**SOUTH BAYLO UNIVERSITY**

# Effectiveness of Acupuncture for Drug Craving and Anxiety in Patients with Substance Use Disorder: A Systematic Review and Meta-Analysis

by

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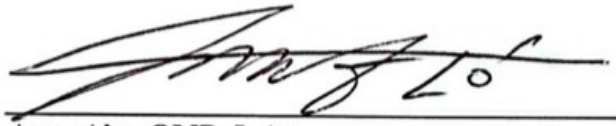

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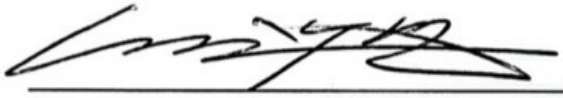

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**Effectiveness of Acupuncture for Drug Craving and Anxiety in Substance Use Disorder: A Systematic Review and Meta-Analysis**

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## ABSTRACT

This study systematically reviewed randomized controlled trials on the effectiveness of acupuncture in reducing drug craving and anxiety among individuals with substance use disorder. Using predefined inclusion and exclusion criteria, trials published from 2000 onward were identified through searches of major electronic databases (PubMed, Google Scholar, Scopus, Gale Power Search, ProQuest, Wiley Online Library, Research Gate, Cochrane Library, APA PsycNet, and MDPI, supplemented by manual searches of publisher platforms and academic networking sites. Keywords included acupuncture, substance use disorder, substance abuse, drug craving, and anxiety. PRISMA guidelines were followed, and risk of bias was assessed using the Cochrane tool. Nine randomized controlled trials involving 748 participants met the inclusion criteria and were pooled using meta-analysis.

For drug craving, the pooled standardized mean difference (SMD) was 0.62 (95% CI 0.39, 0.84) under the common-effect model and 0.55 (95% CI 0.17, 0.94) under the random-effects model, favoring acupuncture and accompanied by considerable heterogeneity ($I^2 = 64.6$ %, $p = 0.0149$). Anxiety outcomes showed similar benefits, with pooled SMDs of 0.72 (95% CI 0.50, 0.94) and 0.70 (95% CI 0.43, 0.97) and lower

heterogeneity ($I^2$ = 27.4%, p = 0.2289). Subgroup analysis indicated that both electroacupuncture/integrative meditation with ear acupressure and manual acupuncture produced moderate reductions in craving (SMD 0.51 vs. 0.81, common-effect model), without statistically significant differences between stimulation methods. Sensitivity analysis that retained all trials, including Wen et al. (2021) with its large effect size (SMD 2.03; 95% CI 1.59, 2.46), produced larger pooled effects for craving (common-effect SMD about 0.91; random-effects SMD about 0.76) and increased heterogeneity ($I^2 \approx 86.9\%$), highlighting the strong influence of this study on the overall estimates.

Overall, the findings suggest that acupuncture can meaningfully reduce drug craving and anxiety as an adjunctive treatment for substance use disorder, although heterogeneity and potential publication bias warrant cautious interpretation.

Keywords*: acupuncture, substance use disorder, drug abuse treatment, drug craving, anxiety*

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# I. INTRODUCTION

Substance use disorder (SUD) cases across the world are rapidly increasing, presenting long-term adverse effects on the health, functioning, and overall well-being among patients.[1] In America alone, there were approximately 48.4 million Americans who are battling against SUD, wherein they were recorded to be 12 years old and older.[2] Meanwhile, in the Philippines it was revealed that there are approximately 1.7 million Filipinos in 2019 who were confirmed to be taking illegal drugs.[3] Moreover, drug abuse has been proven to cause consequences on behavior, biochemical, financial, and social aspects of an individual. In terms of behavioral and biochemical consequences, substances would disrupt the reward system of the brain, further leading to compulsive drug-seeking and interfering with brain functioning that could lead to mental health issues, such as anxiety. [4] Therefore, there is a growing concern with SUD, especially with the serious consequences it entails.

Further, drug craving, or the intense desire for a particular substance, is one of the diagnostic criteria of SUD according to the DSM-5.[5] Moreover, interventions primarily focus on reducing drug craving to prevent potential relapse,[6] and can also help decrease anxiety among the SUD population.[7] In response to these challenges, the Substance Abuse and Mental Health Services Administration (SAMHSA) established the Treatment Improvement Protocol in 2020 to guide SUD treatment, including case management and recovery support services.[7] However, despite these efforts, there is a decreasing trend in the number of individuals receiving SUD treatment.[8]

Meanwhile, acupuncture gained public interest when a doctor in Hong Kong claimed its effectiveness in addressing withdrawal symptoms from opioids in 1972.[9] Additionally, as pharmacological and psychosocial interventions remain insufficient, and some patients refuse such treatment programs, acupuncture has been considered a safer option with minimal side effects for SUD treatment.[10] Despite increasing interest in acupuncture, evidence regarding its effectiveness remains inconsistent, warranting further systematic evaluation.[11–15]

In line with this, the current study focuses on evaluating the effectiveness of acupuncture for drug craving and anxiety among patients with SUD. Specifically, this study conducted a systematic literature review and meta-analysis of relevant studies since 2000 that utilized acupuncture interventions for drug craving and anxiety, particularly using the NADA protocol. [16–21]

## OBJECTIVES

This study aims to systematically review and synthesize evidence on the therapeutic effectiveness of acupuncture for reducing drug craving and anxiety among individuals with substance use disorder, using meta-analysis. Specifically, the study seeks to:

1. Evaluate, through meta-analysis, the effectiveness of acupuncture at various acupoints in reducing drug craving among patients diagnosed with substance use disorder.
2. Determine, through meta-analysis, the effectiveness of acupuncture at various acupoints in decreasing anxiety levels among patients diagnosed with substance use disorder.
3. Examine the effectiveness of the NADA protocol and other commonly used acupoint combinations as interventions for drug craving and anxiety in this population.
4. Perform subgroup analyses to investigate potential sources of heterogeneity, specifically comparing the impact of different stimulation methods (Electroacupuncture vs. Manual Acupuncture) on therapeutic outcomes.
5. Conduct a sensitivity analysis to confirm the robustness of the findings, specifically address concerns for publication bias and outliers.

## LITERATURE REVIEW

This section synthesizes existing evidence on substance use disorder, drug craving, anxiety among individuals with SUD, and acupuncture-based interventions, with emphasis on randomized controlled trials and related clinical studies that inform the present systematic review and meta-analysis. Both foreign and domestic literature are included to provide comprehensive context for the research question and outcomes.

### Substance Use Disorder

According to data from the 2018 National Survey on Drug Use and Health, 14.8 million of the 20.3 million drug use disorders that affected people aged 12 and older over the previous year were linked to alcohol. The survey found that 2 million people had an opiate use problem and 4.4 million people had a marijuana use disorder when other substances were taken into account.[15] Substance use disorders contribute substantially to the global illness burden, particularly among adolescents and young people.[16] This disorder is impartial regarding gender, age, race, or religious affiliation, suggesting that substance misuse is intrinsically linked to human nature as a whole.[22] Furthermore, despite these alarming statistics, a substantial proportion of individuals with SUD remain untreated. Several studies reported that people encounter multiple barriers, such as limited access to treatment facilities, financial constraints, stigma, and lack of awareness regarding available services. [15,16] These barriers not only perpetuate ongoing substance use but also hinder early intervention efforts, thereby contributing to the escalating global burden of SUD.

Essentially, SUDs are complex conditions characterized by uncontrolled substance use despite negative effects, according to the American Psychiatric Association. The

National Institute on Drug Abuse (NIDA), on the other hand, defines drug addiction as a chronic, relapsing condition that is typified by obsessive drug-seeking behavior despite harmful consequences. [17] Additionally, the root causes of addiction vary among social, interpersonal, cultural, environmental, and familial factors. Individuals misuse substances for the pleasure they provide, often influenced by peer exposure, curiosity, and accessibility of drugs. [20] Over time, repeated exposure alters brain function, particularly within the reward system, reinforcing dependence and compulsive behavior. Consequently, the interplay of these biological, psychological, and social factors reinforces a cyclical pattern in which individuals persist in substance use despite increasing harm to themselves and others. [17,20]

Moreover, a continual rise in human, social, health, and financial expenditures—manifested through substance-related violence, criminal behavior, medical requirements, court mandates, rehabilitation services, diminished labor productivity, and judicial costs—is evident due to the cyclical nature and increasing population of substance users globally.[18] Unfortunately, the detrimental consumption of alcohol leads to 3.3 million fatalities annually, while the global average consumption of pure alcohol per individual aged 15 years or older is 6.2 liters annually.[19] A study also argued that substance abuse can further lead to significant and long-term physical health complications, including infectious infections, hepatic damage, and overdose, as well as psychological issues such as depression, diminished self-efficacy, and anxiety.[29] Taken together, these findings indicate that SUD is not merely an individual health problem but also a pressing public health concern that strains families, communities, and national health systems. [18,19,29] Thus, it

becomes imperative to consider comprehensive management strategies that include, but are not limited to, conventional pharmacological and psychosocial treatments.

Meanwhile, a study revealed that illicit substances, including methamphetamine, heroin, cocaine, and alcohol, were deemed very detrimental, while novel psychoactive compounds such as cathinones and synthetic cannabinoids were classified among the most dangerous substances. Cannabis was positioned in the midrange, comparable to benzodiazepines and ketamine, and slightly more favorable than the previous European survey. Prescribed medications, including opioids, were deemed less dangerous compared to the assessments in the USA, Canada, and Australia. The non-opioid prescription analgesics ranked at the lowest position. [23] However, all of these drugs are powerful medications for pain relief but can further lead to abuse, misuse, overdose, and even death due to consumption of high dosage, prolonged duration, and extended-release and long-acting formulations. [24]

Another study revealed that males aged 22 to 24 years were observed to utilize harmful substances more frequently than females. Tobacco was the most prevalent substance of abuse, followed by alcohol, with the majority being exposed to these substances by their peers between the ages of 17 and 24 years. Most individuals ingested the medication many times daily, subsequently on a weekly basis, and acquired it from local vendors. These drugs induced hallucinations and euphoria upon intake. Oral complications, including ulcers and malignancies, ranked highest among the side effects. Respiratory and gastrointestinal complications, coupled with an inability to focus on work, constituted additional side effects. [21]

Drug addiction has also become a significant social issue in South Korea, and there are presently no definitive treatments available. This situation aims to establish a foundation for research on Korean medicine for drug addiction in South Korea, given the scarcity of clinical investigations in this area. Certain research indicates that acupuncture is safe and may mitigate withdrawal symptoms associated with drug addiction. Nonetheless, its effectiveness may be influenced by numerous factors, and many outcomes have proved ineffectual. [53]

**Drug Craving**

Drug craving is considered a pivotal factor in compulsive drug consumption and relapse following treatment.[25] It is a thoroughly recognized phenomenon in individuals with substance use disorder and constitutes a primary clinical characteristic of the condition.[27] This compulsion is shaped by multiple variables, including physical dependency, in which the body has acclimated to the drug's presence, and psychological dependence, where the mind links the substance to pleasure or alleviation from distress.[30]

Specifically, craving, in addition to serving as a diagnostic criterion, is fundamentally a dynamic condition that can fluctuate in strength and frequency daily within the same individual, influenced by both internal and external influences. Daily variations in drug craving have been demonstrated to forecast substance usage within hours, rendering it a significant focus for intervention.[26] Moreover, the manifestations of drug craving often encompass an intense fixation on acquiring a particular substance, irritation or anxiety, obsession with subsequent usage, restlessness, bodily discomfort, annoyance or agitation, and emotional turmoil.[30]

In clinical and research contexts, drug craving is commonly assessed using standardized instruments, such as visual analogue scales (VAS) or structured craving questionnaires. [25,26] These tools enable clinicians and researchers to quantify craving intensity, monitor fluctuations over time, and evaluate the effectiveness of specific interventions. In the present study, such measures were crucial for determining whether acupuncture interventions produced meaningful reductions in craving among patients with SUD.

