Psychology Research and Behavior Management

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Endogenous Oxytocin and Depressive Symptoms in Drug Abstainers: The Roles of Perceived Social Support and Drug Abstinence Self-Efficacy

Qingqi Zhang[1], Bingtao Zhou[1], Xiaoqian Liu[2], Da Yi[1], Ai Ma[2], Yumeng Liu[1], Ke Qi[3]

[1]School of Criminal Justice, China University of Political Science and Law, Beijing, 100088, People's Republic of China; [2]School of Sociology, China University of Political Science and Law, Beijing, 100088, People's Republic of China; [3]The Psychological Counselling Centre, China University of Political Science and Law, Beijing, 100088, People's Republic of China

Correspondence: Ke Qi, The Psychological Counselling Centre, China University of Political Science and Law, Beijing, 100088, People's Republic of China, Email qqkk_psy@163.com

Purpose: Depressive symptoms is highly prevalent among individuals in drug abstinence and substantially hinders rehabilitation. Grounded in the biopsychosocial model, this study examined the associations among endogenous oxytocin, perceived social support, drug abstinence self-efficacy, and depressive symptoms among drug abstainers.

Patients and Methods: A cross-sectional study was conducted with 339 participants recruited from a compulsory drug abstinence center in China in November 2023. Salivary oxytocin levels were assessed using enzyme immunoassay. Participants completed validated self-report measures of depressive symptoms (PHQ-9), perceived social support (PSSS), and drug abstinence self-efficacy (SELD). Data were analyzed using SPSS 26.0 and the PROCESS macro with 5000 bootstrap samples to test the proposed mediation and moderated mediation models.

Results: Higher endogenous oxytocin was associated with lower depressive symptoms and greater perceived social support. Perceived social support partially mediated the oxytocin–depressive symptoms association. Drug abstinence self-efficacy moderated both the direct and indirect paths, with stronger associations observed among individuals with higher self-efficacy.

Conclusion: Endogenous oxytocin may be a protective correlate of depressive symptoms in drug abstainers, partly through its association with perceived support. These associations are amplified by greater drug abstinence self-efficacy. The findings bridge biological, social, and cognitive perspectives, proposing practical intervention approaches to mitigate depressive symptoms and enhance abstinence outcomes for drug abstainers.

Keywords: moderated mediation, substance use, mental health intervention, neuropeptide regulation

Introduction

Depressive symptoms, which represent one of the most prevalent and burdensome mental health concerns, have become a major global public health issue. WHO estimates that about 280 million people suffer from depression, and many more experience subclinical or undiagnosed depressive symptoms worldwide.[1] Although depressive symptoms are widespread, individuals in drug abstinence exhibit particularly severe and persistent symptomatology compared to the general population.[2] Studies have shown that individuals in drug abstinence face considerable psychological distress, with depressive symptoms being among the most frequently reported symptoms.[3] Notably, the prevalence of clinically significant depression in this population in China has been estimated to exceed 54%.[4] Persistent depressive symptoms not only compromise abstinence outcomes and quality of life but also weaken abstinence motivation, impair executive functions, and elevate the risk of relapse.[5,6] The impact of these issues goes beyond individual suffering, leading to broader societal consequences, including increased healthcare expenses, a higher risk of criminal relapse, and threats to public safety. Given these wide-reaching effects, it is crucial to understand the underlying mechanisms of depressive symptoms in drug abstainers to inform the development of effective interventions.

https://doi.org/10.2147/PRBM.S549474
Received: 14 July 2025
Accepted: 17 October 2025
Published: 23 October 2025

Theoretical Foundation: The Biopsychosocial Model

The biopsychosocial model of depressive symptoms emphasizes that depressive symptoms result from the complex interaction of biological, psychological, and social factors.[7] Biologically, neurochemical dysregulation and hormonal imbalances increase vulnerability.[8] Psychologically, maladaptive cognitions and diminished self-efficacy intensify depressive processes. Socially, inadequate perceived support and interpersonal stressors exacerbate emotional distress.[9] This integrative framework suggests that understanding depressive symptoms requires examining factors across multiple domains rather than focusing on isolated causes. Guided by this theory, the study explores how biological (oxytocin), social (social support), and psychological (drug abstinence self-efficacy) factors interact to influence depressive symptoms in drug abstainers.

Oxytocin and Depressive Symptoms Among Drug Abstainers

Oxytocin (OT) is a peptide hormone synthesized by the paraventricular and supraoptic nuclei of the hypothalamus and secreted by the posterior pituitary. It was initially named for its role in facilitating childbirth.[10] Extensive research has demonstrated that oxytocin plays a central role in emotional regulation, social functioning, and stress responses.[11–13] Neurobiological studies indicate that oxytocin modulates hypothalamic-pituitary-adrenal (HPA) axis activity, suppressing corticotropin-releasing factor and cortisol secretion and consequently mitigating depressive symptoms.[14] Study has shown that reduced serum oxytocin levels are significantly associated with more severe depressive symptoms, indicating a potential protective role of oxytocin.[15] Moreover, clinical trials have demonstrated that intranasal oxytocin administration effectively alleviates negative affect in patients with depression.[16] In opioid-dependent individuals undergoing abstinence, a double-blind study revealed that daily administration of 40 IU of intranasal oxytocin for four weeks significantly reduced depressive symptoms.[17]

While most research has examined the effects of exogenous oxytocin on depressive symptoms, concerns remain regarding its ecological validity and the transient nature of its influence. Focusing on endogenous oxytocin, which naturally produced by the body, the present study aims to elucidate its natural regulatory role, providing a more accurate reflection of underlying processes. Building on prior empirical findings, the present study focuses on endogenous oxytocin and proposes Hypothesis 1: Endogenous oxytocin levels will negatively predict depressive symptoms among individuals undergoing drug abstinence.

The Mediating Role of Perceived Social Support

Perceived social support refers to the cognitive appraisal of being reliably connected to others.[18] Social cognitive theory emphasizes that the perception of support resources serves as a stronger psychological predictor than the actual receipt of support.[19] From an evolutionary perspective, oxytocin, often termed the "hormone of love", enhances individuals' perceived strength of social bonds (eg, maternal attachment, interpersonal trust), thereby increasing perceived social support and alleviating depressive symptoms.[20,21]

On the one hand, Higher oxytocin levels are associated with greater perceived social support, reflecting an increased likelihood of feeling cared for and connected to others.[22] Cognitive science research indicates that oxytocin biases attention toward positive social cues (eg, smiling faces, friendly language) and amplifies the rewarding value of social interactions, thereby enhancing perceived social support.[23] In addition, endogenous oxytocin inhibits hyperactivation of the amygdala-hypothalamic-pituitary-adrenal (HPA) axis, attenuating stress responses to social stressors and enhancing individuals' sensitivity to and utilization of social support resources.[24] On the other hand, perceived social support has been consistently shown to negatively predict depressive symptoms.[25,26] Individuals with higher levels of perceived social support tend to report better emotional adjustment and a lower risk of experiencing depressive symptoms.[27] Research on individuals in drug abstinence has shown that enhancing perceived social support has been found to reduce depressive symptoms and facilitate long-term recovery.[28] Based on this, the present study proposes Hypothesis 2: perceived social support mediates the relationship between oxytocin and depressive symptoms among individuals in drug abstinence.

