot study, we enrolled 74 heroin users and had a 71.6% (53/74) retention rate after the intervention. Of the participants who completed the treatment sessions, 98.1% (52/53) reported that the intervention was helpful for their relapse prevention[23]. Based on the preliminary findings, we refined our protocol and then conducted a randomized controlled trial in 2011 in a rehabilitation center in China to evaluate the effect of the MSDE intervention. Our previous reports indicated that the MSDE intervention could decrease craving and depression of the participants at post-treatment[24] and yield improvements in abstinence at the two-year follow-up[25, 26]. In the current report, we provide a systematically updated summary of the results based on the three-year follow-up. In addition to craving and depression, we also report the improvements of the readiness to change and aggression (since aggression is related to depression and involved in the process of relapse[27, 28]) after completion of the intervention. The primary hypothesis of this report was that the MSDE intervention would continue to improve the abstinence at the three-year follow-up. Based on the literature review of the relevant studies, we sought to clarify how the MSDE intervention improves the readiness, craving, and negative emotions of the participants, and how these improvements predict the long-term abstinence.

1 SUBJECTS AND METHODS

1.1 Participants

Male heroin users from a compulsory drug rehabilitation center in Xiangyang city (located in Hubei province, central China) were recruited. The heroin users who met all of the following inclusion criteria were included: (1) heroin dependence as diagnosed by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)[29], (2) receiving detoxification treatment in the compulsory drug rehabilitation center for over one year, and (3) willing and able to participate in the study and sign the informed consent. Accordingly, the individuals were excluded if they met the criteria as follows: (1) substance dependence on other illicit drugs, (2) high myopia or other ophthalmic diseases, (3) psychotic disorder as assessed by the DSM-IV, such as schizophrenia, and (4) major organ dysfunction, such as cardiac insufficiency, hepatic insufficiency or renal insufficiency. We have conducted two studies previously, which used comprehensive strategies for illicit drug users discharged from compulsory drug rehabilitation centers and reported effect sizes of 1.69 and 0.43[30, 31]. Thus, a large effect size of 0.7 was expected in the MSDE intervention based on these two studies. A minimum sample size of 64 participants was required in the present study, given the expected effect size of 0.70 for the proportion of participants' abstinence, a desired power of 0.80, and a significance level of 0.05 (2-tailed). Given the possible loss, a total of 98 participants were enrolled in this study. Of the participants, three in the intervention group and six in the control group declined to participate in the continued intervention and follow-up. Therefore, they were excluded from this study. The final samples included in this study were 89 of the participants. Fig. 1 shows the participant flow from the initial recruitment to the three-year follow-up.

1.2 Study Design

By using a list of computer-generated random numbers, simple randomization was applied by the principal investigator to randomly assign the participants to the MSDE intervention group or control

