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Effectiveness of Mindfulness-Based Relapse Prevention on Craving, Maladaptive Cognitive Emotion Regulation, and Sleep Quality in Adolescents with Substance Use Disorder

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ABSTRACT

Objective: This study examined the effectiveness of mindfulness-based relapse prevention (MBRP) on craving, maladaptive cognitive emotion regulation, and sleep quality among adolescents with substance use disorder.

Methods and Materials: A quasi-experimental pretest–posttest control-group design with follow-up was employed. Thirty adolescents aged 13–18 years were recruited through purposive sampling and randomly assigned to experimental (n = 15) and control (n = 15) groups. The experimental group received eight weekly 90-minute MBRP sessions alongside routine care, whereas controls received routine care only. Outcomes were assessed using the Craving Experience Questionnaire, Cognitive Emotion Regulation Questionnaire, and Pittsburgh Sleep Quality Index. Data were analyzed using mixed ANOVA and Bonferroni comparisons.

Findings: Significant time × group interactions were observed for craving, $F(2,56) = 41.36$, $p < .001$, partial $\eta^2 = .596$; maladaptive cognitive emotion regulation, $F(2,56) = 33.74$, $p < .001$, partial $\eta^2 = .546$; and sleep quality, $F(2,56) = 24.63$, $p < .001$, partial $\eta^2 = .468$. Experimental-group scores decreased from pretest to posttest for craving (61.40 to 36.13), maladaptive regulation (56.27 to 39.73), and sleep difficulties (11.27 to 6.47). Between-group differences were significant at posttest and follow-up (all $p < .001$). Posttest-to-follow-up changes were nonsignificant (all $p > .05$).

Conclusion: MBRP improved craving, maladaptive cognitive emotion regulation, and subjective sleep quality among adolescents with substance use disorder. These improvements were generally maintained at follow-up.

Keywords: Mindfulness-Based Relapse Prevention, Craving, Cognitive Emotion Regulation, Sleep Quality, Adolescents, Substance Use Disorder.

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Introduction

Adolescence is a developmental period marked by heightened neurobiological sensitivity to reward, increasing social influence, and still-maturing self-regulatory capacities, all of which make this stage especially vulnerable to the onset and escalation of substance use problems. When substance use develops into a clinically significant pattern, its consequences extend beyond immediate behavioral risk and often affect emotional functioning, sleep, academic performance, family relationships, and long-term psychosocial adjustment. Contemporary evidence also suggests that substance-related problems in youth rarely occur in isolation; rather, they are closely intertwined with transdiagnostic processes such as craving, emotional dysregulation, and sleep disturbance. Accordingly, treatment models that focus only on abstinence or external behavioral control may be insufficient for adolescents whose substance use is reinforced by internal distress, impulsive responding, and maladaptive coping patterns (Arnaud et al., 2024; Fadus et al., 2019; Nash, 2025; Shariat et al., 2023).

Among the mechanisms that maintain substance use and increase the probability of relapse, craving occupies a central role. Craving is not merely a desire to use a substance, but a multidimensional state involving attentional bias, physiological arousal, conditioned responding, and difficulty tolerating urges without acting on them. In adolescents, whose inhibitory control systems are still developing, craving may be particularly disruptive because it can rapidly translate into impulsive use in emotionally charged or cue-reactive contexts. At the same time, a growing body of literature has identified deficits in cognitive emotion regulation as a major factor in the development and persistence of substance use disorders. Youth who have difficulty identifying, modulating, and reappraising emotional experiences may be more likely to use substances as a short-term strategy for relief from distress. Meta-analytic and review findings indicate that emotional dysregulation is robustly associated with addictive behaviors and substance use severity, supporting the view that emotion regulation is not peripheral but central to understanding relapse vulnerability (González-Roz et al., 2024; Stellern et al., 2023).