The Moderating Role of Drug Abstinence Self-Efficacy

Drug abstinence self-efficacy refers to one's confidence in avoiding drug use when encountering relapse-related cues or high-risk situations.[29] According to Bandura's self-efficacy theory,[30] self-efficacy functions as a core cognitive resource that influences how individuals appraise difficulties, mobilize coping strategies, and utilize available resources. Within this cognitive framework, drug abstainers with higher self-efficacy tend to interpret challenges as manageable, maintain optimistic expectations about recovery, and more effectively engage both internal biological regulators (eg, endogenous oxytocin) and external social resources (eg, social support) to regulate negative affect. In contrast, individuals with low self-efficacy are prone to feelings of helplessness and pessimism, which may dampen the beneficial influence of oxytocin on emotion regulation and hinder the translation of social support into actual psychological benefits.

The stress-buffering hypothesis further suggests that the protective effects of social support rely on the individual's capacity to cognitively process and behaviorally utilize such resources.[31] From this perspective, drug abstinence self-efficacy plays a moderating role by determining the extent to which positive factors—such as oxytocin-induced perception of support—can effectively reduce depressive symptoms. Those with high abstinence self-efficacy are better positioned to convert these positive inputs into emotional resilience,[32] whereas those with low self-efficacy may remain vulnerable to depressive symptoms despite adequate oxytocin levels or sufficient social support. Research on nicotine addiction indicates that perceived social support increasingly alleviates depressive symptoms over time among individuals with high abstinence self-efficacy, whereas no such effect is observed in those with low self-efficacy.[33] Although the moderating role of abstinence self-efficacy has not been directly examined in drug abstinence populations, similar patterns have been observed in alcohol and nicotine addiction. Therefore, we propose the following hypotheses:Hypothesis 3(a): Drug abstinence self-efficacy moderates the direct association between endogenous oxytocin and depressive symptoms (the negative association is stronger at higher drug abstinence self-efficacy). Hypothesis 3(b): Drug abstinence self-efficacy moderates the association between perceived social support and depressive symptoms (perceived support predicts lower symptoms more strongly when drug abstinence self-efficacy is high).

Current Study

In the present study, depression is operationalized specifically as the severity of self-reported depressive symptoms rather than as a clinical diagnosis of major depressive disorder. This study aimed to examine the psychological mechanisms underlying depressive symptoms in drug users who have been withdrawn, focusing on the role of endogenous oxytocin, perceived social support, and drug abstinence self-efficacy. Drawing on prior findings, we propose a moderated mediation model (See Figure 1): endogenous oxytocin may reduce depressive symptoms via increased perceived social support, and this indirect pathway may vary depending on one's level of abstinence self-efficacy. This model integrates biological, social, and cognitive factors to better understand emotional outcomes during addiction recovery and may provide implications for personalized interventions.

Materials and Methods

Participants and Procedure

This cross-sectional investigation was executed in November 2023, targeting individuals in drug abstinence. The selection criteria for participants were as follows: (1) a minimum of one year's history of drug use; (2) no history of physical or mental health disorders prior to abstinence; (3) no recent administration of psychotropic medications. Participants reported use of substances commonly observed in compulsory rehabilitation populations, including opioids

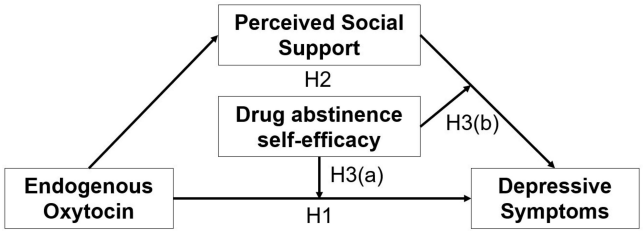

Figure 1 The moderated mediation model.

https://doi.org/10.2147/PRBM.S549474

(eg, heroin, morphine), synthetic drugs (eg, methamphetamine, ketamine, MDMA), cannabis, and, less frequently, prescription drugs (eg, benzodiazepines).

A total of 375 addicts participated in the paper-based questionnaire survey, resulting in 339 valid datasets, which corresponds to an effective response rate of 90.4%. Data from 36 individuals were expunged due to: (1) abnormal response times, either excessively long or short; (2) intentional selection of uniform response patterns; (3) extensive data omissions. Participants were assured of confidentiality, with anonymized data used solely for research purposes. To minimize response bias, the order of scales and items was randomized. All participants provided written informed consent prior to participation, including consent for saliva collection and oxytocin analysis. For participants under 18 years of age, written informed consent was obtained from a parent or legal guardian, alongside the participants' own assent. This study protocol received ethical clearance from the Ethics Committee of the School of Sociology at China University of Political Science and Law. The demographic characteristics of the 339 valid participants are summarized in Table 1.

Measures

Measurement of Endogenous Oxytocin Levels in Saliva

Previous research indicated that saliva sampling is a dependable, straightforward, and expedient technique for assessing hormone levels, outperforming plasma-based methods.[34] Participants are required to abstain from ingesting food, beverages, or engaging in oral hygiene for a minimum of 60 minutes prior to providing a 6 mL saliva sample into a designated laboratory-provided tube. Post-collection, samples are promptly preserved at −20°C and dispatched for analysis. Enzyme immunoassay is utilized to quantify endogenous oxytocin concentrations in the saliva of individuals with amphetamine use disorder. Therefore, this study also employed Enzyme Immunoassay to quantify the concentration of endogenous oxytocin, with measurements reported in picograms per milliliter (pg/mL).