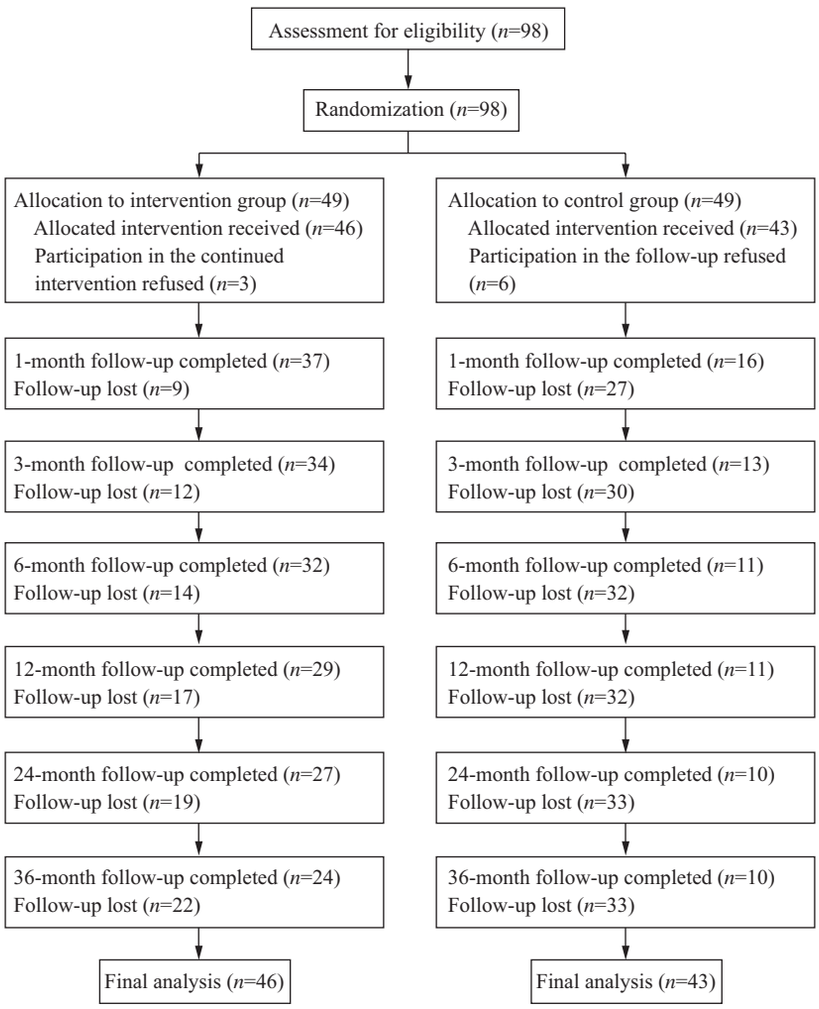

Fig. 1 Flow diagram of study participants

group. After randomization, participants completed the baseline assessments. Afterward, participants in the intervention group received an MSDE intervention (described below in detail), and those in the control group received a series of lectures on skills training, which were group health education sessions on coping skills. Therapists were all senior psychological consultants. An intervention manual was developed, and the therapists were trained. For ensuring fidelity to the intervention protocol, a team discussion was held after the completion of each session, and the therapists were supervised by a psychologist research team. The baseline measurements were repeated after treatment completion. Then, participants were followed up at 1, 3, 6, 12, 24, and 36 months after leaving the rehabilitation center. The intervention and follow-up occurred from June 2011 to November 2014. The therapists in the study were not involved in data collection or data analysis, and data collectors were blinded to the randomization and allocation data. The study protocol was approved by the Institutional Review Board of School of Public Health, Tongji Medical College, Huazhong University of Science and Technology. The prospective registration of the clinical trial was conducted, and the registration number at the Chinese Clinical Trial Registry is ChiCTR-TRC-11001387. Signed informed consent was obtained from each participant.

1.3 MSDE Description

Primarily, the MSDE intervention consists of motivational interviewing, coping skills training, EMDR, and mindfulness-based psychotherapy as follows. (1) The motivational interviewing protocol was used to increase participants' readiness to change[32]. Achievements of people who succeeded in quitting drugs were shown by video. The therapists then set up a discussion on how the participants themselves or someone they know have successfully dealt with their drug problems in the past. The participants were asked to do decisional balance exercises (e.g., explore the pros and cons of using heroin, weigh the benefits and disadvantages of behavior change). The