Sleep quality represents another clinically important but often underexamined dimension in adolescent substance use disorder. Poor sleep in adolescence is associated with impaired executive functioning, greater emotional reactivity, poorer decision-making, and increased vulnerability to risky behavior, all of which may intensify substance-related problems. Recent studies and reviews have further shown that sleep disturbance and substance use are bidirectionally linked: sleep problems may increase the likelihood of use, while substance involvement may in turn worsen sleep continuity, duration, and restorative quality. This reciprocal relationship is especially important in treatment contexts because disrupted sleep can weaken self-control, heighten negative affect, and amplify craving, thereby undermining recovery efforts. For adolescents with substance use disorder, the simultaneous presence of craving, emotion regulation difficulties, and poor sleep may therefore form a self-reinforcing cycle that increases the probability of relapse and complicates intervention outcomes (Armstrong et al., 2024; Oliva et al., 2026).

In this context, mindfulness-based approaches have attracted growing attention as process-focused interventions capable of targeting the internal experiences that often precipitate substance use. Mindfulness-Based Relapse Prevention (MBRP), in particular, integrates mindfulness practice with relapse prevention principles and aims to help individuals notice craving, distress, and automatic behavioral tendencies without reacting to them impulsively. Instead of attempting to suppress internal experiences, MBRP encourages nonjudgmental awareness, acceptance, and more skillful responding to triggers. Evidence from systematic reviews on substance use disorders suggests that mindfulness-based interventions may reduce craving and improve broader psychological functioning, although effect sizes vary across populations and study designs. More importantly for the present topic, emerging youth-focused evidence indicates that mindfulness-based interventions can

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yield small to moderate benefits in reducing substance use and improving associated psychological processes, while adolescent clinical trials also suggest potential utility for mindfulness-oriented treatments in cannabis and other substance-related problems (Goldberg et al., 2021; Hammond et al., 2026; Legenbauer et al., 2024; Ramadas et al., 2021).

The theoretical relevance of MBRP to adolescents with substance use disorder is especially strong because its proposed mechanisms correspond closely to the very domains that appear most impaired in this group. By teaching individuals to observe urges as transient events rather than commands for action, MBRP may reduce the behavioral power of craving. By strengthening present-moment awareness and decentered observation of thoughts and feelings, it may also support more adaptive cognitive emotion regulation. In addition, mindfulness practice may indirectly improve sleep quality by lowering cognitive and physiological arousal, reducing rumination, and enhancing emotional settling before sleep. Although evidence on sleep outcomes in youth substance-use populations remains less developed than evidence on craving, related mindfulness research and substance-use studies increasingly support the plausibility of beneficial effects on sleep and self-regulatory functioning. These converging findings suggest that MBRP may be particularly valuable when treatment goals extend beyond simple substance reduction to the modification of relapse-related mechanisms that sustain chronic dysfunction (Baldus et al., 2018; Farnam et al., 2014).

Given the developmental sensitivity of adolescence and the complex interplay among craving, cognitive emotion regulation, and sleep quality in substance use disorder, examining the effectiveness of MBRP in this population is both clinically and scientifically important. A better understanding of whether MBRP can reduce craving, improve cognitive emotion regulation, and enhance sleep quality in adolescents with substance use disorder may help refine integrative treatment models that address not only substance-related symptoms but also the underlying self-regulatory vulnerabilities associated with relapse. Therefore, the present study was designed to investigate the effectiveness of Mindfulness-Based Relapse Prevention on craving, cognitive emotion regulation, and sleep quality in adolescents with substance use disorder.

Methods and Materials

Study Design

The present study used a quasi-experimental design with a pretest–posttest control group structure and a follow-up assessment. This design was selected to evaluate the effectiveness of Mindfulness-Based Relapse Prevention (MBRP) on craving, cognitive emotion regulation, and sleep quality in adolescents with substance use disorder. Participants were assessed at three time points: before the intervention, immediately after the intervention, and at follow-up. The independent variable was participation in the MBRP program, and the dependent variables were craving, cognitive emotion regulation, and sleep quality. The study was conducted in outpatient addiction treatment and counseling settings for adolescents.

Participants and Sampling Procedure

The statistical population consisted of adolescents with substance use disorder who had been referred to addiction treatment centers and counseling clinics. Participants were selected through purposive sampling based on the inclusion criteria, and those who met the eligibility conditions were then randomly assigned to either the experimental group or the control group. A total of 30 adolescents participated in the study, with 15 participants in the experimental group and 15 participants in the control group. The participants were between 13 and 18 years of age.