Patient Health Questionnaire-9 (PHQ-9)

The Patient Health Questionnaire-9 (PHQ-9) is a validated self-report measure that is widely used in both clinical and research settings for the assessment of depressive symptoms.[35] The PHQ-9 is scored by assigning each item a value from 0 (Not at all) to 3 (Nearly every day). The total score is calculated by summing the scores of all 9 items, yielding

Table 1 Demographic Characteristics of Male Addicts (N=339)

Characteristic	Frequency	Percent (%)
Biological sex		
Male	173	51.0
Female	166	49.0
Age		
16–25	5	1.5
26–40	182	53.7
41–55	141	41.6
>55	11	3.2
Duration of Abstinence		
< 3 months	97	28.6
3–6 months	105	31.0
> 6months	137	40.4
Years of Drug Use		
1–3	106	31.3
4–6	153	45.1
7–9	63	18.6
>9	17	5.0
Only-child status		
Yes	160	47.2
No	179	52.8

a possible range of 0 to 27, with higher scores indicating more severe depressive symptoms (Sample item: Trouble falling or staying asleep or sleeping too much). In the current study, Cronbach's α for PHQ-9 was 0.891.

The Perceived Social Support Scale (PSSS)

The Perceived Social Support Scale (PSSS) is a psychological assessment instrument designed to measure the extent to which individuals perceive social support. This instrument consists of 12 items, partitioned across three subscales: family, friend, and other support.[36] Each item is rated on a 7-point Likert scale, ranging from 1(strongly disagree) to 7(strongly agree). The aggregate score is indicative of the level of perceived social support, with elevated scores denoting a stronger perception (Sample item: My friends really try to help me). In this study, the PSSS exhibited a high overall internal consistency ($\alpha = 0.93$), with the subscales demonstrating reliability coefficients of $\alpha = 0.86$ for family support, $\alpha = 0.85$ for friend support, and $\alpha = 0.86$ for other support.

The Self-Efficacy List for Drug Users (SELD)

The Self-Efficacy List for Drug Users (SELD) is a validated measure for assessing the self-efficacy of individuals with substance dependence to resist drug use. This scale consists of 17 items across three dimensions: environmental triggers, negative affect, and positive affect.[37] Utilizing a 5-point Likert scale, responses range from 1 (strongly disagree) to 5 (strongly agree). An illustrative item is: "When you are feeling ill, you would choose to relapse." Items are reverse-scored to aggregate a total that accurately reflects drug abstinence self-efficacy. Higher scores denote greater efficacy. In this study, the scale exhibited an overall internal consistency of α=0.90, with subscale reliabilities of α=0.89 for environmental triggers, α=0.80 for negative affect, and α=0.90 for positive affect.

Control Variables

Participants completed a self-report inventory wherein they provided demographic data, encompassing age, duration of abstinence, years of drug use, and only-child status. Empirical evidence from prior investigations has demonstrated that the demographic characteristics (biological sex, age, duration of abstinence, years of drug use, only-child status, and so on) of addicts are associated with depressive symptoms.[38–42] In this study, we controlled these variables, which were operationalized as dummy variables, with age stratified into four distinct cohorts: 16–25 years, 26–40 years, 41–55 years, and over 55 years. The dummy-codes used to represent biological sex were 1 for "male" and 2 for "female". Duration of abstinence was trichotomized, with codes assigned as 1 for less than 3 months, 2 for 3–6 months, and 3 for over 6 months. Years of drug use was categorized into four groups: 1–3 years, 4–6 years, 7–9 years, and more than 9 years. Only-child status was binary, with 1 representing an only child and 2 indicating the presence of siblings.

Data Analysis

We used SPSS 26.0 for data processing, including the common method variance test, descriptive statistics, and Pearson correlation analyses. Prior to regression analysis, all continuous variables were standardized. The PROCESS macro was employed to test the proposed models.[43] A total of 5000 bootstrapping samples were used to determine the significance of the mediation and moderated mediation effects with 95% confidence intervals (CIs).

Results

Common Method Variance Test (CMV)

A Harman's single-factor test was implemented to evaluate the impact of common method variance (CMV). The unrotated factor analysis indicated a Kaiser-Meyer-Olkin (KMO) statistic of 0.924, with a significant Bartlett's Test of Sphericity ($p < 0.001$). Four factors were extracted, with the first factor accounting for 23.42% of the variance, which is well below the criterion of 40% as suggested by Podsakoff et al.[44] This indicates that the influence of CMV on the results of this study can be excluded.

Descriptive Statistics and Pearson Correlations

The results of descriptive statistics and Pearson correlation analyses are presented in Table 2. Consistent with hypotheses, levels of endogenous oxytocin were negatively correlated with depressive symptoms ($r = -0.28$, $p < 0.01$), and positively correlated with perceived social support ($r = 0.38$, $p < 0.01$). Depressive symptoms were negatively associated with both perceived social support ($r = -0.31$, $p < 0.01$) and drug abstinence self-efficacy ($r = -0.16$, $p < 0.01$). No significant

Table 2 Descriptive Statistics and Correlation Analysis of Variables (N = 339)

	M	SD	1	2	3	4
1. Endogenous oxytocin	166.95	39.71	1			
2. Perceived social support	59.65	15.49	0.38***	1		
3. Depressive symptoms	7.40	6.32	−0.28***	−0.31***	1	
4. Drug abstinence self-efficacy	37.65	16.36	−0.03	−0.06	−0.16**	1

Notes: **p < 0.01; ***p < 0.001.

correlations were observed between drug abstinence self-efficacy and the levels of endogenous oxytocin, as well as perceived social support.

Mediation Analyses

Model 4 of the PROCESS macro was used to test the mediating effect of perceived social support between endogenous oxytocin and depressive symptoms after controlling biological sex, age, duration of abstinence, years of drug use, and only-child status. Table 3 revealed that endogenous oxytocin positively predicted perceived social support (β = 0.37, SE = 0.05, p < 0.001) and negatively predicted depressive symptoms (β = −0.20, SE = 0.06, p < 0.001). Additionally, perceived social support was a significant negative predictor of depressive symptoms (β = −0.22, SE = 0.06, p < 0.001). These findings indicate that perceived social support partially mediated the association between endogenous oxytocin and depressive symptoms (indirect effect= −0.08, 95% CI [−0.141, −0.029]). Generally, this model accounted for 29.51% of the total effect, which supported Hypothesis 1 and Hypothesis 2.

Moderated Mediation Analyses

Moderated mediation analysis was conducted to investigate whether drug abstinence self-efficacy moderated the mediating role of perceived social support. Model 15 of the PROCESS macro was employed to assess moderated mediation effects. In all analyses, we controlled covariates, including biological sex, age, duration of abstinence, years of drug use, and only-child status. As shown in Table 4, the association between endogenous oxytocin and depressive symptoms (β = −0.11, SE=0.05, p = 0.034) and the association between perceived social support and depressive symptoms (β = −0.12, SE=0.06, p = 0.029) were both moderated by drug abstinence self-efficacy.