Meanwhile, a study revealed that physical exercise markedly diminishes drug cravings by augmenting cardio-respiratory fitness and enhancing inhibitory control. Moreover, it demonstrated that men possessed superior physical activity levels, cardio-respiratory fitness, and self-control in comparison to women, whereas women displayed heightened psychological desires.[28] Essentially, individuals struggling with drug cravings frequently become preoccupied with ideas regarding the acquisition of the substance. Their everyday pursuits center on devising strategies to obtain the substance, disregarding obligations and interpersonal connections. This profound fixation results in sub-optimal decision-making, as the craving for the substance eclipses other considerations. Unfortunately, the individual may further partake in hazardous or unlawful activities to fulfill the desire. [30]

In addition, cravings are likely to be most intense during the initial 1–3 weeks following the cessation of drugs and alcohol. Following the initial three weeks, the desires may diminish in intensity. They may fluctuate according to the time of day, external stimuli, and emotional state. It is possible to experience several days devoid of cravings prior to their subsequent onset. A shared characteristic of all desires is their fleeting and

transitory nature.[31] Consequently, treatment for this condition should focus on enhancing self-regulation, managing cravings and the onset of negative emotions such as despair and anxiety, and increasing sensitivity to alternate reinforcers.[32] Therefore, interventions that can help stabilize physiological arousal, regulate mood, and strengthen self-control, such as exercise or acupuncture-based treatments, may play an important role in reducing the intensity and frequency of drug cravings in this population.[28,30,32]

Drug craving is not a classical TCM disease category but can be understood through similar mechanisms such as anxiety. Craving reflects:

- Shen disturbance → compulsive desire and loss of control
- Phlegm misting the Mind → impaired judgment and addictive behavior
- Liver-Qi stagnation → emotional dysregulation
- Heart and Kidney deficiency → lack of grounding and willpower

Deficiency patterns predispose individuals to emotional instability, while excess patterns drive compulsive behavior. This dual mechanism explains the overlap between anxiety and substance use disorders. [57]

In addition to the pattern-based description above, Maciocia describes "craving" as a pathological state of constant, never-satisfied desire that can be directed toward substances, material objects, or social recognition.[60] Within the major Chinese philosophical traditions of Confucianism, Buddhism, and Daoism, such craving or desire is regarded as a fundamental root of mental–emotional suffering, a view that resonates with the compulsive drug-seeking and loss of control characteristic of substance use disorders.[60]

At the level of pattern differentiation, craving is said to affect the Heart and scatter Qi while simultaneously stirring the Pericardium through "Minister Fire" arising from the Kidneys, thereby disturbing the Mind (Shen) and predisposing to manic-like behavior, impulsivity, and difficulty regulating urges.[60] Depending on the underlying constitution, this dynamic may generate Heart-Fire or Heart Empty Heat, which clinically presents with palpitations, a red face, red tip of the tongue, insomnia, mental restlessness, and an Overflowing (or Overflowing-Empty) Rapid pulse—features frequently observed in patients with intense drug craving and anxiety.[60] Maciocia further notes that, in such presentations, points including Shenmen (HE-7), Du-19 (Houding), Ren-15 (Jiuwei), and Daling (P-7) are selected to calm the Shen, regulate Heart- and Minister Fire, and thereby help moderate craving.[60] This TCM view of craving as a Heart–Mind disturbance complements biomedical models that link drug craving with dysregulated reward circuits, stress responsivity, and heightened relapse risk in individuals with SUD.

**Anxiety among Patients with Substance Use Disorder**

Anxiety is commonly defined in modern medicine as a state of excessive fear, worry, and physiological arousal. In Traditional Chinese Medicine (TCM), however, anxiety is not described as a single disease entity but is understood through classical syndromes such as Fear and Palpitations (Jing Ji) and Panic Throbbing (Zheng Chong). These conditions closely correspond to generalized anxiety and panic disorders and reflect disturbances of the Shen (Mind), which is housed in the Heart.

Rather than focusing solely on symptoms, TCM emphasizes pattern differentiation, identifying both the root cause and manifestation of disease. Anxiety is therefore understood as a disorder involving multiple organ systems, internal imbalances, and emotional dysregulation. This framework also provides a basis for understanding drug craving, which shares similar mechanisms involving Shen disturbance, Qi imbalance, and internal disharmony.

In TCM, anxiety arises primarily from disturbance of the Shen. The Heart governs the Shen, and when the Heart is harmonious and adequately nourished by Blood, the Mind remains calm and stable. However, when the Heart is affected by deficiency or excess pathological factors, the Shen becomes unsettled, leading to anxiety, restlessness, palpitations, and insomnia. [56]

Maciocia describes two main clinical presentations of anxiety: an unsettled Mind and an obstructed Mind. In the former, the patient experiences anxiety and restlessness but maintains clarity and insight. In the latter, the Mind is disturbed by pathological factors such as Phlegm or Blood stasis, leading to more severe symptoms, including confusion, panic, or obsessive thinking.

Additionally, anxiety may be associated with rebellious Qi of the Chong Mai (Penetrating Vessel), which manifests as internal urgency, chest tightness, palpitations, and a rising sensation from the lower abdomen to the chest. This reflects a deeper level of imbalance involving the extraordinary vessels and the Heart–Kidney axis.

The primary etiological factor in anxiety is emotional stress, which disrupts the normal flow of Qi. Emotions such as fear, worry, anger, and shock initially cause Qi

stagnation. Over time, this stagnation may transform into Heat, injure Yin and Blood, or generate Phlegm, all of which disturb the Shen. [57] Maciocia outlines a progression of pathology:

- Qi stagnation → Heat → agitation of the Mind
- Prolonged Heat → damage to Yin and Blood
- Qi deficiency → inability to support mental function
- Phlegm → obstruction of the Mind
- Blood stasis → chronic emotional disturbance

Lifestyle factors also contribute significantly. An irregular diet weakens the Spleen and leads to Phlegm formation. Overwork depletes Kidney-Yin and affects the Heart. Loss of Blood reduces nourishment to the Shen, resulting in anxiety. These factors highlight the multifactorial nature of anxiety in TCM.

A key concept in TCM is that anxiety may arise from both deficiency (Empty) and excess (Full) conditions, often coexisting within the same patient. Deficiency is a major underlying factor in chronic anxiety and reflects the failure to nourish and anchor the Shen.

- Heart-Blood deficiency results in palpitations, insomnia, poor memory, and persistent uneasiness due to lack of nourishment to the Mind.
- Heart-Yin deficiency leads to restlessness, irritability, night sweating, and mental agitation due to Empty Heat. [56]
- Heart–Kidney disharmony reflects failure of communication between Fire and Water, leading to anxiety, insomnia, and emotional instability.

- Kidney deficiency is associated with fear, insecurity, and lack of willpower, often seen in chronic or deep-seated anxiety.
- Spleen deficiency contributes to worry, overthinking, fatigue, and inability to concentrate due to insufficient Qi and Blood production.
- Lung-Qi deficiency may lead to sadness, grief, and emotional fragility, contributing to anxiety.

These deficiency patterns demonstrate that anxiety is often rooted in internal weakness, where the Mind lacks proper support and stability. Excess patterns involve active pathological disturbance affecting the Shen:

- Liver-Qi stagnation causes emotional tension, irritability, and anxiety due to impaired Qi flow. [56]
- Liver-Heat arises from prolonged stagnation, further agitating the Mind.
- Phlegm-Heat harassing the Heart leads to severe anxiety, restlessness, and possible panic or obsessive symptoms.
- Blood stasis contributes to chronic emotional disturbance and fixed anxiety patterns. [56]

In these cases, anxiety is not due to lack of nourishment, but rather to obstruction or agitation of the Mind. Maciocia emphasizes that many cases involve mixed Full-Empty conditions, where deficiency forms the root and excess forms the branch. For example:

- Kidney deficiency → weak foundation
- Liver Qi stagnation → emotional disturbance

- Phlegm → obstructs the Mind

This combined pattern is particularly relevant in chronic anxiety and substance use disorders.

Anxiety in TCM is not limited to the Heart but involves multiple organs:

- Heart → houses Shen; responsible for palpitations and insomnia
- Liver → regulates Qi; associated with emotional stress and tension
- Spleen → governs thought; linked to worry and overthinking
- Lungs → affected by grief ; contribute to emotional vulnerability
- Kidneys → associated with fear and chronic anxiety[57]

This multi-organ involvement explains the variability in anxiety presentations.

According to a study, substance use disorders correlate with elevated levels of anxiety and depression. It is particularly linked to profound despair and anxiety. An evident correlation exists between the existence of anxiety and depression and the severity of drug-related issues. Depression and anxiety frequently co-occur in individuals with substance use disorders. [33] Unfortunately, the abuse of substances has emerged as a global issue among young adults, resulting in circumstances that precipitate significant social and health-related challenges. Anxiety disorders co-occurring with substance use significantly affect incidence, treatment complexity, and clinical outcomes.[34] Furthermore, comorbid anxiety has been associated with poorer adherence to treatment plans, increased likelihood of early dropout, and higher relapse rates following completion of rehabilitation

programs.[33,34,35] This suggests that addressing anxiety symptoms is not merely an adjunctive concern, but rather a central component of effective SUD management.

Moreover, the use of substances can exacerbate the progression of another mental health condition, whereas untreated mental health issues may heighten the susceptibility to high-risk substance use or the development of a substance use disorder. Thus, the simultaneous treatment of both complications can further enhance the likelihood of successful recovery. [34] Similarly, anxiety and alcohol consumption disorder each possess the potential to act as a causative factor in the emergence of the other. Prospective studies indicate that the presence of either anxiety illness or an alcohol use disorder independently forecasts the subsequent emergence of other conditions. Anxiety disorders and alcohol dependency can mutually serve as causal stimuli for one another, with anxiety disorders contributing to the maintenance of pathological alcohol consumption. [35]

Further, individuals with Generalized Anxiety Disorder are considerably more prone to developing substance use disorders compared to those without anxiety. As the symptoms of the disease advance, individuals may resort to narcotics for self-medication. Frequently, alcohol and drugs serve to evade reality, alleviate anxiety symptoms, and induce a feeling of euphoria. [36] Another study claimed that the most prevalent comorbid disorders are anxiety, mood, and substance use disorders. In numerous instances, initial introduction to illicit substances transpires during youth. This may progress to substance dependence, followed by anxiety symptoms, perhaps resulting in dysfunction in maturity. Conversely, certain research suggests that anxiety illness serves as a predisposing factor for substance use disorder, indicating that persons afflicted with anxiety are more susceptible to future substance use and dependency. [37] Consequently, there is a clear need

for interventions that can alleviate anxiety while simultaneously supporting recovery from substance use. In this regard, acupuncture has gained attention as a complementary approach that may modulate both anxiety symptoms and addiction-related processes, thereby offering potential benefits for individuals with SUD who experience significant psychological distress. [38,39,46]

In Traditional Chinese Medicine (TCM), Deadman's *A Manual of Acupuncture* describes Shenmen HE-7 as the shu-stream and yuan-source point of the Heart channel and emphasizes it as the foremost point to calm and regulate the spirit. According to Deadman, when Heart blood or yin are deficient, or when Heart fire or phlegm-fire agitates the Heart, the Heart can no longer properly house the shen, resulting in symptoms such as restlessness, insomnia, palpitations, fear, and mania-depression; Shenmen HE-7 is indicated to "restore peace and harmony to the spirit" in these presentations. Baihui DU-20, located at the vertex on the midline, is discussed in both Cheng Xinnong's *Chinese Acupuncture and Moxibustion* and in Deadman's *A Manual of Acupuncture* as a major Governing-vessel point that meets with multiple yang channels and influences the "sea of marrow" (brain). Deadman attributes to DU-20 the actions of pacifying and subduing yang, raising clear yang, benefiting the head and sense organs, nourishing the sea of marrow, and calming the spirit, with indications including headache, dizziness, agitation, insomnia, and mental disorders.[58] Xinnong further stresses DU-20's dual ability to raise clear yang and descend excess yang, explaining its use both for prolapse and for upward-flaring yang that manifests as head distension, irritability, and restlessness.[59] Together, these classic sources frame Shenmen HE-7 and Baihui DU-20 as key points for stabilizing the Heart–shen and

Heart–brain axis, providing a theoretical rationale for their frequent use in acupuncture protocols targeting anxiety.

**Acupuncture as Intervention**

Acupuncture is a medical treatment system and philosophy that involves the insertion of fine needles or application of pressure to designated spots on the body. This treatment technique originates from Traditional Chinese Medicine (TCM), rooted in the philosophical tenets of Confucianism and Taoism. This concept posits that health arises from the alignment of qi, meaning "vital energy," which encompasses the yin/yang contradiction permeating all physical realms. [38] Essentially, this traditional framework views health as a state of dynamic balance, and illness—including addiction and anxiety—as a manifestation of disrupted qi flow across specific meridians. [38]

Various acupuncture procedures are thought to alleviate withdrawal symptoms seen during recovery. These symptoms can be categorized into physical and psychological manifestations. Acupuncture is frequently employed for physical conditions such as sports injuries, in conjunction with therapies like cognitive behavioral therapy (CBT), which fosters novel cognitive patterns. The healing process inevitably involves physical withdrawal symptoms that acupuncture may alleviate. Acupuncture stimulates the release of endorphins, the brain's intrinsic analgesics. Endorphins interact with opioid receptors similarly to substances such as heroin and morphine; hence, acupuncture may assist in alleviating the muscle aches and pains associated with substance withdrawal.[54] In addition, acupuncture is generally regarded as a safe intervention when administered by trained

practitioners, with most reported adverse events being minor and transient, such as slight bleeding, bruising, or brief soreness at needle sites.[39] This favorable safety profile further supports its consideration as an adjunctive therapy in the management of substance use disorders.