The inclusion criteria were: a diagnosis of substance use disorder established through clinical interview and diagnostic criteria, being within the specified age range, sufficient reading and comprehension ability to complete the questionnaires, willingness to participate in the research, and parental or legal guardian consent. The exclusion criteria included severe psychiatric disorders requiring immediate specialized care, acute withdrawal symptoms at

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the time of assessment, concurrent participation in another structured psychological intervention, severe cognitive impairment, and absence from more than two intervention sessions.

Ethical Considerations and Procedure

Before data collection, the necessary permissions were obtained from the relevant treatment centers. The purpose of the study, its procedures, and the voluntary nature of participation were explained to both the adolescents and their parents or legal guardians. Written informed consent was obtained from guardians, and assent was obtained from the adolescent participants. They were assured that their information would remain confidential, would be used only for research purposes, and that withdrawal from the study at any stage would not affect their routine treatment services.

After screening and enrollment, all participants completed the research measures at the pretest stage. Following baseline assessment, the experimental group received Mindfulness-Based Relapse Prevention in addition to routine care, while the control group continued to receive the routine services available at the treatment centers. At the end of the intervention period, both groups completed the posttest assessment, and a follow-up assessment was later conducted to evaluate the persistence of the treatment effects.

Intervention

The intervention consisted of eight weekly group sessions of Mindfulness-Based Relapse Prevention, each lasting approximately 90 minutes. The intervention was delivered by a therapist trained in mindfulness-based approaches and adolescent counseling. MBRP is a structured intervention developed to integrate mindfulness practices with the principles of relapse prevention and has been widely described as an approach that helps individuals observe craving, affective distress, and automatic behavioral tendencies in a nonjudgmental and nonreactive manner (Bowen et al., 2021).

The protocol was developmentally adapted for adolescents by using age-appropriate language, interactive discussion, and shorter experiential practices when necessary. The intervention focused on increasing awareness of internal and external triggers, recognizing automatic patterns associated with substance use, observing craving-related experiences without immediate reaction, strengthening acceptance-based coping, improving emotional awareness, and promoting more deliberate responses in high-risk situations.

In the first session, participants were introduced to the treatment goals, group rules, and the concept of mindfulness as purposeful, present-moment, and nonjudgmental awareness. Psychoeducation was also provided regarding relapse, risk situations, and the role of "automatic pilot" in substance use behavior. In the second session, participants learned to identify internal and external triggers and were introduced to basic practices such as mindful breathing and body awareness. In the third session, the focus was on craving and urge awareness, and participants were trained in observing urges as transient experiences rather than commands that require action. The technique of urge surfing was practiced. In the fourth session, the relationship between emotions, thoughts, bodily sensations, and substance use behavior was explored, and participants practiced allowing difficult internal states without impulsive avoidance.

In the fifth session, greater emphasis was placed on maladaptive cognitive-emotional responses to stress, including rumination, catastrophizing, and self-blame. Participants were encouraged to notice these mental patterns with greater psychological distance. In the sixth session, mindfulness skills were applied to interpersonal stressors and high-risk situations, with an emphasis on pausing, observing, and choosing more adaptive responses. In the seventh session, attention was given to relapse warning signs, self-care, daily routine regulation, and sleep-related habits, and participants were encouraged to integrate mindfulness skills into emotionally difficult moments and nighttime routines. In the eighth session, previous material was reviewed, participants discussed their experiences,

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individualized relapse prevention plans were completed, and recommendations were provided for maintaining mindfulness practice after the intervention ended.

The control group did not receive the MBRP sessions during the study period and continued only with the routine services normally provided by the treatment centers.

Measures

Demographic and Clinical Information Form

A researcher-developed demographic and clinical information form was used to collect background data on the participants. This form included age, gender, educational level, living arrangement, family status, age of onset of substance use, primary substance used, duration of substance use, treatment history, and relapse history. It also included information on psychiatric history, medication use, and prior psychological services. This form was reviewed by specialists in adolescent psychopathology and addiction treatment to ensure content relevance and clarity.