The simple slope analysis presented in Figure 2 revealed that for addicts with high drug abstinence self-efficacy (1 SD above the mean), the negative impact of endogenous oxytocin on depressive symptoms was more pronounced (β_{simple} = −0.30, SE = 0.08, p < 0.001) compared to those with low drug abstinence self-efficacy (β_{simple} = −0.07, SE = 0.07, p = 0.325). This indicates that as endogenous oxytocin levels increase, depressive symptoms decrease more significantly among addicts with higher drug abstinence self-efficacy. Similarly, the simple slope analysis in Figure 3 indicated that for addicts with high drug abstinence self-efficacy (1 SD above the mean), perceived social support had a stronger negative impact on depressive symptoms (β_{simple} = −0.34, SE = 0.08, p < 0.001) than that of the addicts with low drug abstinence self-efficacy (β_{simple} = −0.09, SE = 0.08, p = 0.268). That is, with increasing perceived social support, depressive

Table 3 The Mediation Effect of Perceived Social Support (N=339)

Outcome	Predictors	β	SE	p	95% CI
Perceived social support	Endogenous oxytocin	0.37	0.05	< 0.001	[0.27, 0.47]
	R^2 = 0.16, F = 10.54, p < 0.001				
Depressive symptoms	Endogenous oxytocin	−0.20	0.06	< 0.001	[−0.30, −0.09]
	Perceived social support	−0.22	0.06	< 0.001	[−0.33, −0.11]
	R^2 = 0.14, F =7.51, p < 0.001				

Table 4 The Moderated Mediation Model Effect of Drug Abstinence Self-Efficacy (N=339)

Outcome	Predictors	β	SE	p	95% CI
Perceived social support	Endogenous oxytocin	0.37	0.05	< 0.001	[0.27, 0.47]
	R^2 = 0.16, F = 10.54, p < 0.001				
Depressive symptoms	Endogenous oxytocin	−0.19	0.05	< 0.001	[−0.29, −0.08]
	Perceived social support	−0.21	0.05	< 0.001	[−0.32, −0.11]
	Drug abstinence self-efficacy	−0.19	0.05	< 0.001	[−0.28, −0.09]
	Endogenous oxytocin × Drug abstinence self-efficacy	−0.11	0.05	0.034	[−0.22, −0.01]
	Perceived social support ×Drug abstinence self-efficacy	−0.12	0.06	0.029	[−0.23, −0.01]
	R^2 = 0.21, *F* = 9.48, p < 0.001				

symptoms diminish more for individuals with high drug abstinence self-efficacy, implying that higher drug abstinence self-efficacy may serve as a protective factor against depressive symptoms in addicts.

Discussion

The present study investigated the psychological mechanisms underlying depressive symptoms among individuals in drug abstinence, focusing on the roles of endogenous oxytocin, perceived social support, and abstinence self-efficacy. Consistent with our hypotheses, all three proposed pathways were supported, offering novel empirical evidence for a moderated mediation model that uniquely integrates biological, social, and cognitive protective factors in depressive symptoms among drug abstainers.

Endogenous Oxytocin and Depressive Symptoms

Consistent with Hypothesis 1, we found that higher levels of endogenous oxytocin were significantly associated with lower depressive symptoms among individuals in drug abstinence. This result corroborates previous findings suggesting that oxytocin serves as a key neurobiological modulator of affective states. Specifically, oxytocin has been shown to downregulate the activity of the hypothalamic-pituitary-adrenal (HPA) axis, leading to reductions in cortisol secretion and depression-related affective symptoms.[45,46] In the context of addiction withdrawal, where individuals often endure high physiological and psychological distress, endogenous oxytocin may act as an intrinsic buffer that alleviates depressive symptomatology.

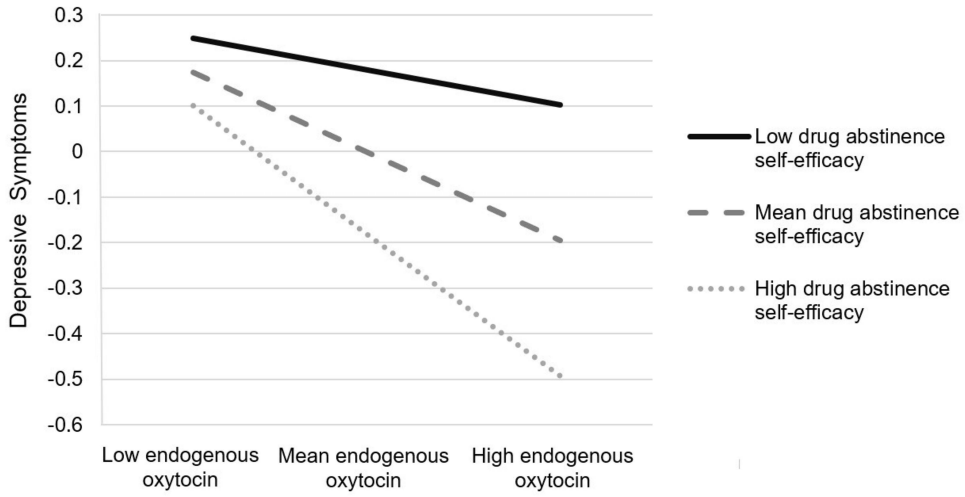

Figure 2 Moderating effect of drug abstinence self-efficacy on the relationship between endogenous oxytocin and depressive symptoms.

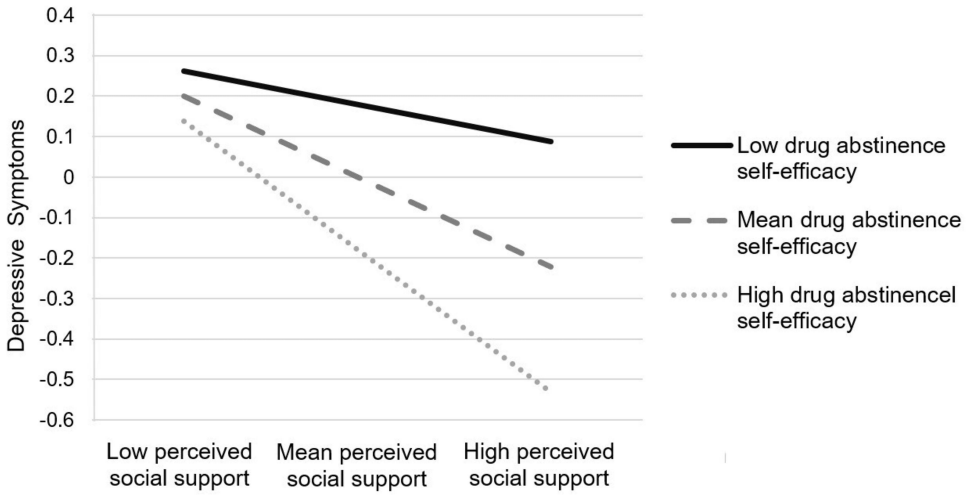

Figure 3 Moderating effect of drug abstinence self-efficacy on the relationship between perceived social support and depressive symptoms.