The paramount challenge in effectively treating drug addiction is to mitigate the elevated incidence of relapse into drug-seeking behaviors. The opponent process theory, as a motivational framework, indicates that excessive drug-seeking behavior in the context of negative reinforcement of drug dependency is characterized by depletion of the brain's reward system and activation of the brain's stress system. The adverse emotional condition induced by the brain's stress system during drug withdrawal may exacerbate acute drug cravings and promote drug-seeking behaviors through negative reinforcement processes. A reduction in dopamine neurotransmission inside the nucleus accumbens and activation of corticotropin-releasing factors in the extended amygdala are posited to play a role in facilitating this motivated behavior. A postulated brain stress response mechanism is believed to heighten drug cravings and facilitate relapse into drug-seeking behavior throughout the obsession and anticipation phases of dependence, triggered by stress described as nonspecific responses to bodily demands. Acupuncture has demonstrated efficacy in alleviating drug addiction and stress-related psychiatric conditions, including anxiety and depression. [55] Thus, acupuncture's potential to influence both reward and stress systems provides a plausible neurobiological explanation for its observed effects on craving, mood, and relapse-related behaviors in individuals with SUD. [45,47,51]

In line with this, acupuncture's efficacy has been evaluated in several hundred controlled clinical trials, and extensive systematic reviews of these studies are currently

accessible. The outcomes for migraines, low back pain, and temporomandibular disorders are deemed favorable by some and challenging to interpret by others. For illnesses such as fibromyalgia, knee osteoarthritis, and tennis elbow, the evidence is deemed promising; nonetheless, further high-quality study is required. The research regarding diseases such as chronic pain, neck discomfort, asthma, and drug addiction is deemed unclear and challenging to interpret. The data for smoking cessation, tinnitus, and weight reduction are typically considered unfavorable. [39] Although the evidence for acupuncture in SUD remains mixed, the presence of promising yet inconclusive findings underscore the importance of more focused investigations. Specifically, there is a need to clarify whether acupuncture produces clinically relevant improvements in key outcomes such as drug craving and anxiety, and to determine under which conditions and protocols these benefits are most likely to occur. [39,46]

There are various types of acupuncture, but the current study entailed numerous RCTs that employed the standard National Acupuncture Detoxification Association (NADA) protocol. Essentially, the NADA-standardized 3- to 5-point ear acupuncture protocol, developed as a community-oriented reaction to challenging circumstances similar to those of today, has become the most extensively utilized acupuncture-assisted protocol, applicable not only to substance dependence but also to various behavioral health contexts.[40] Additionally, the NADA protocol is frequently employed to address behavioral health, addictions, mental health issues, and emotional trauma. It is commonly utilized in undergoing drug and alcohol detoxification, demonstrating efficacy in managing withdrawal symptoms and fostering a sense of tranquility and mental clarity in patients. [41] NADA is being incorporated into dual-diagnosis environments to assist patients with

substance use disorders who also exhibit additional behavioral health symptoms. Patients have indicated substantial advantages, including enhancements in sadness, anxiety, aggression, concentration deficits, and issues related to energy and bodily discomforts such as aches and headaches. NADA has demonstrated effectiveness in the successful completion of a 90-day inpatient dual-diagnosis treatment program for individuals with borderline personality disorder, as well as in tobacco cessation.[52] Given its standardized nature, feasibility in group settings, and broad application in addiction services, the NADA protocol offers a practical template for evaluating acupuncture's therapeutic value in SUD populations.[40–42] For this reason, many of the randomized controlled trials included in the present study employed NADA or closely related auricular acupuncture protocols when examining drug craving and anxiety outcomes.

The auricular acupuncture utilizing the NADA protocol involve the following points: sympathetic, shen men, kidney, liver, and lung, which offer equilibrium and yin replenishment in the context of a presumed diagnostic of yin deficiency, "empty fire," with traditional medical diagnoses related to behavioral health. The NADA procedure entails bilateral manual needling of one to five locations, often administered regularly (often daily), with participants seated silently in groups for 30–45 minutes, or the administration of seeds/beads, commonly on Shen Men or Reverse Shen Men.[42]


**Figure 1.** National Acupuncture Detoxification Association (NADA) Protocol Auricular Acupuncture Points[42] (Stuyt et al, 2018)

A study focused on the investigation of short and long-term effects of auricular acupuncture on anxiety, sleep, drug use, and addiction treatment utilization in adults with substance abuse. However, it was claimed that there is insufficient evidence that could demonstrate the significant advantage of adjunct methods over traditional treatments.[11] Similarly, another study integrated acupuncture within the standard of care during outpatient opioid tapering and assessed its impact on withdrawal symptoms, psychological distress, and pain. This study suggests that auricular acupuncture may be implemented within the standard of care for patients undergoing outpatient opioid weaning regimens. Although results were not statistically significant, the researchers support future research and reveal a promising expansion of treatment options for patients physically dependent on opioid medication.[12]

Aside from auricular acupuncture, body acupuncture was also used for SUD treatments. A study revealed that most frequently used acupuncture points on the

extremities for the treatment of opiate addiction often consist of the Zusanli (ST36), San yin jiao (SP6), Hegu (LI4), Neiguan (PC6).[43]

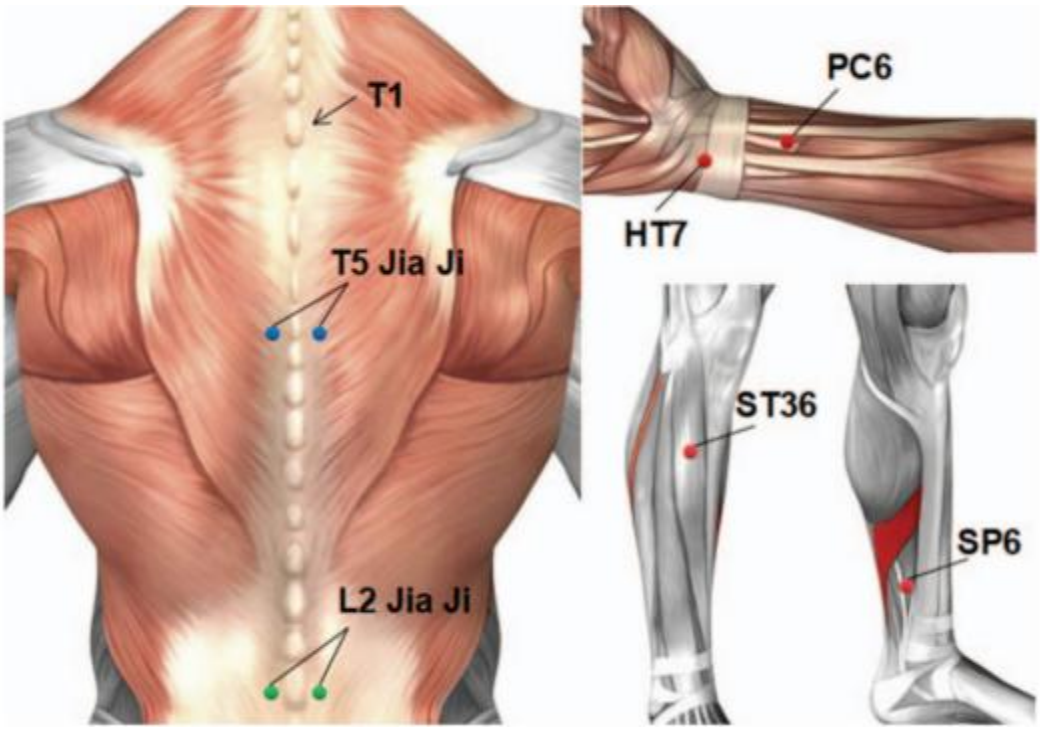


**Figure 2.** Anatomic Locations of Body Acupuncture Sites[44] (Zheng et.al, 2018)

Another study revealed the effectiveness of addressing anxiety and abstinence on methamphetamine addiction. Specifically, acupoints comprised bilateral Jia ji (T5, L2), bilateral Neiguan (PC6), Shen men (HT7), bilateral Zusanli (ST36), and San yin jiao (SP6). The needles were put 6 to 10 mm into Nei Guan and Shen Men, and 10 to 15 mm into other acupoints. Following the attainment of Deqi, the bilateral traditional huatuojiaji points (T5, L2) were linked to the EMS Professional.[44]

Further, substance dependence is a persistently recurring condition that impacts individuals across diverse backgrounds. Many feel that effective therapy interventions for

substance addiction significantly diminish the rates of craving and relapse. Numerous therapy modalities have been utilized in addressing drug addiction; yet an effective medical intervention to mitigate the elevated rates of recurrence remains elusive.[45]

Similarly, research indicates that acupuncture may be advantageous for substance use disorders, as it has demonstrated efficacy in increasing abstinence rates, diminishing cravings, alleviating withdrawal symptoms, and enhancing overall quality of life. This effect is thought to arise from acupuncture's bidirectional influence on regulating neurotransmitters that modulate drug cravings through somatosensory afferent processes and normalizing the hypo reactivity or hyperactivity of the mesolimbic dopamine system in substance addiction. Despite substantial evidence affirming the efficacy and safety of acupuncture for substance use disorders, it is not recommended in most clinical practice recommendations.[46]

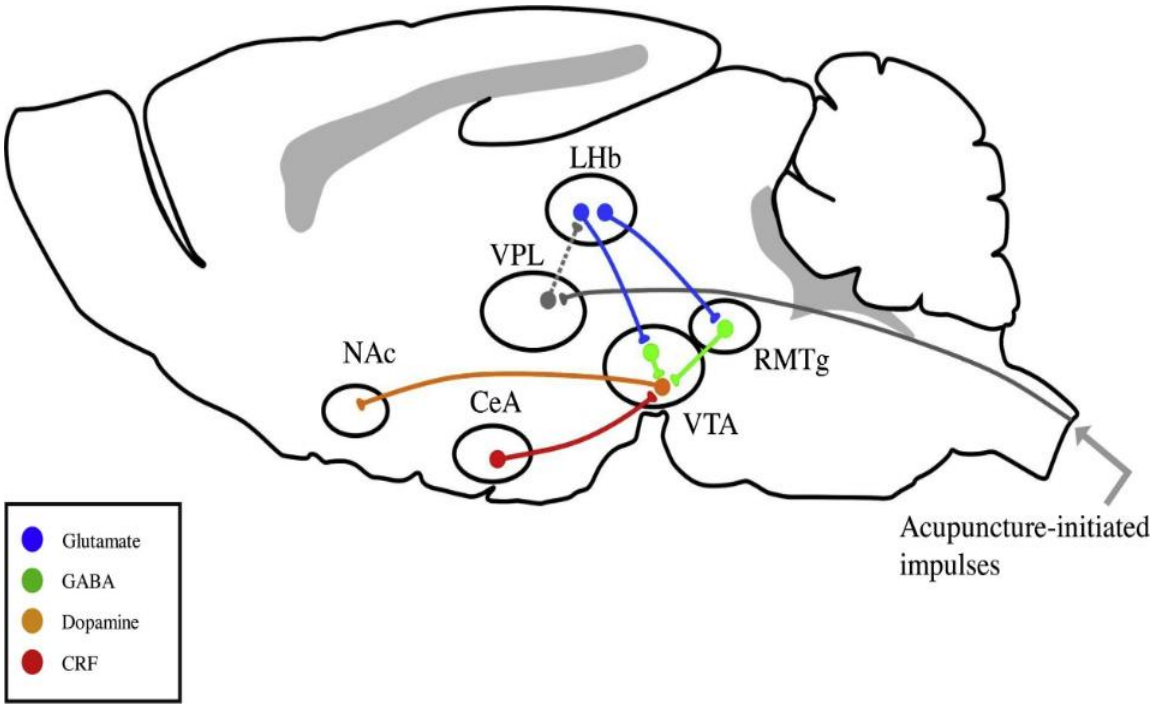


**Figure 3.** Acupuncture-initiated impulses[45] (Lee et al, 2021)

The central dopamine system is crucial in the acupuncture approach to cocaine addiction; the signaling pathway between the ventral tegmental area (VTA) and nucleus accumbens (NAc), which modulates behavior and psychology following chronic cocaine use, is a significant target of acupuncture intervention. Furthermore, acupuncture mitigates cocaine-induced seizures or acute psychomotor responses via the circuits connecting the paraventricular thalamus and the lateral habenula (LHb) to the rostro medial tegmental (RMTg) nucleus. The data indicates that acupuncture may influence multiple cocaine-induced problems through the stimulation of several brain regions; however, the interrelation of these regions and the peripheral nervous system mechanisms involved remain unclear.[51]