therapists then helped the participants to recognize the discrepancies between their heroin-using behavior and their life goals and helped them to set treatment goals. (2) The coping skills training adapted from a cognitive-behavioral therapy manual[33] was used to help the participants deal with high-risk situations. The coping skills utilized in the MSDE intervention protocol mainly included skills of coping with craving and thoughts about heroin, skills of coping with the excuses for relapse, refusal skills, skills to identify seemingly irrelevant decisions, all-purpose coping plans, problem-solving skills, management of stress and negative emotions, and management of time and assets. (3) The standard EMDR protocol outlined by Shapiro[34, 35] was modified in our protocol and aimed to reduce cravings and negative emotions. First, the therapists collected thorough information from the participants and created a safe space for them. During preparation, the participants were given instructions regarding cue-induced cravings and EMDR and were informed that they could stop the treatment whenever they felt uncomfortable. In the desensitization phase, the therapists used a stick (facing the participants, one meter away from the participants' faces) to direct the participants to move their eyes back and forth and simultaneously told them to ask themselves for feelings, body sensations, and images related to heroin use. Positive cognition was installed after completion of desensitization, and the participants were asked for the original images and how they felt about themselves. The positive cognition might be statements, such as "I can remain in abstinence." In the closure phase, the therapists had a conversation with the participants, talked about images and body sensations that emerged, and taught the participants several techniques for relaxation and installing positive cognition. (4) The mindfulness-based psychotherapy mainly included mindfulness practice and positive psychology intervention and was integrated into our protocol for decreasing negative emotions, establishing an emotional connection, and improving mental energy. The therapists briefly gave the participants instruction on the subconscious and belief systems before psychotherapy began and identified the participants' psychological needs. Activities, such as dancing, were applied to help the participants release their negative emotions. After the participants' emotional release, the therapists helped them develop a strong spiritual bond with themselves, with their parents, and with others. The participants were guided to appreciate their lives and feel the connection to their families. Additionally, they were asked to express their appreciation and admiration to each other by handshake, eye contact, and words. Afterward, the participants were directed to bring up their disturbing events and emotions. Meditation was simultaneously introduced to help the participants observe their feelings and sensations, thus allowing for the mental block to fade away and to reshape the imprints left on their minds. Finally, participants were guided to gain new insights into themselves. They were asked to write down their own merits and demerits. The therapists then gave the participants specific instructions to help them modify their negative self-cognition (e.g., changing the "labels" representing their negative conceptions).

In this study, the MSDE intervention was conducted six days per week and four hours per day (9:00 to 11:00 am and 2:30 to 4:30 pm) for four weeks. Before group sessions began, a therapeutic relationship was first established. In each session, the psychological therapists spent 15 to 20 min having the participants listen to music and asking them to move their bodies in order to feel empowered. The participants then participated in meditation to be guided into a relaxed state. Afterward, the participants were divided into groups. Group psychotherapy, including motivational interviewing, skills training, mindfulness practice, and positive psychology intervention was implemented through discussions, games, and role-play. In the final 10 to 15 min, the session was closed. The participants shared their feelings, and the therapists provided a summary and assignment. In the final week, a modified EMDR was applied. A summary of the intervention schedule is presented in table 1.

As we reported in the preliminary trial[23], the MSDE intervention presented a strategy of group psychotherapy that the patients were willing to accept. It should be noted that the schedule reported in the current study was arranged in consultation with the drug rehabilitation center and was, to some extent, intensive for the participants who were all about to discharge one month later. Surely the schedule of the MSDE intervention can be re-arranged if there is enough time. However, we recommend that the therapists should

Table 1 The schedule of the Motivation-Skill-Desensitization-Mental Energy intervention

Week	Day	Time	Schedule
Week 1	Day 1	3 h	Therapeutic relationship established and baseline assessment
Week 1	Day 2 to 4	90 min per session	Motivational interviewing (6 sessions)
Week 1 to 2	Day 5 to 12	90 min per session	Skills training (12 sessions)
Week 3	Day 13 to 18	90 min per session	Mindfulness-based psychotherapy (12 sessions)
Week 4	Day 19 to 23	90 min per session	Eye movement desensitization and reprocessing (10 sessions)
Week 4	Day 24	1.5 h	Assessment after intervention completion

better follow the procedures introduced by Prof. Zeng-zhen WANG[36]. To summarize, we recommend that: (1) before every group session begins, the therapists should implement parts of the mindfulness-based interventions (e.g., listening to music, dancing, meditation) to make the participants feel empowered and relax; (2) the group sessions should be arranged in the order of motivational interviewing, skill training, mindfulness-based intervention, and EMDR. The therapists should note that the components presented in the MSDE intervention are interrelated and interactive. That is, the increases in mental energy and motivation would promote the participants to receive the interventions; meanwhile, the implements of skill training, mindfulness-based psychotherapy, and EMDR would contribute to the increases in the participants' self-efficacy and their readiness to change.