Moreover, functional MRI studies have demonstrated that oxytocin administration leads to decreased amygdala activation in response to negative or threatening stimuli, suggesting a dampening of emotional hyperarousal and a potential shift toward more adaptive affective appraisal.[47] This mechanism may be particularly relevant for individuals with a history of substance use, whose emotion regulation systems are often dysregulated. Our findings extend the relevance of oxytocin's mood-regulating function to drug-abstinent populations, and suggest that endogenous oxytocin is not only a trait-like biological marker but also a protective factor against depressive symptoms in high-risk groups.

Furthermore, the protective role of endogenous oxytocin may be shaped by individual differences in oxytocin receptor (OXTR) expression and sensitivity, which are influenced by genetic and epigenetic mechanisms. Variations in OXTR function could partly explain interindividual variability in oxytocin's antidepressant effects. In addition, oxytocin operates within a broader neuroendocrine network involving the mesolimbic dopaminergic and serotonergic–prefrontal systems that jointly regulate reward processing, cognitive control, and affective regulation. These interactions may partly explain the variability in oxytocin's antidepressant effects. From a neuroplasticity perspective, longitudinal neuroimaging research has demonstrated that recovery from addiction involves gradual recalibration of socio-emotional circuits, characterized by reduced amygdala hyperreactivity and strengthened prefrontal regulation.[48] Oxytocin may facilitate this process by attenuating amygdala responses to social threat and enhancing the salience of positive social cues,[49] thereby promoting affective neuroplasticity and contributing to the reduction of depressive symptoms during protracted abstinence.

The Mediating Role of Perceived Social Support

Supporting Hypothesis 2, perceived social support was found to mediate the relationship between endogenous oxytocin and depressive symptoms. This finding indicates that oxytocin's protective effect on mental health may, in part, operate through its influence on social cognition—specifically, on how individuals perceive and internalize social support. The result aligns with prior studies suggesting that oxytocin enhances social bonding, trust, and affiliative motives,[50,51] all of which contribute to higher levels of perceived support.

From a social-cognitive perspective, individuals with higher oxytocin levels may be more attuned to the emotional intentions of others, more responsive to positive social interactions, and more likely to interpret ambiguous social situations in a supportive rather than threatening manner.[52] These processes may collectively enhance their sense of being understood, respected, and emotionally connected to others.

Studies show that higher perceived social support has been robustly associated with lower levels of depressive symptoms across both clinical and non-clinical populations.[30,53] In the context of drug abstinence, perceived social support plays a critical role in reducing feelings of isolation, mitigating stigma, and promoting emotional regulation. Our

findings provide a mechanistic explanation for this buffering effect, highlighting perceived social support as a key psychological mediator linking oxytocin to emotional outcomes (depressive symptoms) during the recovery process.

While our model examined the mediating role of perceived social support in a unidirectional manner, prior longitudinal research indicates that the relationship between social support and depressive symptoms may be reciprocal, with improvements in one reinforcing the other.[54] In addition, different sources of support may vary in their protective impact. Family support appears particularly effective in mitigating depression during abstinence, whereas peer or therapeutic support may depend more on contextual factors, with its impact moderated by abstinence duration and perceived group cohesion.[55] Future research should distinguish among these support sources to elucidate their differential contributions to emotional recovery in addiction rehabilitation settings.

The Moderating Role of Drug Abstinence Self-Efficacy

In line with Hypotheses 3(a) and 3(b),[56] drug abstinence self-efficacy significantly moderated both the direct and indirect pathways from endogenous oxytocin to depressive symptoms. Individuals with high drug abstinence self-efficacy experienced a stronger negative association between endogenous oxytocin and depressive symptoms, suggesting that oxytocin's protective effects are more likely to be realized when individuals believe in their capacity to resist drug use. This finding is consistent with Bandura's self-efficacy theory, which posits that individuals' beliefs about their ability to manage high-risk situations influence how effectively they utilize internal and external coping resources.[57] Furthermore, this result aligns with the self-regulation model of depressive symptoms, which posits that personal agency plays a pivotal role in emotional recovery.[58] High drug abstinence self-efficacy reflects stronger internal coping resources and a greater sense of behavioral control,[59] which may facilitate the utilization of neurobiological modulators like oxytocin for mood regulation. Conversely, low drug abstinence self-efficacy is often accompanied by hopelessness and learned helplessness, which may blunt or counteract oxytocin's mood-regulating effects, thereby limiting its protective role.[60]

Similarly, the moderation effect extended to the indirect pathway through perceived social support. Individuals with high abstinence self-efficacy benefited more from perceived social support, exhibiting greater reductions in depressive symptoms as their sense of support increased. This finding is consistent with the stress-buffering hypothesis, which emphasizes that the psychological benefits of social support are contingent upon the individual's ability to cognitively appraise and behaviorally utilize such resources,[61] which posits that individual coping resources shape the efficacy of social support in mitigating depressive symptoms and emotional distress.[62] High self-efficacy fosters proactive coping and optimistic appraisals, thereby converting perceived support into genuine emotional resilience. Individuals with low self-efficacy may perceive themselves as undeserving or incapable of sustaining support, which diminishes the effectiveness of social support in alleviating depressive symptoms.[63]

Beyond the cognitive dimension, recent neuropsychological models suggest that drug abstinence self-efficacy may also operate through implicit motivational processes. High self-efficacy is associated with greater dopaminergic resilience—the ability to preserve or restore reward system responsiveness following chronic substance exposure—and with enhanced capacity to redirect reward-seeking toward adaptive, non–substance-related goals.[64,65] This motivational reallocation may amplify the effects of oxytocin and perceived social support on mood regulation by reinforcing approach-oriented behaviors and promoting engagement in prosocial activities. Such integration of motivational and affective pathways provides a more comprehensive account of how self-efficacy bridges neurobiological and psychosocial factors in emotional recovery during abstinence.