Consequently, acupuncture has become the most promising evidence-supported, non-pharmacological intervention available to reduce public opioid dependence. Acupuncture analgesia has been demonstrated to engage various classes of opioid neuropeptides, including enkephalins, endorphins, dynorphins, endomorphins, and nociceptin (sometimes referred to as orphanin FQ). Substance P, vasoactive intestinal peptide, and calcitonin gene-related peptide, among non-opioid neuropeptides, have been examined for their contributions to the various analgesic and anti-inflammatory effects of acupuncture.[47]

Further, the treatment for drug addiction is referred to as rehabilitation, which includes a step known as detoxification, during which drug chemicals are eliminated from the body of the patient. The existing detoxification procedure employs both pharmaceutical and non-pharmacological approaches. Also, acupuncture with the NADA protocol serves

as a non-pharmacological methodology for drug detoxification, addressing the limitations of prior standard pharmacological and non-pharmacological treatments.[48]

Acupuncture, as a treatment for substance use disorders, entails the insertion and stimulation of needles at meridian points believed to regulate dopamine and reduce cortisol, with the objective of restoring balance to dopamine levels disrupted by substance use, ultimately diminishing cravings and withdrawal symptoms. The needed expertise and abilities for administering acupuncture, particularly in patients diagnosed with substance use disorders, make it more suitable for specialized care rather than primary care environments.[49]

A study demonstrates that neurobiological alterations subsequent to acupuncture therapy, suggesting that the intervention exerts a physiological effect. Neuroimaging evidence indicates that acupuncture influences brain functions, particularly the regulation of neurotransmitters like dopamine, which significantly contributes to the onset and reinforcement of addiction. These scans illustrate alterations in activity within regions such as the amygdala and hypothalamus. These regions are implicated in functions associated with emotions, drives, and reward processing, indicating that acupuncture may induce substantial alterations in mood and behavior.[50]

# II. MATERIALS AND METHODS

The current study utilized a meta-analysis approach, considering its suitability in evaluating relevant studies to address the established research objectives. Essentially, this approach facilitates an improved understanding regarding the usage of acupuncture as an intervention for drug craving and anxiety among SUD patients without requiring the establishment of causal relationship within the scope of the study. Thus, the randomized controlled trial (RCT) studies in this paper were synthesized to further garner findings as those of experimental approaches.

## Search Strategies

The studies included in this research were extracted from the following databases: (1) PubMed, (2) Google Scholar, (3) Scopus, (4) Gale Power Search, (5) ProQuest, (6) Wiley Online Library, (7) ResearchGate, (8) Cochrane Library, (9) APA PsycNet, and (10) MDPI. Moreover, the researcher used a custom filter, such as 2000 to March 2026 for the publication date, full text, and Randomized Controlled Trials (RCT), with combinations of the following keywords: “Acupuncture,” “substance use disorder,” “Substance Abuse,” “Drug Craving,” and “Anxiety.” Boolean operators such as “and” and “or” were used, such as searching for “acupuncture and substance use disorder” and “acupuncture and drug craving.” Also, the researcher ensured that the studies were extracted from reputable journal publishers.

Additionally, the reference lists of relevant primary studies and reviews were manually screened to identify any additional eligible RCTs that might not have appeared

in the initial database searches. This manual search helped reduce the risk of missing potentially important studies.

**Eligibility Criteria**

Eligibility was defined using a PICO framework:

- Population (P): Adults diagnosed with substance use disorder or drug addiction.
- Intervention (I): Acupuncture-based interventions, categorized by stimulation method: Electroacupuncture (EA and IMEA) and Manual Acupuncture (Auricular and Body points).
- Comparison (C): Behavioral interventions (e.g., counseling, CBT, relaxation therapy), pharmacological treatment, standard care, no treatment, or sham/placebo acupuncture.
- Outcomes (O): Quantitative measures of drug craving and/or anxiety assessed by validated scales (e.g., VAS, OCDS, SCA, VCCQ, SAS, STAI, and related instruments).

**Inclusion Criteria**

The researcher thoroughly reviewed the articles in accordance with the following inclusion criteria:

1. The studies should be randomized controlled trials (RCTs) evaluating the effectiveness of acupuncture (including manual, electrical, or integrative pressure techniques) for drug craving and/or anxiety.

2. The studies should be published not earlier than 2000 and should be in the English language.
3. Availability of sufficient quantitative data (e.g., means, standard deviations, or convertible statistics) for the intervention and control groups for at least one relevant outcome.
4. Control group receiving behavioral treatment, pharmacological therapy, standard care, no treatment, or sham/placebo acupuncture.

**The Exclusion Criteria**

The researcher looked for criteria that violated the inclusion criteria, resulting in the exclusion of the paper. However, the researcher also evaluated the RCT papers in accordance with the following exclusion criteria:

1. Non-randomized studies, narrative reviews, systematic reviews, meta-analyses, case reports, or animal studies.
2. Duplicate publications of the same dataset.
3. Studies that did not involve acupuncture as the primary intervention or did not report drug craving or anxiety outcomes.
4. Trials outside the defined PICO (e.g., non-SUD populations).

**Study Selection**

After removing duplicates, titles and abstracts were screened for relevance to the research question. Full texts of potentially eligible articles were then retrieved and assessed against the inclusion and exclusion criteria. The study selection process was documented

using a PRISMA-style (PRISMA-P (Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols) flow diagram, detailing numbers of records identified, screened, excluded, and included in the final meta-analysis.

**Data Extraction**

From each included RCT, the following data were extracted using a standardized template:

- Study characteristics (first author, year, country)
- Participant characteristics (sample size per group, diagnostic criteria, substance type)
- Intervention details (type of acupuncture, acupoints, session frequency, treatment duration)
- Comparator details (type of control condition)
- Outcome measures for drug craving and anxiety (scale used, time points analyzed)
- Quantitative data (group means, standard deviations, and sample sizes for relevant outcomes).

When numerical data were not clearly reported in the text, values were obtained from tables or approximated from figures when feasible to enable inclusion in the quantitative synthesis.

**Types of Interventions**

Acupuncture interventions in the included trials comprised auricular acupuncture (e.g., NADA protocol), electroacupuncture, body acupuncture, and integrative meditation with ear acupressure. Control conditions included methadone maintenance therapy, standard inpatient rehabilitation, behavioral therapies (counseling, CBT, relaxation training), sham/placebo acupuncture, and no-treatment controls. Formal subgroup meta-analyses by acupuncture modality (e.g., electroacupuncture vs body acupuncture vs auricular acupuncture) or substance type were not performed because the small number of trials per subgroup would have yielded underpowered and potentially misleading comparisons.

**Risk of Bias Assessment**

The researcher assessed risk of bias for each included study using the Cochrane Collaboration tool. The following domains were rated as low, high, moderate, or unclear risk:

- Selection bias (random sequence generation, allocation concealment)
- Performance bias (blinding of participants and personnel)
- Detection bias (blinding of outcome assessment)
- Attrition bias (incomplete outcome data)
- Reporting bias (selective reporting)
- Other bias (e.g., baseline imbalance, small sample sizes).

Risk-of-bias judgments were summarized in tabular form and visualized using an online risk-of-bias visualization tool (robvis).

**Statistical Analysis**

As mentioned above, the study utilized meta-analysis; hence, the extracted data were analyzed using Cochrane Review Manager (RevMan) 5 and RStudio. Specifically, for continuous outcomes, the mean or mean difference and pooled standard deviation from the included studies were used to calculate standardized mean differences (SMDs) with 95% confidence intervals (CIs), accounting for the different measurement scales used across trials.[14] SMDs were calculated from post-treatment group means and standard deviations for each outcome.

Additionally, the heterogeneity was further examined using the $I^2$ and $\tau^2$. It was interpreted by the Cochrane manual guide[14]:

- 0% to 40%: might not be important
- 30% to 60%: may represent moderate heterogeneity
- 50% to 90%: may represent substantial heterogeneity
- 75% to 100%: considerable heterogeneity

. Additionally, all obtained data were made available only to the researcher; they were securely stored with the sole purpose of analysis and interpretation for the current study. The researcher aimed to provide the utmost data security to ensure that sensitive information is adequately protected.

# III. RESULTS

This section presents the findings of the included randomized controlled trials (RCTs) in relation to the study objectives: (1) to evaluate the effectiveness of acupuncture at various acupoints in reducing drug craving among patients with substance use disorder, and (2) to determine its effectiveness in decreasing anxiety levels in this population.

## Description of included trials

The database search initially identified 748 potentially relevant studies. After removal of duplicates, 633 records were screened by title and abstract. Studies were excluded if they lacked full text, did not report usable data on drug craving or anxiety, were published before 2000, or did not use acupuncture as the primary intervention. Following this process, 68 full-text articles were assessed for eligibility, and ultimately 9 RCTs met all inclusion criteria and provided sufficient data for meta-analysis.

## Study characteristics

The nine included RCTs involved a range of acupuncture modalities, comparators, and patient populations. Interventions comprised auricular acupuncture using the NADA protocol, electroacupuncture, body acupuncture, and integrative meditation with ear acupressure. Control conditions included methadone maintenance treatment alone, standard inpatient rehabilitation, behavioral therapies (such as counseling, CBT, and relaxation training), placebo or sham acupuncture, and no-treatment controls.

Acupoints varied across studies and included auricular points (e.g., Shen Men, sympathetic, kidney, liver, lung), as well as body points such as Baihui (GV20), Neiguan

(PC6), Shenmen (HT7), Zusanli (ST36), and Jiaji (EX-B 2). Treatment duration ranged from 2 to 8 weeks, with session frequencies spanning from multiple sessions per day to several sessions per week. Outcomes primarily focused on subjective measures of drug craving and anxiety, assessed using validated instruments such as the Visual Analogue Scale (VAS), Obsessive Compulsive Drug Use Scale (OCDS), Substance Craving Scale (SCA), Visual Cocaine Craving Questionnaire (VCCQ), Self-Rating Anxiety Scale (SAS), State-Trait Anxiety Inventory (STAI), Hamilton Anxiety Rating Scale (HAMA), and related scales.

**Pooled effects on drug craving**

Across the seven craving outcomes derived from the nine included RCTs, acupuncture was associated with a moderate reduction in drug craving compared with control conditions. The pooled standardized mean difference (SMD) for craving was 0.62 (95% CI 0.39, 0.84) under the common-effect model and 0.55 (95% CI 0.17, 0.94) under the random-effects model, both favoring acupunctures. Heterogeneity was substantial ($I^2$ = 64.6%, $\tau^2 = 0.1441$, $\chi^2 = 14.12$, $p = 0.0149$), indicating meaningful variability in effect sizes between studies.

**Pooled effects on anxiety**

Six trials reported anxiety outcomes, yielding six anxiety comparisons. The pooled SMD for anxiety was 0.72 (95% CI 0.50, 0.94) under the common-effect model and 0.70 (95% CI 0.43, 0.97) under the random-effects model, again favoring acupuncture over control. Heterogeneity for anxiety was lower ($I^2$ = 27.4%, $\tau^2 = 0.0367$, $\chi^2 = 6.89$, $p = 0.2289$), suggesting more consistent effects across studies than for craving.

**Sensitivity analysis for drug craving**

A sensitivity analysis that retained all studies and specifically examined the influence of Wen et al. (2021) showed that this trial had a substantial impact on the pooled craving effect. When Wen et al. (2021), which reported a large effect size (SMD 2.03; 95% CI 1.59, 2.46), was fully incorporated into the sensitivity model, the pooled SMD for craving increased to about 0.91 under the common-effect model and 0.76 under the random-effects model, and heterogeneity rose to $I^2 \approx 86.9\%$ ($p < 0.0001$). These findings indicate that Wen et al. (2021) inflates both the magnitude of the pooled effect and the degree of between-study variability, suggesting that the overall effectiveness of acupuncture for craving is likely more modest than the estimate obtained when this influential study is emphasized.