Craving Experience Questionnaire (CEQ)

Craving was measured using the Craving Experience Questionnaire (CEQ). The CEQ is a brief, theory-based self-report measure developed to assess craving as a multidimensional subjective experience rather than a simple desire state. It was developed within the framework of the Elaborated Intrusion Theory of Desire and is designed to assess the intensity and cognitive-affective features of craving, including intrusive thoughts and imagery associated with the desired substance or behavior. The original brief form of the CEQ contains 10 items and has been described as a conceptually grounded and psychometrically sound instrument for assessing craving-related experiences (May et al., 2014).

The CEQ includes forms that assess either the strength of craving at the present moment or the frequency of craving over a specified time interval. In clinical and research settings, it has been used to examine craving-related dimensions such as the strength of desire, subjective need, vividness of craving-related mental imagery, and intrusiveness of associated thoughts. This structure makes it particularly appropriate for studies on mindfulness-based interventions, because MBRP directly targets awareness of urges, intrusive craving cognitions, and the capacity to observe such experiences without automatic behavioral enactment. Higher scores indicate greater craving severity. In the present study, the total score was used as the main indicator of craving, with higher scores reflecting stronger and more persistent craving experiences (May et al., 2014).

Cognitive Emotion Regulation Questionnaire (CERQ)

Cognitive emotion regulation was assessed using the Cognitive Emotion Regulation Questionnaire (CERQ) developed by (Garnefski et al., 2001). The CERQ is a self-report instrument designed to identify the cognitive strategies individuals use in response to stressful or threatening life experiences. Unlike broader coping scales, this questionnaire specifically focuses on the cognitive dimension of emotion regulation, making it highly relevant for studies examining internal self-regulatory processes associated with substance use and relapse.

The full version of the CERQ consists of 36 items divided into nine subscales, each represented by four items: self-blame, other-blame, rumination, catastrophizing, putting into perspective, positive refocusing, refocus on planning, positive reappraisal, and acceptance. The instrument is scored on a Likert-type format, and higher scores on each subscale indicate greater use of that strategy. Conceptually, some strategies such as self-blame, rumination, and catastrophizing are often considered less adaptive, whereas strategies such as positive reappraisal and refocus on planning are generally considered more adaptive (Garnefski & Kraaij, 2007; Garnefski et al., 2001).

The CERQ has shown favorable psychometric properties in previous research, including acceptable to strong internal consistency and support for its factorial structure. It has been used widely in both adolescent and adult samples and is considered a useful instrument for distinguishing between maladaptive and adaptive cognitive responses to distress. In the present study, both the overall profile of cognitive emotion regulation and the balance between adaptive and

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maladaptive strategies were considered relevant, because adolescents with substance use disorder often rely on maladaptive cognitive-emotional responses that can intensify craving and relapse vulnerability (Garnefski & Kraaij, 2007; Garnefski et al., 2001).

Pittsburgh Sleep Quality Index (PSQI)

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) developed by (Buysse et al., 1989). The PSQI is one of the most widely used self-report instruments for the assessment of subjective sleep quality and sleep disturbance. It evaluates sleep over a one-month interval and conceptualizes sleep as a multidimensional construct rather than a single symptom domain.

The PSQI contains 19 self-rated items that produce seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. These component scores are summed to yield a global sleep quality score ranging from 0 to 21, with higher scores indicating poorer sleep quality. A global score above the conventional cutoff of 5 is generally interpreted as reflecting poor sleep quality (Buysse et al., 1989).

The PSQI has demonstrated strong clinical utility and broad applicability across medical and psychological populations. Because adolescents with substance use disorder often experience problems with sleep onset, continuity, and daytime functioning, this questionnaire was considered highly suitable for the present study. In the current research, the global PSQI score was used as the main indicator of sleep quality, with lower scores at posttest and follow-up interpreted as improvement in sleep functioning (Buysse et al., 1989).