Practical Implications

Firstly, rehabilitation programs should integrate behavioral strategies that can enhance endogenous oxytocin levels, such as mindfulness training, emotionally supportive interactions, and aerobic exercise. Empirical studies have shown that mindfulness interventions significantly increase oxytocin release and improve affective regulation among individuals with emotional disturbances.[56,66]

Secondly, treatment systems should prioritize the development of peer-led support groups and family-involved therapy to enhance perceived social support. Peer-delivered services have been shown to be effective in reducing depressive symptoms and promoting recovery outcomes across substance-using populations.[67,68]

Thirdly, Drug abstinence centers should implement Intervention strategies such as cognitive-behavioral therapy (CBT),[69] motivational interviewing (MI), and self-regulation skills to strengthen drug abstinence self-efficacy, particularly in the early stages of detoxification. In the current study, higher drug abstinence self-efficacy appears to amplify the psychological benefits of both oxytocin and perceived support, suggesting that fostering this belief system could serve as a critical leverage point for maximizing abstinence outcomes and promoting long-term mental health recovery.

Lastly, the present findings provide a theoretical foundation for developing integrated clinical protocols that combine psychotherapeutic, psychosocial, and oxytocin-enhancing approaches. Such comprehensive programs—incorporating social skills training, experiential group interventions, and mindfulness-based interpersonal practices—may foster emotional bonding and stress resilience, thereby promoting the sustained alleviation of depressive symptoms among individuals in drug abstinence.

Limitation and Future Directions

Despite its contributions, this study has several limitations. Firstly, the cross-sectional design limits causal inferences. Future studies could employ longitudinal or ecologically valid experimental paradigms—such as social stress tasks with acute oxytocin administration—to verify the proposed causal pathways. Secondly, perceived social support, abstinence self-efficacy, and depressive symptoms were assessed solely through self-report measures. Depressive symptoms were operationalized as self-reported severity rather than clinical diagnosis, and no structured diagnostic interviews were conducted. Future research should integrate objective indicators of social and emotional regulation, such as clinician-rated assessments, behavioral tasks, and biological markers, to enhance construct validity and reduce reliance on subjective reporting. Thirdly, although we focused on endogenous oxytocin, individual differences in receptor sensitivity or genetic polymorphisms were not measured and may further explain variability in outcomes. Finally, although sociodemographic and clinical factors (eg, duration of abstinence, years of drug use) were statistically controlled, we did not include systematic assessments of withdrawal-related symptoms, which may overlap with depressive manifestations. Moreover, stressor-related variables were not directly assessed. Future studies should include explicit measures of stress exposure to more fully operationalize the biopsychosocial model.

Conclusion

This study investigated the psychological mechanisms linking endogenous oxytocin to depressive symptoms in drug abstainers. Findings show that higher oxytocin levels predict lower depressive symptoms both directly and indirectly via perceived social support. These protective effects are stronger among individuals with higher drug abstinence self-efficacy, suggesting a key moderating role. Intervention strategies that facilitate endogenous oxytocin secretion, enhance perceived social support, and strengthen drug abstinence self-efficacy may offer promising avenues for reducing depressive symptoms and supporting long-term abstinence.

Ethics Statement

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the School of Sociology at China University of Political Science and Law (protocol code ZLS2023004, March 10, 2023).

Informed Consent Statement

Written informed consent was obtained from all participants prior to data collection, including consent for the collection and analysis of saliva samples for oxytocin measurement.

Acknowledgments

The authors gratefully acknowledge the support of the officers and participants.

Funding

This research was supported by the Major Project of the Chinese Ministry of Education (No. DEA220353) and the National Natural Science Foundation of China (No. U2336213).

Disclosure

The authors report no conflicts of interest in this work.