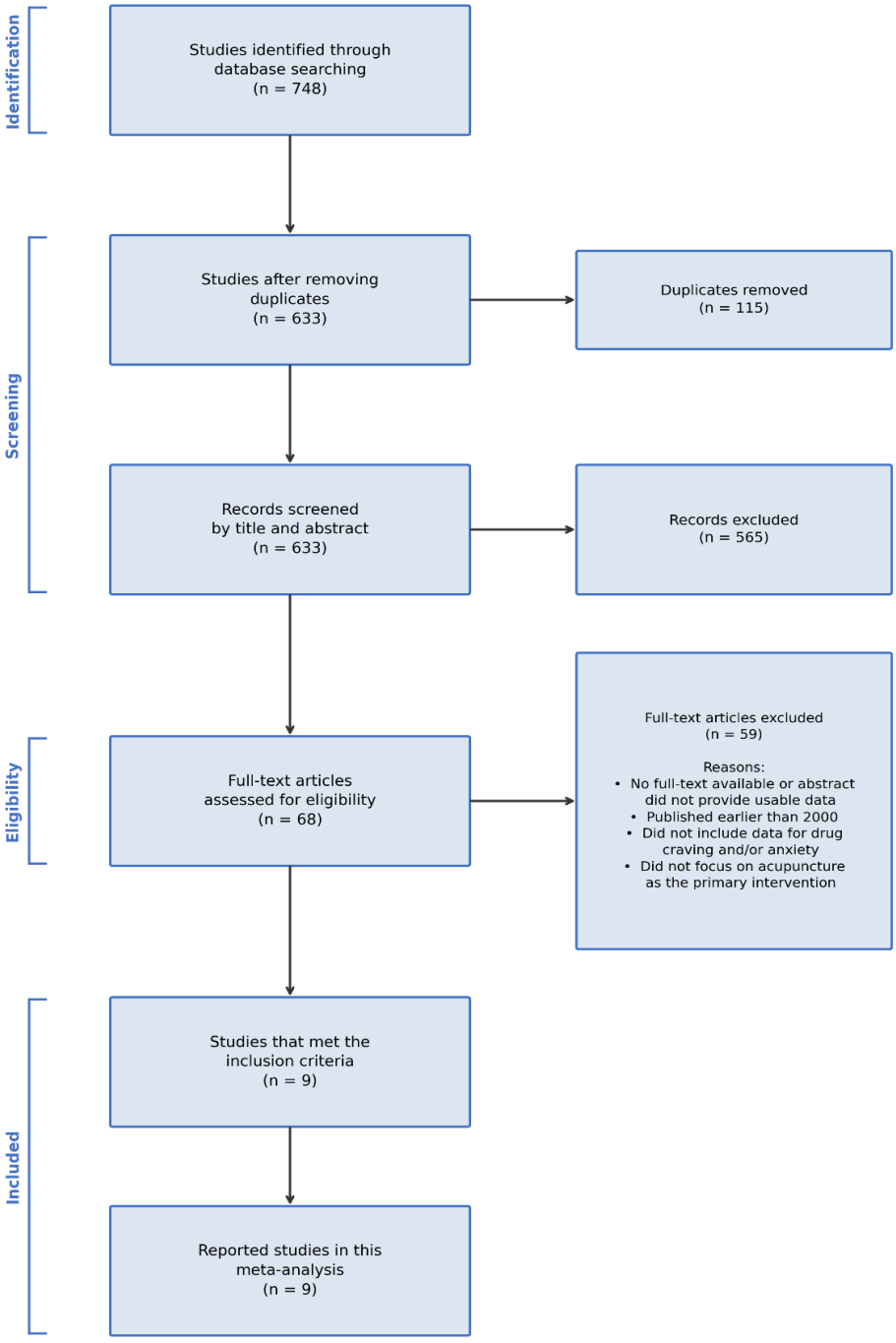


**Figure 4.** Flowchart of Trials Selection

**Table 1.** Characteristics of RCTs

| Study | Intervention | | Acupuncture Points | Sessions | Outcome | Arms | Study Design | Condition; Country |
|---|---|---|---|---|---|---|---|---|
| | Experimental | Control | | | | | | |
| Wen et al. 2021 | Acupuncture with methadone maintenance treatment (disposable stainless-steel needles (Huatuo, Suzhou, China), used 0.3 × 25 mm or 0.3 × 40 mm lengths and diameters) | Methadone maintenance treatment (MMT) | Dingshen-zhen, Sishen-zhen, and Shouzhi-zhen | Patients underwent 18 sessions (3 times each week) over 6 weeks. | Craving (VAS) Insomnia (PSQI) | 2 (acupuncture with MMT, MMT) | Parallel-arm RCT | Opioid-dependent patients; China |
| Krause et al. 2020 | NADA Acupuncture (disposable sterile steel needles (0.2 mm diameter, 15 mm length, Dong Bang | Standard inpatient rehabilitation treatment | Sympathetic, shen men, kidney, liver, lung | 20 sessions (30 mins each) for 6 consecutive weeks. | Drug Craving (OCDS) Anxiety (STAI) Depression (BDI) | 3 (NADA, Sham, treatment as usual) | Three-arm RCT, single-blinded | Alcohol addict patients; Germany |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Needles®, DONGBANG Acupuncture Inc., Korea) | | | | | | | |
| Chan et al. 2014 | Auricular acupuncture (stud needles for 20 mins) | Placebo AA with minimal acupuncture without electrical stimulation | Shen Men | Twice per week for 4 weeks | Drug Craving (VAS) | 2 (true acupuncture, sham acupuncture) | randomized, single-blinded, parallel-group | Heroin addicts; Taiwan |
| Jing-ping et al. 2013 | Electroacupuncture (disposable filiform needles of 0.35 mm in diameter and 40 mm in length) | Pharmacologic intervention (methadone, doxepin) | Jiaji (EX-B 2) | 20 minutes per day for 2 weeks | Drug Craving (VAS) Anxiety (SAS) | 2 (electroacupuncture, pharmacological intervention control) | 2-arm RCT | Patients of Drug Rehabilitation Center of Shiyan Public Security Bureau. China |
| Chen et al. 2013 | Integrative Meditation and Ear Acupressure (five herbal seeds pressed 20 times) | Behavioral Treatments (Counseling, CBT, Relaxation Training) | Shen Men, subcortex, heart, lung, and liver | 4-5 sessions per day for 3 weeks | Cocaine/ heroine craving (CHCS) Anxiety (STAI) Depression (BDI) Withdrawal symptom | 2 (IMEA, Behavioral Treatment) | 2-armed, randomized controlled pilot study | Cocaine-dependent patients. Baltimore, Maryland |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Cocaine Craving (VCCQ) Situational confidence Self-efficacy | | | |
| Song et al. 2012 | Body Acupuncture (filiform needles, 0.35 mm diameter, 40 mm in length) | No Treatment | Baihui (GV 20), bilateral Neiguan (PC 6), Shenmen (HT 7), Zusanli (ST 36) | 30 minutes per session, twice a week for 8 weeks | Anxiety (SAS) Sleep Quality (PSQI) | 2 (body acupuncture, control group) | 2-armed, RCT | Heroin addicts; China |
| Yan et al. 2012 | Acupuncture (0.5-1.0 cun disposable needles, 0.22 mm in diameter and 25 mm in length) | No treatment | Neiguan (PC 6) | 20 minutes per session, 3 times a week for 4 weeks | Anxiety (HAMA) | 3 (Neiguan, Shenmen, control) | 3-armed, RCT | Heroin addicts; China |
| Song et al. 2010 | Body acupuncture with psychological desensitization (10 mm and 15-20 mm for 30 minutes) | No treatment | Baihui (GV 20), Neiguan (PC 6) | 30 minutes per session, twice a week for 8 weeks | Drug Craving (VAS) Anxiety (SAS) | 2 (acupuncture treatment with psychological desensitization, control group) | 2-armed, RCT | Heroin addicts; China |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Killeen et al. 2002 | NADA auricular Acupuncture | Placebo | Shen men, sympathetic, kidney, lung, liver | 45 mins session | Drug Craving (SCA) Cocaine Craving (CCQ) | 2 (auricular acupuncture, sham/placebo) | 2-armed, RCT | Cocaine-dependent patients; United States |

**Heterogeneity and Exploratory Analysis**

Figures 5 and 6 indicate an overall beneficial effect of auricular and body acupuncture in reducing drug craving and anxiety among individuals with substance use disorders, although marked heterogeneity is evident. For drug craving, the forest plot combining seven outcomes from the nine RCTs yielded a pooled SMD of 0.62 (95% CI 0.39, 0.84) under the common-effect model and 0.55 (95% CI 0.17, 0.94) under the random-effects model, both favoring acupuncture. Heterogeneity statistics showed $I^2$ = 64.6% ($\tau^2$ = 0.1441, $\chi^2$ = 14.12, p = 0.0149), indicating that variability among studies is unlikely to be due to chance alone. Although the pooled effect is moderate, the presence of substantial heterogeneity underscores uncertainty arising from between-study differences.

For anxiety, the second plot, comprising six comparisons, produced somewhat smaller but still favorable effects, with SMDs of 0.72 (95% CI 0.50, 0.94) for the common-effect model and 0.70 (95% CI 0.43, 0.97) for the random-effects model. Heterogeneity was lower ($I^2$ = 27.4%, $\tau^2$ = 0.0367, $\chi^2$ = 6.89, p = 0.2289), suggesting more consistent effects across trials than for craving.

Exploratory consideration of study characteristics suggests several potential contributors to heterogeneity, including intervention type (auricular vs. body acupuncture vs. electroacupuncture/integrative meditation with ear acupressure), substance type, comparator (e.g., methadone maintenance, behavioral therapy, sham acupuncture), and specific outcome measures used. For instance, some trials employing Jiaji-based electroacupuncture in opioid-dependent populations appeared to report larger reductions in craving, whereas certain auricular protocols in cocaine- or alcohol-dependent samples

showed more modest or non-significant effects. However, these patterns were identified descriptively rather than through formal subgroup meta-analysis and should therefore be interpreted with caution.

Overall, the findings indicate encouraging pooled effectiveness of acupuncture for reducing craving and anxiety, while simultaneously emphasizing the need for future, well-powered, subgroup-focused research to clarify the moderate-to-high heterogeneity and to identify the clinical contexts in which acupuncture interventions are most beneficial.

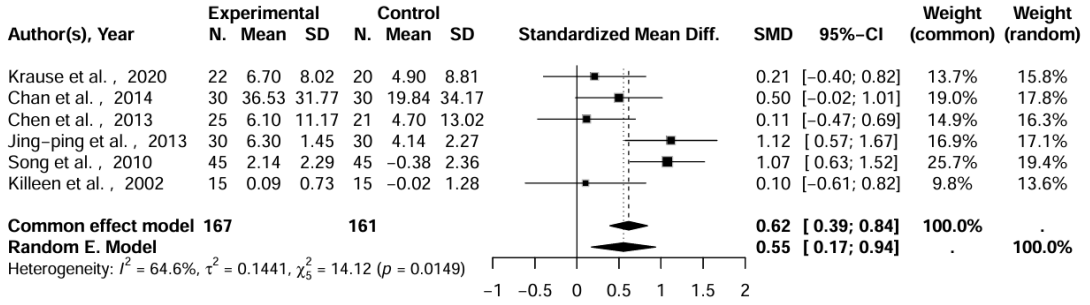


**Figure 5**. Forest Plot (Drug Craving)

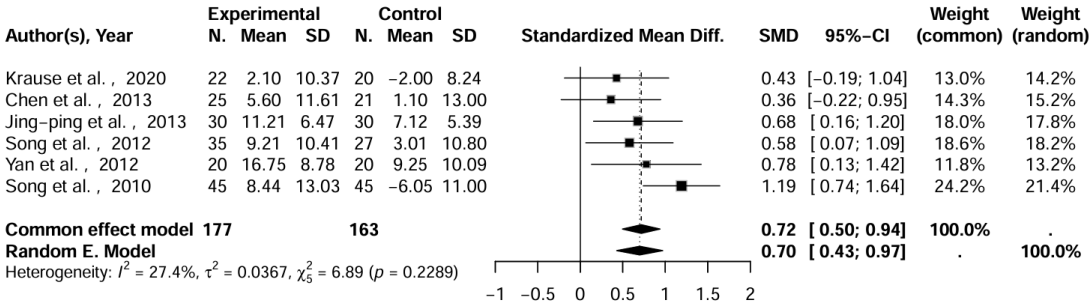


**Figure 6.** Forest Plot (Anxiety)

## Outcomes

### Drug Craving Outcomes

The pooled estimates indicated that acupuncture-related interventions yielded moderate improvements in drug craving, although effect sizes varied by study. The meta-analysis showed a standardized mean difference (SMD) of 0.62 under the common-effect model and 0.55 under the random-effects model, indicating a moderate decrease in craving intensity, with considerable heterogeneity ($I^2$ = 64.6%) reflecting diversity among trials. Significant effects were observed in investigations by Jing-ping et al. (2013) and Song et al. (2010), where SMDs exceeded 1.0, underscoring acupuncture's capacity to substantially diminish subjective cravings in some detoxification settings. In contrast, Krause et al. (2020), Chen et al. (2013), and Killeen et al. (2002) reported smaller or negligible impacts, while Chan et al. (2014) demonstrated a moderate but borderline effect. Collectively, these findings indicate that acupuncture can meaningfully reduce drug cravings in specific contexts; however, its effectiveness appears contingent on study design, patient characteristics, and comparator interventions, highlighting the importance of sensitivity analyses and subgroup investigations to clarify where the most substantial benefits occur.