Administration and Scoring

All measures were administered in paper-and-pencil form under standardized conditions at pretest, posttest, and follow-up. Participants received clear instructions, and procedural questions were addressed when necessary. They were reminded that their responses would remain confidential and would not affect the services they were receiving. Scoring was performed according to the instructions for each instrument. For the CEQ and PSQI, higher scores indicated greater clinical difficulty. For the CERQ, interpretation depended on the specific subscale, with some reflecting maladaptive strategies and others reflecting adaptive cognitive responses.

Validity Control Procedures

To enhance internal validity, the same assessment procedures were used for both groups across all three measurement points. Questionnaires were administered in comparable settings, and efforts were made to minimize distractions during data collection. Session attendance was monitored closely, and participants who missed more than two sessions were excluded from the final analysis. To reduce expectancy bias, participants were informed that the study aimed to evaluate psychological variables related to recovery and coping rather than emphasizing the presumed superiority of one condition over another. In addition, the therapist followed a structured intervention protocol to maintain consistency in treatment delivery.

Data Analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS). First, descriptive statistics including means and standard deviations were calculated for all variables. Before inferential analyses were conducted, the assumptions of normality, homogeneity of variances, and homogeneity of regression slopes were examined.

To evaluate the effectiveness of the intervention, repeated-measures analysis of variance and multivariate analysis of covariance were used as appropriate. Pretest scores were controlled where necessary to determine whether the experimental and control groups differed significantly at posttest and follow-up on the variables of craving, cognitive emotion regulation, and sleep quality. Effect sizes were also calculated to estimate the magnitude of the intervention effects. The significance level for all analyses was set at 0.05.

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Findings and Results

Because the study used a two-group, three-time-point design, the data were analyzed using a mixed between-within subjects analysis of variance (mixed ANOVA). Before conducting the main analyses, the assumptions of normality, homogeneity of variances, and sphericity were examined. Descriptive statistics were then calculated for craving, maladaptive cognitive emotion regulation, and sleep quality across pretest, posttest, and follow-up in the experimental and control groups. Finally, mixed ANOVA was used to test the main effects of time and group, as well as the Time × Group interaction effect. Bonferroni-adjusted pairwise comparisons were performed to determine the pattern of change across measurement occasions.

Table 1

Descriptive statistics for craving, maladaptive cognitive emotion regulation, and sleep quality across study phases

Variable	Group	Pretest M ± SD	Posttest M ± SD	Follow-up M ± SD
Craving	Experimental	61.40 ± 8.72	36.13 ± 7.09	39.07 ± 7.54
	Control	59.87 ± 9.11	57.93 ± 8.84	56.47 ± 8.31
Maladaptive cognitive emotion regulation	Experimental	56.27 ± 6.18	39.73 ± 5.84	41.20 ± 6.02
	Control	55.60 ± 6.55	54.80 ± 6.29	53.93 ± 6.13
Sleep quality	Experimental	11.27 ± 2.11	6.47 ± 1.88	6.93 ± 2.04
	Control	10.93 ± 2.26	10.60 ± 2.14	10.27 ± 2.08

Table 1 shows that the experimental and control groups had relatively similar mean scores at pretest across all three outcome variables. Following the intervention, the experimental group demonstrated a marked reduction in craving, maladaptive cognitive emotion regulation, and poor sleep quality, whereas the control group showed only minimal change across time. At follow-up, the experimental group maintained most of its improvement, although a slight increase in craving and maladaptive cognitive emotion regulation was observed relative to posttest. Nevertheless, the follow-up means remained substantially better than pretest values, suggesting relative maintenance of treatment gains.

Table 2

Tests of statistical assumptions prior to the main analysis

Variable	Shapiro–Wilk (Residuals), W	p	Levene's Test at Pretest, F	p	Mauchly's Test of Sphericity, χ^2	p
Craving	0.96	.318	0.21	.651	1.84	.399
Maladaptive cognitive emotion regulation	0.97	.441	0.09	.771	2.13	.345
Sleep quality	0.95	.227	0.16	.695	1.58	.454

As shown in Table 2, the assumptions required for mixed ANOVA were met for all dependent variables. Shapiro–Wilk tests indicated that the residual distributions did not significantly deviate from normality. Levene's tests further showed that the variances of the two groups were homogeneous at baseline. In addition, Mauchly's test of sphericity was non-significant for all variables, indicating that the assumption of sphericity was satisfied and that the standard F statistics could be interpreted without correction.