1.4 Measures

The participants were followed up at 1, 3, 6, 12, 24, and 36 month(s) after their discharge. The timeline follow-back procedure modified for telephone interview was utilized to gather the participants' self-reported use of heroin and other illicit drugs[37]. The participants' abstinence rates in the follow-ups were the primary outcomes. Abstinence was defined as no consumption of heroin or other illicit drugs at any time during each follow-up interval.

Secondary outcomes were the readiness to change, craving, depression, and aggression. The participants' readiness for quitting drugs was determined by the Contemplation Ladder (CL), a single-item measure which has shown good predictive and discriminant validity for adult drug users[38]. Craving was measured using the Obsessive Compulsive Drug Use Scale (OCDUS)[39, 40]. The Chinese version of the OCDUS uses a three-factor structure: "interference of heroin", "frequency of craving", and "control of heroin" with internal consistency coefficients of 0.82, 0.81, and 0.66, respectively, for the three dimensions[40]. The Chinese versions of the Beck Depression Inventory (BDI)[41] and the Aggression Questionnaire (AQ)[42] served as tools reflecting the severity of depression and aggression reported by the participants. The assessments described above have all been validated in Chinese settings.

1.5 Data Analysis

Baseline differences in participant characteristics between the two groups were compared using the χ^2 test for categorical variables and *t*-test for continuous variables. Based on the intention-to-treat strategy, the participants who relapsed and those who did not complete follow-up were not considered to be abstinent. Thus all the 89 participants were included in data analysis. The generalized estimating equation (GEE) model, which allows for missing observations, was used to analyze the repeated observed abstinence rates. With baseline scores included as the covariates, a series of analyses of covariance (ANCOVAs) were performed to detect group differences in the secondary outcomes. All statistical analyses were performed in SAS 9.4[43], and the significance level was set at α=0.05 (2-tailed).

2 RESULTS

2.1 Baseline Characteristics

Baseline participant characteristics are shown in table 2. The participants' mean age was 35.0 years (SD=6.6), and the mean heroin use time was 7.8 years (SD=4.3). Thirty-five participants (39.3%) were single, and the majority of them were employed (59/89, 66.3%) with an educational background of junior high school (49/89, 55.1%). No significant group differences were observed in the baseline characteristics.

2.2 Changes in Readiness to Change, Craving, Depression, and Aggression

Controlling for baseline scores, a series of ANCOVAs showed a significant increase in

Table 2 Characteristics of participants at baseline

Baseline characteristics	Intervention group (*n*=46)	Control group (*n*=43)	*P*[a]
Age, year, mean (SD)	34.4 (6.1)	35.7 (7.1)	0.380
Years of heroin use, year, mean (SD)	7.7 (4.4)	8.0 (4.2)	0.719
Marital status, *n* (%)			0.660
Single	17 (37.0)	18 (41.9)	
Married or cohabitation	12 (26.1)	13 (30.2)	
Divorced or widowed	17 (37.0)	12 (27.9)	
Employment, *n* (%)			0.824
Unemployed	16 (34.8)	14 (32.6)	
Employed	30 (65.2)	29 (67.4)	
Education, *n* (%)			0.123
Senior high school or higher	13 (28.3)	8 (18.6)	
Junior high school	27 (58.7)	22 (51.2)	
Primary school or lower	6 (13.0)	13 (30.2)	

[a] Group means were compared using *t*-tests, and categorical variables were compared using χ^2 tests. SD: standard deviation. Note that the results were different from the previous report[24] due to the different number of the participants.

participants' CL score (P<0.001) as well as decreases in the OCDUS score (P<0.001), BDI score (P<0.001), and AQ score (P=0.033). The two groups' post-treatment comparisons are shown in table 3.