### Anxiety Outcomes

For anxiety outcomes, the pooled estimates indicated that acupuncture produced moderate improvements, with SMDs of 0.72 under the common-effect model and 0.70 under the random-effects model. Heterogeneity was relatively low ($I^2$ = 27.4%), suggesting more consistency across trials than for craving. Notably, studies by Jing-ping et al. (2013),

Song et al. (2010), Song et al. (2012), and Yan et al. (2012) reported moderate to substantial reductions in anxiety (SMDs roughly 0.58–1.19), highlighting acupuncture's potential to alleviate psychological distress during detoxification. In contrast, Krause et al. (2020) and Chen et al. (2013) showed smaller, non-significant effects, indicating variability in treatment effectiveness depending on study design, outcome measures, and sample characteristics.

Overall, the findings suggest that acupuncture appears effective for both drug craving and anxiety, with moderate effect sizes observed across pooled analyses. Reductions in drug craving were somewhat more variable, whereas anxiety effects were more consistent but still influenced by small-study and methodological factors. Sensitivity analyses, including models that emphasized high-impact studies such as Wen et al. (2021), indicated that the direction of benefit for craving was stable, even though the exact magnitude of the pooled effect was sensitive to influential trials. Clinically, these results support the use of auricular and body acupuncture as adjunctive therapies for patients with substance use disorders, offering meaningful reductions in craving and anxiety symptoms during withdrawal rather than serving as standalone treatments.

## Subgroup Analysis

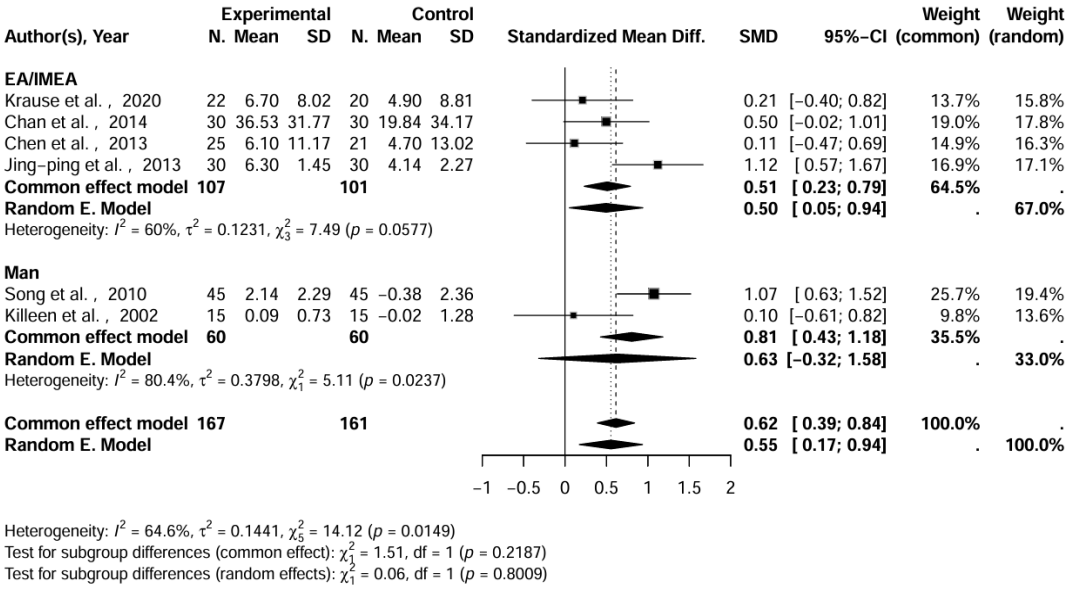


**Figure 7**. Subgroup Analysis between EA/IMEA and Manual acupuncture

The subgroup analysis comparing electroacupuncture/integrative meditation with ear acupressure (EA/IMEA) to manual acupuncture indicated that both techniques yielded moderate improvements in drug craving, albeit with differing patterns of consistency. The pooled effect size for EA/IMEA was 0.51 under the common-effect model and 0.50 under the random-effects model, with substantial heterogeneity ($I^2 = 60\%$). Within this subgroup, studies by Jing-ping et al. (2013) and Chen et al. (2013) reported significant effects, whereas Krause et al. (2020) and Chan et al. (2014) found smaller, non-significant changes, highlighting variability in effectiveness. Manual acupuncture showed a larger pooled effect size of 0.81 in the common-effect model; however, the random-effects estimate decreased to 0.63 with wide confidence intervals, and heterogeneity was high ($I^2 = 80.4\%$). Song et al. (2010) documented a substantial benefit, whereas Killeen et al. (2002) showed a

non-significant effect, contributing to the observed inconsistency. When both subgroups were combined, the overall analysis demonstrated a moderate reduction in drug craving (SMD 0.62 for the common-effect model and 0.55 for the random-effects model) with considerable heterogeneity ($I^2$ = 64.6%). Tests for subgroup differences were not statistically significant, indicating no clear evidence that EA/IMEA or manual acupuncture is superior, although manual acupuncture exhibited somewhat larger average effects with greater variability.

Overall, the findings suggest that acupuncture, regardless of modality, can meaningfully reduce drug cravings, but treatment effects likely depend on study design, patient characteristics, and specific intervention protocols.

**Sensitivity Analysis with Wen (Drug Craving)**

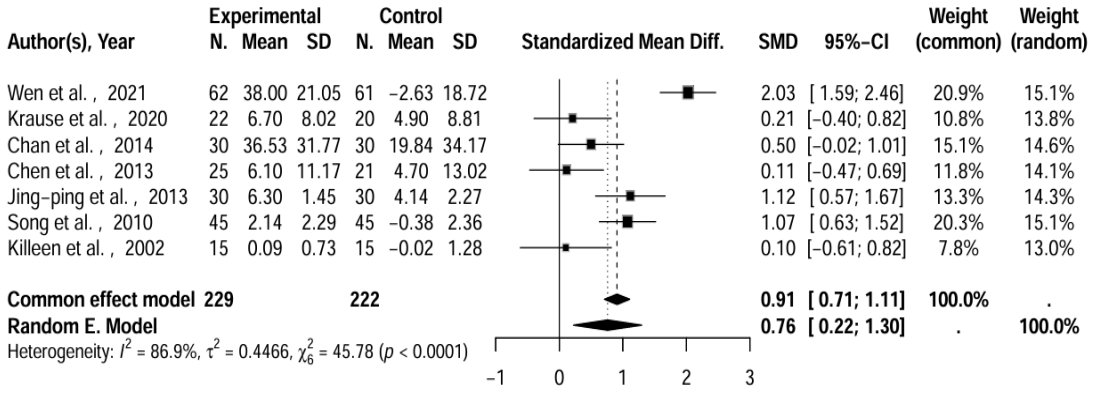


**Figure 8**A. Forest Plot of Drug Craving with WEN

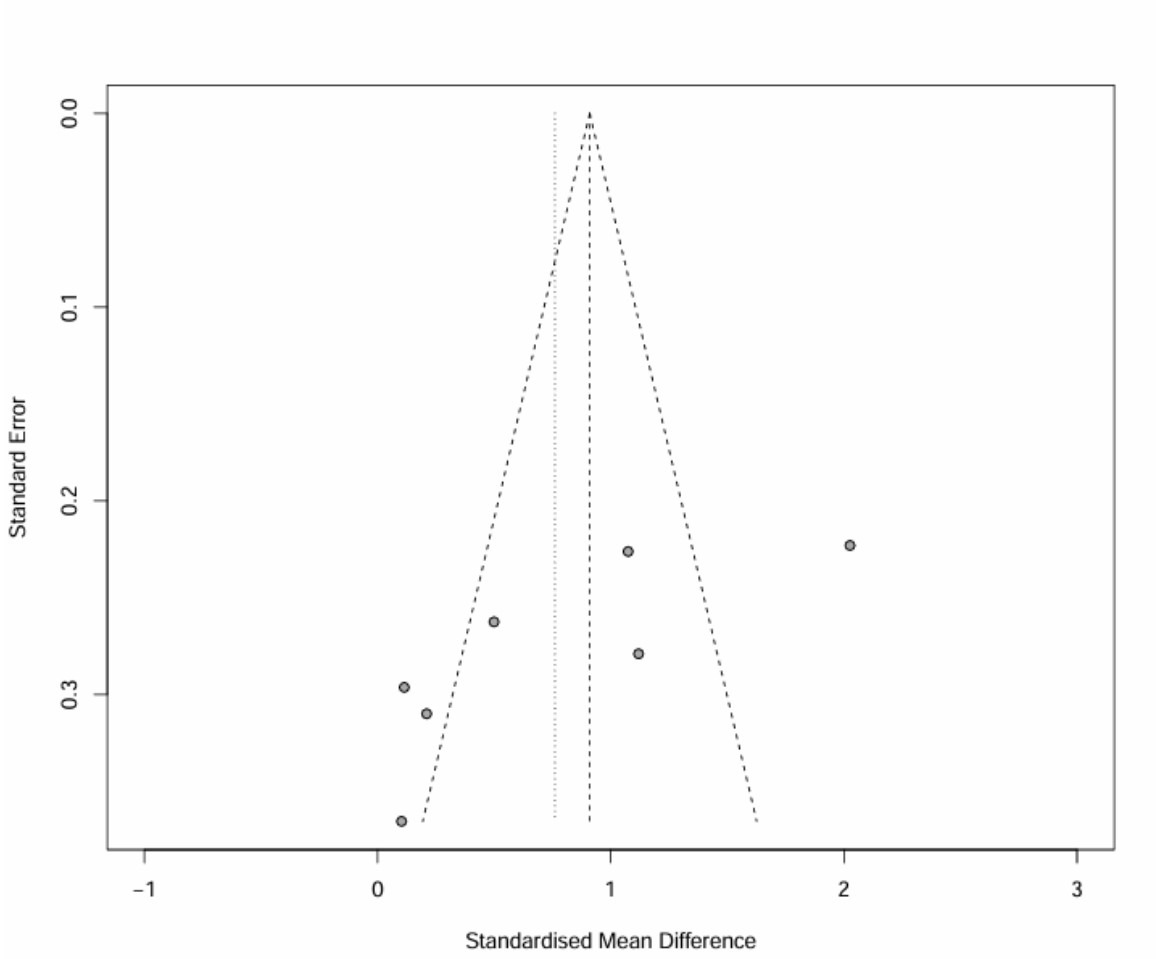


**Figure 8B.** Funnel plot for Drug Craving with Wen

The sensitivity analysis that retained all studies and highlighted Wen et al. (2021) revealed that acupuncture interventions continued to show improvements in drug craving, but that the pooled effect size was substantially influenced by this trial. When Wen et al. (2021), which reported a large effect (SMD 2.03; 95% CI 1.59, 2.46), was fully incorporated into the model, the pooled standardized mean differences increased to approximately 0.91 under the common-effect model and 0.76 under the random-effects model, and heterogeneity rose to $I^2 = 86.9\%$ ($p < 0.0001$). These findings indicate that

inclusion of Wen et al. (2021) inflates both the magnitude of the pooled effect and between-study variability, suggesting that the true overall effectiveness of acupuncture on craving is likely more moderate than the estimate observed when this influential study is emphasized.

Moreover, the funnel plot exhibited relative symmetry, suggesting that publication bias alone is unlikely to account for the observed results, although small-study effects remain plausible. Specifically, trials by Jing-ping et al. (2013), Song et al. (2010), and Killeen et al. (2002) showed relatively larger effects, whereas studies by Krause et al. (2020), Chan et al. (2014), and Chen et al. (2013) reported smaller or non-significant changes, underscoring the diversity of findings across investigations.