Table 3

Mixed ANOVA results for craving, maladaptive cognitive emotion regulation, and sleep quality

Variable	Effect	df	F	p	Partial η^2
Craving	Time	2, 56	54.82	< .001	.662
	Group	1, 28	9.47	.005	.253
	Time × Group	2, 56	41.36	< .001	.596
Maladaptive cognitive emotion regulation	Time	2, 56	39.15	< .001	.583
	Group	1, 28	7.92	.009	.221
	Time × Group	2, 56	33.74	< .001	.546
Sleep quality	Time	2, 56	28.46	< .001	.504
	Group	1, 28	5.88	.022	.174
	Time × Group	2, 56	24.63	< .001	.468

Table 3 indicates statistically significant main effects of time for craving, maladaptive cognitive emotion regulation, and sleep quality, suggesting that scores changed across the three measurement occasions. Significant main effects of group were also observed, indicating overall differences between the experimental and control groups. Most importantly, the Time × Group interaction effect was significant for all three variables. This finding demonstrates that the pattern of change over time differed significantly between the two groups and supports the effectiveness of MBRP in reducing craving, decreasing maladaptive cognitive emotion regulation, and improving sleep quality in adolescents with substance use disorder. The obtained effect sizes were moderate to large. The strongest interaction effect was observed for craving (partial η^2 = .596), followed by maladaptive cognitive emotion regulation (partial η^2 = .546) and sleep quality (partial η^2 = .468). These values suggest that the intervention had meaningful practical as well as statistical significance.

Table 4

Bonferroni-adjusted pairwise comparisons for the experimental group across the three assessment phases

Variable	Comparison	Mean Difference	SE	p
Craving	Pretest vs. Posttest	25.27	2.91	< .001
	Pretest vs. Follow-up	22.33	3.02	< .001
	Posttest vs. Follow-up	-2.94	1.72	.118
Maladaptive cognitive emotion regulation	Pretest vs. Posttest	16.54	2.11	< .001
	Pretest vs. Follow-up	15.07	2.19	< .001
	Posttest vs. Follow-up	-1.47	1.03	.174
Sleep quality	Pretest vs. Posttest	4.80	0.78	< .001
	Pretest vs. Follow-up	4.34	0.83	< .001
	Posttest vs. Follow-up	-0.46	0.39	.286

As presented in Table 4, Bonferroni-adjusted comparisons revealed that, in the experimental group, all three outcome variables improved significantly from pretest to posttest and from pretest to follow-up. However, the differences between posttest and follow-up were not statistically significant. This pattern indicates that the gains achieved immediately after treatment were largely maintained during the follow-up period. Although a slight numerical decline was observed between posttest and follow-up for some variables, this decline did not reach statistical significance.

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Table 5

Between-group comparisons at posttest and follow-up

Variable	Phase	Experimental M ± SD	Control M ± SD	t	p	Cohen's d
Craving	Posttest	36.13 ± 7.09	57.93 ± 8.84	-7.43	< .001	2.71
	Follow-up	39.07 ± 7.54	56.47 ± 8.31	-6.01	< .001	2.19
Maladaptive cognitive emotion regulation	Posttest	39.73 ± 5.84	54.80 ± 6.29	-6.79	< .001	2.48
	Follow-up	41.20 ± 6.02	53.93 ± 6.13	-5.73	< .001	2.09
Sleep quality	Posttest	6.47 ± 1.88	10.60 ± 2.14	-5.64	< .001	2.06
	Follow-up	6.93 ± 2.04	10.27 ± 2.08	-4.43	< .001	1.62

Table 5 shows that the experimental group scored significantly lower than the control group at both posttest and follow-up on all three dependent variables. Because lower scores reflected improvement in craving severity, maladaptive cognitive emotion regulation, and poor sleep quality, these findings indicate superior outcomes for the MBRP group compared with routine care alone. The effect sizes were large across all comparisons, further underscoring the strength of the intervention effect.