2.3 Abstinence and Retention in Follow-up

Table 4 shows the abstinence and retention rates of the participants in each group during the 3-year follow-up. The GEE results demonstrated that the abstinence rates declined during the 3-year follow-up. The MSDE intervention group had a significantly greater effect on drug abstinence than the control group (P=0.027). The interaction effect of group and time was not statistically significant. At the end of the 3-year follow-up, 52.2% (24/46) of participants in the MSDE intervention group and 23.3% (10/43) in the control group completed the study. No significant differences were found in the characteristics of the participants who completed the follow-up *versus* those who did not complete follow-up. Reasons for drop out were losing contact at the follow-up time points in all cases. Results of the GEE analysis showed that the retention rate declined over time, and the MSDE intervention group yielded a relatively high retention rate compared to the control group (P<0.001). There was no significant interaction effect.

3 DISCUSSION

In our study, compared to the control group, heroin users who received the MSDE intervention reported higher abstinence rates during the three-year follow-up. Similar to other studies, most of which consisted of multiple interventions[44–47], our study utilized a multi-component intervention protocol and found promising effects when using the combined strategy for preventing relapse. In China, Zhao and colleagues initially reported the effect of Marlatt's relapse prevention approach for treating heroin dependence and showed an abstinence rate of 37.2% in the treatment group compared to 16.7% in the control group at a 3-month follow-up[48]. Although relapse prevention was concluded to be broadly efficacious, the present study suggests that relapse prevention may be more effective in China when combined with other psychological and behavioral interventions.

The MSDE intervention's ability to increase participants' readiness to change and reduce cravings, depression and aggression was also supported in the present study. After treatment, the MSDE intervention led to an immediate significant increase in participants'

Table 3 Changes in CL, OCDUS, BDI, and AQ scores by groups

	Intervention group (n=46)		Control group (n=43)		P
	Baseline	Post-treatment	Baseline	Post-treatment	
CL score, mean (SD)	4.04 (1.98)	5.93 (1.47)	3.77 (1.91)	4.45 (1.61)	<0.001
OCDUS score, mean (SD)	39.04 (10.27)	30.74 (11.83)	39.19 (10.68)	39.58 (7.84)	<0.001
BDI score, mean (SD)	14.87 (6.51)	5.76 (5.14)	13.72 (7.71)	11.65 (7.07)	<0.001
AQ score, mean (SD)	42.95 (14.38)	34.73 (12.32)	43.37 (19.42)	39.99 (20.96)	0.033

CL: Contemplation Ladder; OCDUS: Obsessive Compulsive Drug Use Scale; BDI: Beck Depression Inventory; AQ: Aggression Questionnaire; SD: standard deviation. Note that parts of the results (i.e., the scores of the OCDUS and the BDI) were different from the previous report[24] due to the different number of the participants.

Table 4 Abstinence and retention of participants at follow-up

	Intervention group (n=46)		Results of GEE		
	Intervention group (n=46)	Control group (n=43)	Main effect of group: P	Main effect of time: P	Interaction effect of group and time: P
Abstinence rates, n (%)			0.027	<0.001	0.238
At 1 month	34 (73.9)	11 (25.6)			
At 3 months	29 (63.0)	6 (14.0)			
At 6 months	26 (56.5)	4 (9.3)			
At 12 months	18 (39.1)	4 (9.3)			
At 24 months	15 (32.6)	2 (4.7)			
At 36 months	9 (19.6)	2 (4.7)			
Retention rates, n (%)			<0.001	<0.001	0.165
At 1 month	37 (80.4)	16 (37.2)			
At 3 months	34 (73.9)	13 (30.2)			
At 6 months	32 (69.6)	11 (25.6)			
At 12 months	29 (63.0)	11 (25.6)			
At 24 months	27 (58.7)	10 (23.3)			
At 36 months	24 (52.2)	10 (23.3)			