Taken together, the sensitivity analyses suggest that acupuncture's effectiveness for subjective outcomes such as craving and anxiety is reasonably robust, while also highlighting persistent heterogeneity and the need for larger, well-powered, subgroup-focused trials to clarify which patient populations and intervention protocols yield the most consistent benefits.

**Publication Bias Assessment**

For drug craving outcomes, the funnel plot showed a fairly symmetrical distribution of studies around the pooled effect size. Most points clustered toward the lower part of the plot, suggesting that smaller trials exhibited greater variability in effect estimates, but there was no strong indication of systematic publication bias.

For anxiety outcomes, the funnel plot also showed clustering of RCTs around the pooled effect size, with only minimal asymmetry. This pattern suggests that some smaller studies appeared to report stronger effects than larger trials, which may reflect small-study influences rather than clear publication bias. Overall, the pooled estimates for both outcomes remained statistically significant; however, the presence of moderate asymmetry—particularly for anxiety—warrants cautious interpretation of the magnitude of benefit.

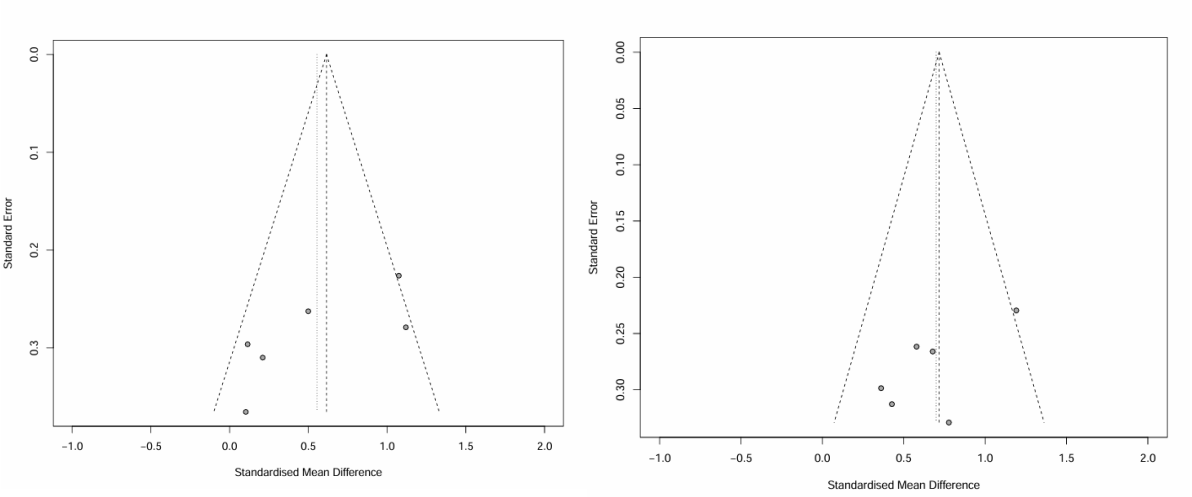


**Figure 9.** *Funnel Plots for Drug Craving and Anxiety*

**Risk of Bias Assessment**

**Table 2.** Risk of Bias

| Study | Random sequence generation | Allocation concealment | Blinding participants/ personnel | Blinding outcome assessment | Other bias |
|---|---|---|---|---|---|
| Wen et al. 2021 | Low | Low | High | High | Unclear |
| Krause et al. 2020 | Low | Unclear | High | Unclear | Low |
| Chan et al. 2014 | Low | Unclear | Unclear | Unclear | Unclear |
| Jing-ping et al. 2013 | Low | Unclear | High | Unclear | Low |
| Chen et al. 2013 | Low | Unclear | Unclear | Unclear | Unclear |
| Song et al. 2012 | Low | Unclear | High | Unclear | Low |
| Yan et al. 2012 | Low | Unclear | High | Unclear | Unclear |
| Song et al. 2010 | Low | Unclear | High | Unclear | Low |
| Killeen et al. 2002 | Unclear | Unclear | Unclear | Unclear | High |

**A. Wen et al. 2021**

| Bias | Judgement | Support for Judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low | The study randomly assigned the respondents using a central randomization system. |
| Allocation concealment (selection bias) | Low | The randomization system used prevents foreknowledge of group allocation. |
| Blinding (performance bias and detection bias) | High | The participants and personnel were aware of the treatment assignment. |

| | | |
|---|---|---|
| Blinding outcome assessment | High | No evidence of outcome assessor being blinded, potentially revealing a detection bias. |
| Other bias | Unclear | Sex imbalance and dropouts noted but severity uncertain |

**B. Krause et al. 2020**

| Bias | Judgement | Support for Judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low | The study explicitly mentioned that patients were randomized using Research Randomizer version 4.0. |
| Allocation concealment (selection bias) | Unclear | Research Randomizer was used for sequence generation, but the study did not describe whether the allocation sequence was concealed from those enrolling participants (e.g., sealed envelopes, central allocation). |
| Blinding (performance bias and detection bias) | High | The control group could not be blinded and outcomes are subjective. |
| Blinding outcome assessment | Unclear | Psychometric measures were self-reported, unclear if assessors were blinded. |
| Other Bias | Low | No adverse events were reported, and baseline characteristics were balanced across groups. |

**C. Chan et al. 2014**

| Bias | Judgement | Support for Judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low | The study reports that the randomization was determined by a computer-generated random number table and was managed by an independent administrator. |

| | | |
|---|---|---|
| Allocation concealment (selection bias) | Unclear | The study did not describe how allocation was concealed. |
| Blinding (performance bias and detection bias) | Unclear | The study did not clarify whether the perceptions of the patients on treatment credibility were assessed, which can entail detection bias. |
| Blinding outcome assessment | Unclear | The primary outcomes involved self-reported measures, and the outcome assessment blinding was not entirely assured. |
| Other bias | Unclear | The sample size was small, and participants were recruited through referrals and advertisements, which may introduce self-selection bias. Methadone was dosed individually by a separate psychiatrist, but it is unclear whether dosing was balanced across groups. Reporting on attrition and dropout was limited |

**D. Jing-ping et al. 2013**

| **Bias** | **Judgement** | **Support for Judgement** |
|---|---|---|
| Random sequence generation (selection bias) | Low | The study used a random digit's table for randomization. |
| Allocation concealment (selection bias) | Unclear | The paper did not mention how allocation was concealed. |
| Blinding (performance bias and detection bias) | High | Blinding was not feasible due to the fundamentally different nature of the interventions (electroacupuncture vs. oral pharmacotherapy). Participants and personnel were necessarily aware of treatment assignment, and both outcomes (VAS, SAS) are subjective self-report measures. |
| Blinding outcome assessment | Unclear | Outcomes were self-reported, revealing to be inherently vulnerable to bias. |
| Other bias | Low | Baseline characteristics were comparable between groups. |

### E. Chen et al. 2013

| Bias | Judgement | Support for Judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low | The participants were stratified by gender, psychiatric medication used, polydrug use, and randomly assigned 1:1 to IMEA and TAU groups. |
| Allocation concealment (selection bias) | Unclear | The paper does not specify how allocation was concealed. |
| Blinding (performance bias and detection bias) | Unclear | The two interventions (IMEA vs. behavioral treatment) were distinctly different, making participant blinding impractical. The study did not report whether personnel involved in data collection were blinded to treatment allocation. |
| Blinding outcome assessment | Unclear | Outcome assessors' blinding status was not described. All outcomes were self reported and participants were aware of their treatment condition. |
| Other bias | Unclear | Baseline characteristics were comparable between groups, with only a small difference in age. However, this was a small pilot study (n = 56) with notable differential attrition: treatment retention at week 8 was 89% for IMEA versus 63% for TAU, which may introduce bias if dropout was related to outcomes. |

### F. Song et al. 2012

| Bias | Judgement | Support for Judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low | The participants were randomized using a random number table. |
| Allocation concealment (selection bias) | Unclear | The paper does not specify how allocation was concealed. |

| | | |
|---|---|---|
| Blinding (performance bias and detection bias) | High | The control group received no treatment, making blinding of participants and personnel impossible. Participants were aware of their group assignment, and all outcomes (SAS, PSQI) are subjective self-report measures susceptible to expectation effects. |
| Blinding outcome assessment | Unclear | The study did not mention whether the assessors who were analyzing the data were blinded. |
| Other bias | Low | Baseline characteristics were comparable between groups. |

**G. Yan et al. 2012**

| **Bias** | **Judgement** | **Support for Judgement** |
|---|---|---|
| Random sequence generation (selection bias) | Low | Participants were allocated into groups using stratified random sampling. |
| Allocation concealment (selection bias) | Unclear | There was no mention of how the random sequence was actually concealed. |
| Blinding (performance bias and detection bias) | High | Blinding was not feasible and expectations could influence outcomes. |
| Blinding outcome assessment | Unclear | The study reported that outcome assessors were blinded. However, the HAMA requires a clinical interview, and unblinded participants in the no-treatment control group may have inadvertently revealed their group assignment during assessment. No safeguards against unblinding were described. |
| Other bias | Unclear | There was a lack of detail on adherence monitoring. |

### H. Song et al. 2010

| Bias | Judgement | Support for Judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low | The participants were randomized using a random number table. |
| Allocation concealment (selection bias) | Unclear | The paper does not specify how allocation was concealed. |
| Blinding (performance bias and detection bias) | High | The control group received no treatment, making blinding of participants and personnel impossible. Participants were fully aware of their group assignment, and both outcomes (VAS for craving, SAS for anxiety) are subjective self-report measures susceptible to expectation effects. |
| Blinding outcome assessment | Unclear | Outcomes were self-reported and there were no specifications whether the assessors who were analyzing the data were blinded. |
| Other bias | Low | Baseline characteristics were comparable between groups. |

### I. Killeen et al. 2002

| Bias | Judgement | Support for Judgement |
|---|---|---|
| Random sequence generation (selection bias) | Unclear | The study described a randomized design but did not specify the method of random sequence generation. |
| Allocation concealment (selection bias) | Unclear | The paper does not specify how allocation was concealed. |
| Blinding (performance bias and detection bias) | Unclear | The sham acupuncture control used non-therapeutic ear points, which may have preserved participant blinding. However, no credibility-of-blinding assessment was reported, and the acupuncturist was necessarily aware of group assignment. |
| Blinding outcome assessment | Unclear | Outcomes were self-reported and there were no specifications whether the assessors who were analyzing the data were blinded. |
| Other bias | High | Baseline characteristics showed imbalances in gender distribution and |

psychiatric comorbidity between groups. With only 30 participants, these differences are unlikely to be fully attributable to chance and may confound craving outcomes. Additionally, the study assessed only a single acupuncture session rather than a treatment course.


**Figure 10.** *The risk of bias assessment for each included study*

Figure 10 displays the study-level risk-of-bias ratings for each randomized controlled trial included in this systematic review and meta-analysis across five domains. Most trials were judged low risk for random sequence generation, suggesting that randomization methods were generally acceptable, although one study (Killeen et al., 2002) remained unclear because the specific procedure was not fully described. Allocation concealment was largely unclear, with only one study (Wen et al., 2021) rated low risk due to its use of a central randomization system, indicating that group assignment may not have been adequately protected from foreknowledge in the remaining trials. Blinding of participants and personnel was frequently judged high risk, which is expected in acupuncture trials where interventions are inherently distinguishable from no-treatment or pharmacological controls; this increases the likelihood that subjective outcomes such as craving and anxiety may have been influenced by expectations. Blinding of outcome assessment was predominantly unclear, as most studies relied on self-reported measures without specifying whether assessors were blinded, implying potential detection bias. The "other bias" domain was variable, reflecting issues such as small sample sizes, baseline imbalances, incomplete reporting, and differential attrition at the level of individual studies.