Overall, the findings showed that adolescents who participated in the Mindfulness-Based Relapse Prevention program exhibited substantial reductions in craving, maladaptive cognitive emotion regulation strategies, and sleep disturbance relative to the control group. These improvements were evident immediately after the intervention and remained generally stable at follow-up. Taken together, the results support the conclusion that MBRP was effective in improving key relapse-related psychological and behavioral outcomes in adolescents with substance use disorder.

Discussion and Conclusion

The present study investigated the effectiveness of Mindfulness-Based Relapse Prevention (MBRP) on craving, maladaptive cognitive emotion regulation, and sleep quality in adolescents with substance use disorder. The findings showed that participation in MBRP was associated with significant reductions in craving, significant improvement in cognitive emotion regulation, and significant improvement in sleep quality compared with the control group. In addition, the pattern of findings across pretest, posttest, and follow-up suggested that the observed gains were not limited to the immediate post-intervention period, but were generally maintained over time. Taken together, these findings support the view that MBRP can simultaneously influence several relapse-related mechanisms and may therefore be especially useful for adolescent populations with substance use disorder, whose emotional reactivity, impulsivity, and self-regulatory instability are often pronounced (Goldberg et al., 2021; Legenbauer et al., 2024).

The first major finding of the present study was that MBRP significantly reduced craving in adolescents with substance use disorder. This result is theoretically important because craving is one of the most immediate and powerful predictors of lapse and relapse. From a mindfulness-based perspective, craving becomes problematic when urges are fused with attention, affective discomfort, intrusive imagery, and automatic behavioral responding. MBRP appears to weaken this chain by helping individuals observe craving-related thoughts, sensations, and impulses as temporary internal experiences rather than signals that require immediate action. Practices such as mindful breathing, urge surfing, and nonjudgmental observation likely enabled participants to tolerate craving states more effectively and to reduce reactive substance-seeking behavior. This interpretation is consistent with previous literature indicating that mindfulness-based interventions can reduce craving and improve self-regulatory functioning in individuals with substance-related problems (Bowen et al., 2021; Goldberg et al., 2021; May et al., 2014).

Another important finding was the improvement in cognitive emotion regulation following participation in

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MBRP. This finding is particularly relevant because difficulties in emotion regulation are increasingly recognized as a central vulnerability factor in substance use disorders. Adolescents with substance use disorder often experience intense emotional states while lacking adaptive cognitive strategies for managing them. Under such conditions, substance use may function as a maladaptive form of short-term emotional relief. Mindfulness-based approaches are especially relevant because they do not simply encourage symptom control or suppression; rather, they foster present-moment awareness, acceptance, decentering, and greater reflective distance from distressing thoughts and feelings. In the present study, reductions in maladaptive cognitive emotion regulation likely reflected lower reliance on rumination, self-blame, catastrophizing, and similar cognitive patterns, along with greater flexibility in responding to emotional distress. This interpretation is in line with prior research showing that deficits in emotion regulation are strongly associated with substance use severity and addictive behaviors more broadly (Garnefski & Kraaij, 2007; Garnefski et al., 2001; González-Roz et al., 2024; Stellern et al., 2023).

The observed improvement in sleep quality is another clinically meaningful aspect of the findings. Sleep problems are common among individuals with substance use disorder and may contribute to relapse risk through several pathways, including reduced inhibitory control, increased emotional lability, greater irritability, and stronger vulnerability to craving. In adolescence, these effects may be even more pronounced because sleep, emotional functioning, and executive regulation are tightly interrelated during this developmental period. The reduction in PSQI scores in the experimental group suggests that MBRP may have influenced not only substance-related cognitions but also broader physiological and psychological processes relevant to sleep. Mindfulness practice may reduce presleep cognitive arousal, repetitive negative thinking, bodily tension, and stress-related activation, all of which can interfere with restful sleep. In addition, improvements in emotional regulation and reductions in craving may indirectly support better sleep continuity and subjective sleep quality. This interpretation is consistent with prior findings indicating that mindfulness-related interventions can improve sleep quality and that sleep disturbance is closely linked with substance use vulnerability and recovery outcomes (Armstrong et al., 2024; Buysse et al., 1989).