GEE: generalized estimating equation

readiness to change as well as decreases in cravings, depression, and aggression. We speculated that this combination of interventions might contribute to the effect on these outcomes. In the MSDE intervention protocol, a stable therapeutic relationship was established, and motivational interviewing was applied first. Motivational interviewing provides positive effects on both participants' readiness to change and treatment retention[49]. Therefore, the motivational interviewing used in the MSDE protocol was supposed to increase the participants' readiness to change and improve their compliance with treatment. In the present study, readiness to change did increase after the MSDE intervention, and the retention rate in the MSDE intervention group was also higher than that in the control group. Evidently, the retention rate may be associated not only with the participants' readiness to change but also with other factors (e.g., therapeutic relationship, the frequency of contacts)[50–52]. However, to some extent, this result demonstrates the effect of the motivational module of the protocol on study compliance. In our study, participants' cravings and depression decreased after the intervention. Coping skills training, an important part of cognitive behavioral therapy, may specifically strengthen the participants' skills of coping with craving and negative emotions[53]. These results are also in line with other studies where both EMDR and mindfulness-based therapies attenuated craving and depression[54–59]. Reduced aggression was also found in the participants that received MSDE intervention. This result is in agreement with a recent review showing that mindfulness-based treatments can reduce aggression[60].

Given that there were only 89 participants included in the present study, it seems prudent not to conduct a causal analysis to explore whether changes in the secondary outcomes predicted abstinence. Although more research is needed to clarify the mechanism of the MSDE intervention, there are several explanations for the long-term preventive effects of the MSDE intervention on relapse and may specify how the improvements in motivation, craving, and negative emotions predict the abstinence. The MSDE intervention protocol mainly consists of motivational interviewing, cognitive behavioral therapy, EMDR, and mindfulness-based therapy. All these components may contribute to the long-term preventive effects on relapse: (1) The improvement in readiness to change: Several meta-analyses have been published to support a long-lasting follow-up effect of motivational interviewing on reducing substance use[61–63]. The patient's intention to change increased by motivational interviewing may contribute to the reduction in substance use[64]. (2) The improvement in craving and negative emotional states: Cognitive behavioral therapy has been demonstrated to have an enduring effect on fostering abstinence through continued use of skills that cope with high-risk situations such as craving and negative emotions[65–68]. Also, several systematic reviews and one meta-analysis support the efficacy of the mindfulness-based intervention for improvements in craving and emotional states and reduction in substance use[69–71]. The mindfulness-based therapy increases the acceptance, non-judgment, and awareness of the patients, thus to reduce their craving and negative emotions and further prevent their use of substances at follow-up[72]. There were not enough studies to conclude any long-term effects of EMDR on relapse. However, some clinical trials suggest that EMDR can reduce the substance users' craving and the vividness of addiction memory, which are related to relapse[54, 55, 73]. In summary, based on these previous studies, it can be inferred that the MSDE intervention may comprehensively attenuate the synergistic effects of the risk factors, thus to improve abstinence among the participants.

Several limitations should be considered in our study. First, it was a small clinical trial. Similar to other follow-up studies of treatment for heroin dependence[74–76], the attrition rates in our study remained high, especially in the control group, which raises concern about the possibility of attrition bias. Lack of motivation to change may be related in part to the low retention rates[50, 51]. Meanwhile, it should be noted that the study participants were required by law to receive regular surveillance in their residential communities after discharge. Losing contact with someone means a possible relapse and reentry into the rehabilitation center[77, 78]. Considering that this situation is common in China, participants who did not participate in the follow-up study should be considered as relapse. Thus, the inclusion of outcome estimates from those who did not participate might not have altered the primary outcome remarkably. Furthermore, the low retention rates did raise concern about a possible reduction in statistical power that a type-2 error (i.e., false-negative result) would have occurred. However, our study reported significant estimates of intervention effects, indicating that there was sufficient power to avoid the false-negative possibility. Nevertheless, a larger sample should also be enrolled in future studies, and strategies such as making more contacts at the early stage of follow-up should be utilized to limit drop-out rates. Second, the abstinence of the participants was self-reported, which may raise concern about the reliability and validity of the abstinence rates. However, self-report is widely used among studies of illicit drug use and is reliable and valid for providing information on drug use. The literature on substance use indicates acceptable reliability and validity of self-reporting when compared to biochemical analyses such as urinalysis[79, 80]. In our study, the participants