References

1. World Health Organization. Depressive disorder (depression). Available from: https://www.who.int/news-room/fact-sheets/detail/depression. Accessed April 25, 2025.
2. Sfendla A, Lemrani D, Ahlstrom BH, Senhaji M, Kerekes N. Risk and protective factors for drug dependence in two Moroccan high-risk male populations. *PeerJ*. 2018;6:e5930. doi:10.7717/peerj.5930
3. Gyawali B, Choulagai BP, Paneru DP, et al. Prevalence and correlates of psychological distress symptoms among patients with substance use disorders in drug rehabilitation centers in urban Nepal. *BMC Psychiatry*. 2016;16:314. doi:10.1186/s12888-016-1003-6
4. Chen Y, Zhao M, Zhang J, et al. Investigation of mental health of convalescing drug abusers under compulsory detoxification. *J Nurs Sci*. 2018;33 (22):76–78.
5. McKay JR. Impact of continuing care on recovery from substance use disorder. *Alcohol Res*. 2021;41(1):01. doi:10.35946/arcr.v41.1.01
6. Shahzadi M, Mahmood K. Level of depression, criminogenic cognition, relapse risk, and quality of life among patients with substance use disorders: level of depression, criminogenic cognition and QoL. *Pak J Health Sci*. 2023;:112–118 doi:10.54393/pjhs.v4i09.1030.
7. Schotte CK, Van Den Bossche B, De Doncker D, Claes S, Cosyns P. A biopsychosocial model as a guide for psychoeducation and treatment of depression. *Depress Anxiety*. 2006;23(5):312–324. doi:10.1002/da.20177
8. Szymkowicz SM, Gerlach AR, Homiack D, Taylor WD. Biological factors influencing depression in later life: role of aging processes and treatment implications. *Transl Psychiatr*. 2023;13(1):160 doi:10.1038/s41398-023-02464-9.
9. Fearey E, Evans J, Schwartz-Mette RA. Emotion regulation deficits and depression-related maladaptive interpersonal behaviours. *Cogn Emot*. 2021;35(8):1559–1572. doi:10.1080/02699931.2021.1989668
10. Gimpl G, Fahrenholz F. The oxytocin receptor system: structure, function, and regulation. *Physiol Rev*. 2001;81(2):629–683. doi:10.1152/physrev.2001.81.2.629
11. Ishak WW, Kahloon M, Fakhry H. Oxytocin role in enhancing well-being: a literature review. *J Affect Disord*. 2011;130(1–2):1–9. doi:10.1016/j.jad.2010.06.001
12. Domes G, Heinrichs M, Michel A, Berger C, Herpertz SC. Oxytocin improves "Mind-Reading" in humans. *Biol Psychiatry*. 2007;61(6):731–733. doi:10.1016/j.biopsych.2006.07.015
13. Matsushita H, Latt HM, Koga Y, Nishiki T, Matsui H. Oxytocin and stress: neural mechanisms, stress-related disorders, and therapeutic approaches. *Neuroscience*. 2019;417:1–10 doi:10.1016/j.neuroscience.2019.07.046.
14. Love TM. The impact of oxytocin on stress: the role of sex. *Curr Opin Behav Sci*. 2018;23:136–142. doi:10.1016/j.cobeha.2018.06.018
15. Scantamburlo G, Hansenne M, Fuchs S, et al. Plasma oxytocin levels and anxiety in patients with major depression. *Psychoneuroendocrinology*. 2007;32(4):407–410. doi:10.1016/j.psyneuen.2007.01.009
16. Scantamburlo G, Hansenne M, Geenen V, Legros JJ, Ansseau M. Additional intranasal oxytocin to escitalopram improves depressive symptoms in resistant depression: an open trial. *Eur Psychiatry*. 2015;30(1):65–68. doi:10.1016/j.eurpsy.2014.08.007
17. Kagizman SC, Hocaoglu C. Oxytocin in the treatment of psychiatric disorders. *Medeni Med J*. 2023;38(3):218–231. doi:10.4274/MMJ.galenos.2023.13707
18. Barrera M. Distinctions between social support concepts, measures, and models. *Am J Community Psychol*. 1986;14(4):413–445. doi:10.1007/BF00922627
19. Lakey B, Orehek E. Relational regulation theory: a new approach to explain the link between perceived social support and mental health. *Psychol Rev*. 2011;118(3):482.
20. Carter CS. Oxytocin pathways and the evolution of human behavior. *Annu Rev Psychol*. 2014;65(1):17–39. doi:10.1146/annurev-psych-010213-115110
21. Park Y. Effects of depression, self-esteem, and social support on suicidal ideation in college students. *Child Health Nurs Res*. 2017;23(1):111–116. doi:10.4094/chnr.2017.23.1.111
22. Tsai T, Tseng H, Chi M, et al. The interaction of oxytocin and social support, loneliness, and cortisol level in major depression. *Clin Psychopharmacol Neurosci*. 2019;17(4):487–494. doi:10.9758/cpn.2019.17.4.487
23. Shamay-Tsoory SG, Abu-Akel A. The social salience hypothesis of oxytocin. *Biol Psychiatry*. 2016;79(3):194–202 doi:10.1037/a0023477.
24. Heinrichs M, Baumgartner T, Kirschbaum C, Ehlert U. Social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress. *Biol Psychiatry*. 2003;54(12):1389–1398 doi:10.1016/S0006-3223(03)00465-7.
25. Gariépy G, Honkaniemi H, Quesnel-Vallée A. Social support and protection from depression: systematic review of current findings in Western countries. *Br J Psychiatry*. 2016;209(4):284–293. doi:10.1192/bjp.bp.115.169094
26. McDougall MA, Walsh M, Wattier K, et al. The effect of social networking sites on the relationship between perceived social support and depression. *Psychiatry Res*. 2016;246:223–229. doi:10.1016/j.psychres.2016.09.018
27. Scardera S, Perret LC, Ouellet-Morin I, et al. Association of social support during adolescence with depression, anxiety, and suicidal ideation in young adults. *JAMA Network Open*. 2020;3(12):e2027491. doi:10.1001/jamanetworkopen.2020.27491
28. Deng Y, Li X, Liu L, Chui WH. Suicide attempts and perceived social support among Chinese drug users: the mediating role of self-esteem and depression. *Int J Environ Res Public Health*. 2021;18(1):208. doi:10.3390/ijerph18010208
29. Hiller ML, Broome KM, Knight K, Simpson DD. Measuring self-efficacy among drug-involved probationers. *Psychol Rep*. 2000;86(2):529–538. doi:10.2466/pr0.2000.86.2.529