The relative maintenance of treatment effects at follow-up is also noteworthy. Although some variables showed slight numerical worsening from posttest to follow-up, these changes were not statistically significant, suggesting that the benefits of treatment remained generally stable over time. This finding is important because relapse prevention is concerned not only with immediate symptom reduction but also with the durability of behavioral and psychological change after formal treatment ends. One possible explanation is that MBRP teaches transferable process-based skills rather than narrowly situation-specific coping responses. Skills such as noticing urges, identifying triggers, pausing before reacting, and observing emotional activation can continue to be used in everyday life after treatment has ended. In this sense, MBRP may help adolescents build an enduring style of self-regulation rather than merely providing temporary symptom management (Bowen et al., 2021; Goldberg et al., 2021).

The findings of the present study also have clear developmental significance. Adolescence is characterized by ongoing maturation of executive functions, greater sensitivity to reward and peer influence, and increased emotional variability. These developmental features may intensify vulnerability to craving, dysregulated emotion, poor sleep, and relapse. The apparent effectiveness of MBRP in the present study may therefore stem partly from its compatibility with the specific self-regulatory challenges of adolescence. Rather than relying exclusively on abstract cognitive change or externally imposed control, mindfulness-based intervention trains adolescents to become aware of their internal experiences in real time and respond with greater reflection and less impulsivity. Previous research similarly suggests that mindfulness-based interventions may improve intermediary processes relevant to adolescent substance use, including stress reactivity,

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attentional control, and impulsive responding (Fadus et al., 2019; Goldberg et al., 2021; Legenbauer et al., 2024).

Despite these promising findings, several limitations should be acknowledged. First, the sample size was relatively small, which may limit the generalizability of the results and reduce statistical precision. Second, the study relied on self-report measures, which are valuable and widely accepted but remain vulnerable to response bias and social desirability effects. Third, the sample was drawn from treatment centers and counseling clinics, which may limit generalization to adolescents in community settings or to those with more severe psychiatric comorbidity. Fourth, because the study used a quasi-experimental design, caution is warranted in making strong causal inferences, even though the presence of a control group and repeated assessments strengthened the internal validity of the study. These limitations are consistent with broader concerns in the literature on mindfulness-based interventions for adolescent substance use, where heterogeneity in samples, methods, and outcomes continues to affect the strength of conclusions (Fadus et al., 2019; Goldberg et al., 2021).

Despite these limitations, the present findings have important clinical implications. The results suggest that MBRP may be a useful adjunct to routine treatment for adolescents with substance use disorder, especially when treatment goals extend beyond reduction of substance use itself to the modification of underlying relapse-related mechanisms. In practice, integrating MBRP into adolescent addiction treatment programs may help young people develop more adaptive ways of responding to craving, reduce maladaptive cognitive emotion regulation strategies, and improve sleep quality, thereby supporting more stable recovery. Given the multidimensional nature of adolescent substance use disorder, interventions that target emotional, cognitive, and behavioral processes simultaneously may be more effective than approaches focused solely on abstinence or behavioral control (Bowen et al., 2021; Legenbauer et al., 2024; Nash, 2025).

Conclusion

In conclusion, the findings of the present study indicate that Mindfulness-Based Relapse Prevention was effective in reducing craving, improving cognitive emotion regulation, and enhancing sleep quality in adolescents with substance use disorder. The significant improvements observed in the experimental group at posttest and follow-up suggest that MBRP may represent a clinically meaningful and developmentally appropriate intervention for adolescents at risk of relapse. By targeting internal processes that frequently sustain substance use—particularly craving, maladaptive emotion regulation, and poor sleep—MBRP appears to offer benefits that extend beyond simple symptom reduction. These findings support the inclusion of mindfulness-based relapse prevention in comprehensive treatment programs for adolescents with substance use disorder and highlight the need for further studies with larger samples, longer follow-up periods, and more rigorous controlled designs to clarify its long-term effectiveness and broader applicability (Bowen et al., 2021; Goldberg et al., 2021; Legenbauer et al., 2024).

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Ethical considerations in this study were that participation was entirely optional.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contribute to this study.

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