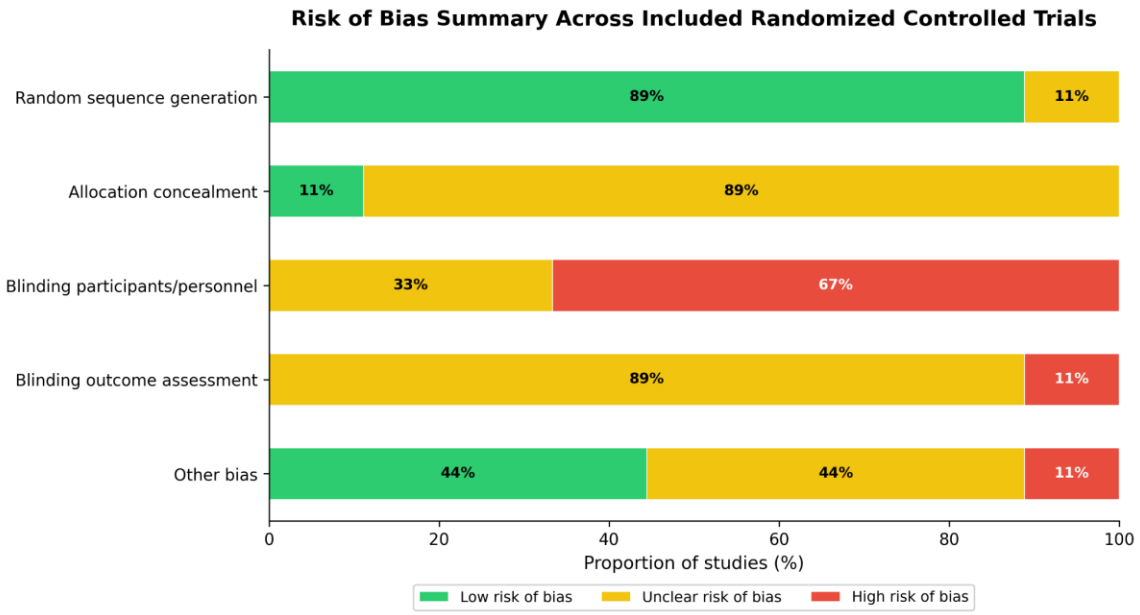


**Figure 11.** *Risk of bias summary included randomized controlled trials (RCTs)*

Figure 11 summarizes the overall distribution of risk-of-bias judgments across all included trials and domains, providing a broader view of methodological strengths and weaknesses. Random sequence generation appears generally robust, with 89% of studies falling into the low-risk category, supporting the adequacy of randomization procedures at the aggregate level. In contrast, allocation concealment was predominantly unclear (89%), with only one study rated low risk, indicating persistent vulnerabilities to selection bias in this body of evidence. Blinding of participants and personnel showed the highest proportion of high-risk ratings (67%), which is expected given the inherent difficulty of blinding acupuncture interventions, particularly when compared with no-treatment or pharmacological controls. Blinding of outcome assessment was predominantly unclear (89%), reflecting widespread reliance on self-reported measures without adequate description of assessor blinding, and suggesting that detection bias cannot be ruled out. The

"other bias" category showed heterogeneous judgments, with studies split between low risk (44%), unclear (44%), and high risk (11%), consistent with concerns about small samples, baseline imbalances, differential attrition, and incomplete reporting across the trials.

Taken together, Figures 10 and 11 show that randomization was generally appropriate, but important weaknesses remain in allocation concealment, blinding, and reporting. These limitations mean that selection, performance, and detection bias are possible, especially for subjective outcomes such as craving and anxiety. As a result, pooled estimates should be interpreted with caution, and future acupuncture trials should prioritize stronger concealment, improved blinding where feasible (e.g., through the use of sham acupuncture controls), clearer reporting, and larger samples to strengthen confidence in the evidence.

# IV. DISCUSSION

The integration of results offers a thorough perspective on the data supporting acupuncture therapies in addiction treatment. The forest plots consistently showed moderate pooled advantages, with standardized mean differences favoring acupuncture for outcomes including craving and anxiety. For drug craving, the aggregated standardized mean difference (SMD) was 0.62 (95% CI 0.39–0.84) with the common-effect model and 0.55 (95% CI 0.17–0.94) with the random-effects model, exhibiting considerable heterogeneity ($I^2$ = 64.6%, $\tau^2$ = 0.1441, $\chi^2$ = 14.12, p = 0.0149), signifying substantial variability among trials. For anxiety, the aggregated SMD was 0.72 (95% CI 0.50–0.94) with the common-effect model and 0.70 (95% CI 0.43–0.97) with the random-effects model, with lower heterogeneity ($I^2$ = 27.4%, $\tau^2$ = 0.0367, $\chi^2$ = 6.89, p = 0.2289), indicating greater consistency across studies. These moderate SMDs suggest that acupuncture may yield clinically meaningful decreases in craving and anxiety, thereby enhancing engagement and adherence in addiction treatment programs.[25–27,33–37] These moderate reductions in anxiety are consistent with the traditional functions ascribed to Shenmen HE-7 and Baihui DU-20 in Deadman's A Manual of Acupuncture and Cheng Xinnong's Chinese Acupuncture and Moxibustion, where these points are described as primary regulators of the shen and the Heart–brain axis.

Clinical implications: From a clinical perspective, these findings suggest several pragmatic points in the SUD care pathway where acupuncture may be considered as an adjunctive option. During the detoxification and early withdrawal phase, auricular or NADA-style protocols can be integrated with standard medical management to help attenuate acute craving and anxiety, potentially improving comfort and early engagement in treatment. In

the early abstinence and stabilization phase, a time-limited course of acupuncture (for example, 2–3 sessions per week over several weeks) may help patients manage residual craving and anxiety that commonly precipitate lapse, thereby supporting adherence to psychosocial and pharmacologic interventions. For individuals who continue to experience prominent anxiety or stress-related relapse risk despite usual care, acupuncture can be offered as a low-risk supplemental modality targeting subjective distress, with the clear understanding that it complements rather than replaces established pharmacologic and psychotherapeutic treatments for substance use disorders.

Given the clinical and methodological heterogeneity across trials, subgroup analyses were undertaken (for example, by acupuncture modality) to explore whether treatment effects differed meaningfully between protocol types. Subgroup analysis indicated that both electroacupuncture/integrative meditation with ear acupressure and manual acupuncture produced moderate reductions in craving (SMD 0.51 vs 0.81 under the common-effect model), without statistically significant differences between stimulation methods. This pattern suggests that different acupuncture modalities may confer broadly similar benefits for craving, although the limited number of trials per subgroup means these findings should be interpreted cautiously.

To assess the robustness of these findings and the influence of individual studies, sensitivity analyses were performed. Sensitivity analysis that retained all studies and highlighted Wen et al. (2021) demonstrated that this trial exerted a strong influence on the pooled craving effect. When Wen et al. (2021), which reported a large effect size (SMD 2.03; 95% CI 1.59–2.46), was fully incorporated into the model, the pooled SMD increased to about 0.91 under the common-effect model and 0.76 under the random-effects model,

and heterogeneity rose to $I^2 \approx 86.9\%$. These findings indicate that inclusion of this single outlying study inflates both the magnitude of the pooled effect and the degree of between-study variability, suggesting that the true overall effectiveness of acupuncture for craving is likely more modest than the estimate obtained when its influence is maximized.

The funnel plots offer supplementary interpretive insight. The distribution of studies on drug craving was generally symmetrical, suggesting that publication bias alone is unlikely to account for the observed results, although small-study effects remain plausible. Minor asymmetry was noted for anxiety, with smaller trials indicating more pronounced effects, suggesting the possibility of selective reporting or methodological inconsistencies. Overall, these patterns support a reasonably robust effect of acupuncture on subjective outcomes such as craving and anxiety, while also underscoring persistent heterogeneity and the need for larger, well-powered, subgroup-focused studies to clarify which patient populations and intervention protocols yield the most consistent benefits.

Risk-of-bias evaluations underscore methodological strengths and limitations. The majority of studies (89%) were assessed as low risk for random sequence generation, signifying generally sufficient randomization protocols. Nonetheless, allocation concealment was predominantly unclear (89%), with only one study (Wen et al., 2021) rated low risk due to its use of a central randomization system, raising concerns about possible selection bias across the remaining trials. Blinding of participants and personnel was rated high risk in 67% of the included studies, which is anticipated given the nature of acupuncture interventions—particularly when compared with no-treatment or pharmacological controls—yet it remains a significant constraint, as it may exaggerate subjective outcomes such as craving and anxiety. Blinding of outcome assessment was

predominantly unclear (89%), as most studies relied on self-reported measures without specifying whether assessors were blinded, indicating that detection bias cannot be ruled out. The "other bias" domain showed heterogeneous judgments, with studies distributed across low risk (44%), unclear (44%), and high risk (11%), reflecting concerns such as small sample sizes, baseline imbalances, differential attrition, and incomplete reporting. These limitations are particularly important when interpreting subjective outcomes and likely contribute to the heterogeneity observed in the pooled analyses.

Taken together, the data suggests that acupuncture is most effective for subjective outcomes, including drug cravings and anxiety, where moderate effect sizes were observed, whereas objective physiological measures exhibit less consistency. The neurobiological plausibility of acupuncture's effects—via modulation of neurotransmitters including serotonin, dopamine, and endorphins—offers a mechanistic justification for its influence on reward circuits, stress responses, and emotional regulation.[32,40–42] Clinically, this supports the incorporation of acupuncture as a supplementary therapy in multimodal treatment regimens for substance use disorders, rather than as a standalone intervention. However, constraints such as limited sample sizes, variability in acupuncture methodologies, and methodological deficiencies underscore the necessity for more extensive, rigorously planned trials with enhanced blinding protocols (e.g., sham acupuncture controls), stronger allocation concealment, and improved reporting standards to validate and refine these encouraging results.[43–45]

# V. CONCLUSION

The evidence from this review suggests that acupuncture interventions can provide meaningful benefits in addiction treatment, particularly by reducing drug cravings and decreasing anxiety. The forest plots indicate moderate pooled effects, while the funnel plots suggest that craving outcomes are relatively robust, although anxiety outcomes may be influenced by small-study effects or publication bias. Risk-of-bias assessments show generally adequate randomization (89% low risk) but highlight important deficiencies in allocation concealment (89% unclear) and blinding of participants and personnel (67% high risk), which may compromise internal validity for subjective outcomes. Blinding of outcome assessment was also predominantly unclear, as most studies relied on self-reported measures without adequate description of assessor blinding. Despite these limitations, the convergence of favorable findings across multiple trials supports acupuncture as a promising adjunctive treatment within multimodal care for substance use disorders. Future research should prioritize larger, rigorously controlled studies with standardized outcome measures, improved blinding procedures (for example, sham acupuncture controls), stronger allocation concealment, and long-term follow-up in order to reduce bias, clarify sources of heterogeneity, and assess the durability of treatment effects.

Overall, acupuncture appears to offer moderate benefits in alleviating key psychological symptoms of addiction; however, additional high-quality evidence is required before its role in routine clinical practice can be defined with confidence. In particular, these findings reinforce the initial focus of this review on drug craving and

anxiety as primary outcomes of interest, underscoring their relevance as key targets for adjunctive acupuncture within comprehensive SUD care.

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## APPENDICES

**DATA SET of 9 rcts**

| Study Author | Year | Me | Se | Ne | Mc | Sc | Nc | Subgroup | Outcome |
|---|---|---|---|---|---|---|---|---|---|
| Wen et al. | 2021 | 38 | 21.05 | 62 | -2.63 | 18.72 | 61 | BA | VAS |
| Krause et al. | 2020 | 6.7 | 8.02 | 22 | 4.9 | 8.81 | 20 | EA | OCDS |
| Krause et al. | 2020 | 2.1 | 10.37 | 22 | -2.0 | 8.24 | 20 | EA | STAI |
| Chan et al. | 2014 | 36.53 | 31.77 | 30 | 19.84 | 34.17 | 30 | EA | VAS |
| Jing-ping et al. | 2013 | 6.3 | 1.45 | 30 | 4.14 | 2.27 | 30 | EA | VAS |
| Jing-ping et al. | 2013 | 11.21 | 6.47 | 30 | 7.12 | 5.39 | 30 | EA | SAS |
| Chen et al. | 2013 | 6.1 | 11.17 | 25 | 4.7 | 13.02 | 21 | IMEA | CHCS |
| Chen et al. | 2013 | 5.6 | 11.61 | 25 | 1.1 | 13 | 21 | IMEA | STAI |
| Song et al. | 2012 | 9.21 | 10.41 | 35 | 3.01 | 10.80 | 27 | BA | SAS |
| Yan et al. | 2012 | 16.75 | 8.78 | 20 | 9.25 | 10.09 | 20 | BA | HAMA |
| Song et al. | 2010 | 2.14 | 2.29 | 45 | -0.38 | 2.36 | 45 | BA | VAS |
| Song et al. | 2010 | 8.44 | 13.03 | 45 | -6.05 | 11 | 45 | BA | SAS |
| Killeen et al. | 2002 | 0.09 | 0.73 | 15 | -0.02 | 1.28 | 15 | EA | SCA |