30. Gutiérrez-Sánchez B, Orgeta V, López-Martínez C, Del-Pino-Casado R. Association between social support and depressive symptoms in informal caregivers of adult and older dependents: a systematic review and meta-analysis. *J Clin Med*. 2023;12(20):6468. doi:10.3390/jcm12206468
31. Harandi TF, Taghinasab MM, Nayeri TD. The correlation of social support with mental health: a meta-analysis. *Electron Physician*. 2017;9 (9):5212–5222. doi:10.19082/5212
32. Litt MD, Kadden RM, Kabela-Cormier E, Petry N. Changing network support for drinking: initial findings from the network support project. *J Consult Clin Psychol*. 2007;75(4):542. doi:10.1037/0022-006X.75.4.542
33. Hoeppner BB, Kelly JF, Urbanoski KA, Slaymaker V. Comparative utility of a single-item versus multiple-item measure of self-efficacy in predicting relapse among young adults. *J Subst Abuse Treat*. 2011;41(3):305–312. doi:10.1016/j.jsat.2011.04.005
34. Daughters K, Manstead AS, Hubble K, Rees A, Thapar A, van Goozen SH. Salivary oxytocin concentrations in males following intranasal administration of oxytocin: a double-blind, cross-over study. *PLoS One*. 2015;10(12):e0145104. doi:10.1371/journal.pone.0145104
35. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med*. 2001;16(9):606–613. doi:10.1046/j.1525-1497.2001.016009606.x
36. Zimet GD, Powell SS, Farley GK, Werkman S, Berkoff KA. Psychometric characteristics of the multidimensional scale of perceived social support. *J Pers Assess*. 1990;55(3–4):610–617. doi:10.1080/00223891.1990.9674095
37. Oene WV, Breteler MMB, Schippers GM, Schrijvers AJP. The validity of the self-efficacy list for drug users (Seld). *Addict Behav*. 2000;25 (4):599–605. doi:10.1016/S0306-4603(99)00028-3
38. Dennis ML, Scott CK, Funk R, et al. The duration and correlates of addiction and treatment careers. *J Subst Abus Treat*. 2005;28(2):S51–S62. doi:10.1016/j.jsat.2004.10.013
39. Cheng S, Jia C, Wang Y. Only children were associated with anxiety and depressive symptoms among college students in China. *Int J Environ Res Public Health*. 2020;17(11):4035. doi:10.3390/ijerph17114035
40. Shahrabadi S, Jalali A, Jalali R, Gholami A. Psychological, social, and motivational factors in persons who use drugs. *Subst Abuse Treat Prev Policy*. 2020;15(1):1–10. doi:10.1186/s13011-020-00273-7
41. Luo D, Tan L, Shen D, et al. Characteristics of depression, anxiety, impulsivity, and aggression among various types of drug users and factors for developing severe depression: a cross-sectional study. *BMC Psychiatry*. 2022;22(1):1–12. doi:10.1186/s12888-022-03933-z
42. Daigre C, Palma-álvarez RF, Sorribes-Puertas M, et al. Abstinence duration and psychopathology among addiction outpatients during 18 months of COVID-19. *Front Psychiatry*. 2024;15:1339730. doi:10.3389/fpsyt.2024.1339730
43. Hayes A, Preacher KJ. Conditional process modeling: using structural equation modeling to examine contingent causal processes. 2013.
44. Podsakoff PM, MacKenzie SB, Lee J-Y, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J Appl Psychol*. 2003;88(5):879. doi:10.1037/0021-9010.88.5.879
45. Heinrichs M, von Dawans B, Domes G. Oxytocin, vasopressin, and human social behavior. *Front Neuroendocrinol*. 2009;30(4):548–557. doi:10.1016/j.yfrne.2009.05.005
46. Smith AS, Wang Z. Salubrious effects of oxytocin on social stress-induced deficits. *Horm Behav*. 2012;61(3):320–330 doi:10.1016/j.yhbeh.2011.11.010.
47. Kanat M, Heinrichs M, Schwarzwald R, Domes G. Oxytocin attenuates neural reactivity to masked threat cues from the eyes. *Neuropsychopharmacology*. 2015;40(2):287–295. doi:10.1038/npp.2014.183
48. Worhunsky PD, Filbey FM, Kober H, et al. Longitudinal changes in network engagement during cognitive control in cocaine use disorder. *Neuropsychopharmacology*. 2021;46(7):1204–1211. doi:10.1016/j.drugalcdep.2021.109151
49. Bethlehem RAI, Lombardo MV, Lai MC, et al. Intranasal oxytocin enhances intrinsic corticostriatal functional connectivity in women. *Mol Psychiatry*. 2017;22(5):658–666. doi:10.1038/tp.2017.72
50. Bartz JA, Zaki J, Bolger N, Ochsner KN. Social effects of oxytocin in humans: context and person matter. *Trends Cognit Sci*. 2011;15(7):301–309. doi:10.1016/j.tics.2011.05.002
51. Goh KK, Chen CH, Lane HY. Oxytocin in Schizophrenia: pathophysiology and implications for future treatment. *Int J Mol Sci*. 2021;22(4):2146. doi:10.3390/ijms22042146
52. Enter D, Hutschemaekers MHM, Roelofs K. Neuroendocrinological aspects of social anxiety and aggression-related disorders. In: *Routledge International Handbook of Social Neuroendocrinology*. Routledge; 2018:635–655.
53. Ouyang M, Gui D, Cai X, et al. Stressful life events and subjective well-being in vocational school female adolescents: the mediating role of depression and the moderating role of perceived social support. *Front Psychol*. 2021;11:603511. doi:10.3389/fpsyg.2020.603511
54. Wang J, Mann F, Lloyd-Evans B, Ma R, Johnson S. Associations between loneliness and perceived social support and outcomes of mental health problems: a systematic review. *BMC Psychiatry*. 2018;18(1):156. doi:10.1186/s12888-018-1736-5
55. Zywiak WH, Longabaugh R, Wirtz PW. Decomposing the relationships between pretreatment social network characteristics and alcohol treatment outcome. *J Stud Alcohol Drugs*. 2002;63(1):114–121. doi:10.1080/00926230252851366
56. Hepburn S-J, Carroll A, McCuaig L. The relationship between mindful attention awareness, perceived stress and subjective wellbeing. *Int J Environ Res Public Health*. 2021;18(23):12290. doi:10.3390/ijerph182312290
57. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Adv Behav Res Ther*. 1977;1(4):139–161. doi:10.1016/0146-6402(78)90002-4
58. Jaiswal A, Carmichael K, Gupta S, Siemens T, Brown N. Essential elements that contribute to the recovery of persons with severe mental illness: a systematic scoping study. *Front Psychiatry*. 2020;11:586230. doi:10.3389/fpsyt.2020.586230
59. Chavarria J, Ferrari JR. The effects of self-regulation and self-efficacy on substance use abstinence. *Alcohol Treat Q*. 2012;30(4):422–432. doi:10.1080/07347324.2012.718960
60. Zhang Y, Feng B, Geng W, Owens L, Xi J. "Overconfidence" versus "helplessness": a qualitative study on abstinence self-efficacy of drug users in a male compulsory drug detention center in China. *Subst Abuse Treat Prev Policy*. 2016;11(1):1–13. doi:10.1186/s13011-016-0073-2
61. Kawachi I, Berkman LF. Social ties and mental health. *J Urban Health*. 2001;78(3):458–467. doi:10.1093/jurban/78.3.458
62. Thoits PA. Mechanisms linking social ties and support to physical and mental health. *J Health Soc Behav*. 2011;52(2):145–161. doi:10.1177/0022146510395592
63. Saleem A, Masood S. Relapse tendency among individuals with substance use: exploring the influence of family dynamic and drug abstinence self-efficacy. *J Devel Soc Sci*. 2024;5(2):01–17. doi:10.47205/jdss.2024(5-II-S)01

64. Volkow ND, Koob GF, McLellan AT. Neurobiologic advances from the brain disease model of addiction. *N Engl J Med*. 2016;374(4):363–371. doi:10.1056/NEJMra1511480
65. Garbusow M, Sebold M, Beck A, et al. Pavlovian-to-instrumental transfer in alcohol dependence: a pilot study. *Neuropsychobiology*. 2016;74(4):193–203. doi:10.1159/000477249
66. Hoehne K, Vrtika P, Engert V, Singer T. Plasma oxytocin is modulated by mental training, but does not mediate its stress-buffering effect. *Psychoneuroendocrinology*. 2022;141:105734. doi:10.1016/j.psyneuen.2022.105734
67. Eddie D, Hoffman L, Vilsaint C, et al. Lived experience in new models of care for substance use disorder: a systematic review of peer recovery support services and recovery coaching. *Front Psychol*. 2019;10:1052. doi:10.3389/fpsyg.2019.01052
68. Maviglia M, Hume D, Cooeyate N. Peer support's role in helping individuals withdraw from psychiatric medications. *J Psychol Clin Psychiatry*. 2023;14(6):157–162. doi:10.15406/jpcpy.2023.14.00746
69. Mostafa Jafari, Shahriar Shahidi, Alireza Abedin. Comparing the effectiveness of cognitive behavioral therapy and the stages of change model on improving abstinence self-efficacy in Iranian substance-dependent adolescents. *Iran J Psychiatry Behav Sci*. 2012;6(2):7–15.