self-reported their use of heroin and other illicit drugs, and the data were gathered by the timeline follow-back approach, which has been validated in different populations with substance-related disorders and can be successfully used with various time intervals[81, 82]. Therefore, the participants' self-reports in our study are reasonably reliable and valid. Also, a stable therapeutic relationship was established in each group before the sessions began. Feelings of safety and trust were established between therapists and participants. Independent research interviewers (not police officers) were utilized in our study to conduct the follow-up interviews, and assurances were given to the participants that their reports would be confidential. Therefore, we minimized the participants' motivation to conceal their behaviors of illicit drug use since the participants have perceived the assurance of confidentiality[83]. Third, a shortcoming of the MSDE intervention was that it included only intrapersonal determinants. Thus, the role of interpersonal factors, such as environmental stimuli and social support, was not understood. Since the interpersonal factors (e.g., peer pressure, family function) may influence the rates of abstinence and retention of the participants, future studies should collect and evaluate the interpersonal information to understand the effects of the MSDE intervention better. Further, revised MSDE intervention protocols should consider interpersonal determinants in order to provide an overview of relationships between high-risk determinants and relapse. Fourth, as a psychological intervention approach, the MSDE intervention conducted in our study was mainly focused on psychological factors associated with relapse. Other biological and clinical factors, such as withdrawal symptoms, were not measured in the present study. However, it should be noted that both psychosocial and physiological components are involved in the process of relapse. Incorporating the MSDE intervention and pharmacotherapy, such as methadone maintenance treatment, may provide additional help for heroin users and enhance treatment effects. Fifth, since the control group in our study received a series of group health education sessions only, it is unclear whether the MSDE intervention could improve success outcomes compared to other psychotherapies. However, as we mentioned before, the MSDE intervention presented here is a multi-component intervention protocol, which seeks to incorporate the motivational interviewing, skill training, EMDR, and mindfulness-based interventions, thus to enhance their advantages and counterbalance their weakness. Therefore, this study aimed to preliminarily explore whether this combined strategy could improve the abstinence of the participants. Future studies are needed to evaluate whether the MSDE intervention can yield better improvements than other psychotherapies. Finally, the participants in this study were all males. Further studies with different populations are needed.

Regardless of the limitations, we present a promising strategy of group psychotherapy for preventing relapse. We fully understand that there is an imbalance between the MSDE model's high requirements on mental health service resources and inadequacy of the resources in China. Therefore, we have conducted 28 MSDE training classes in China for training psychotherapists and social workers from different hospitals, rehabilitation centers, and communities since 2014. Most of the trainees expressed their satisfaction with the MSDE training courses[84, 85]. In 2018, the MSDE intervention has been on the first list of "Project of Application and Generalization of New Techniques and Methods for Drug Detoxification and Rehabilitation" which was released by the Chinese Ministry of Justice and will be applied and generalized nationwide. We will continue to make efforts to generalize the use of the MSDE intervention for drug users in China.

In conclusion, the MSDE intervention presented in this study shows promise in maintaining abstinence for heroin users in China and provides further evidence for using combined strategies for relapse prevention. Given the results demonstrated in the present study, the MSDE intervention should be considered a promising relapse prevention approach for drug users in China.

Conflict of Interest Statement

The authors declare no conflicts of interest in this study.

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(Received April 9, 2018; revised Jan, 21, 2019)