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Introduction

Tobacco cessation reveals smoking as the leading **preventable** cause of death and disability (Dai et al., 2021; Glover & McRobbie, 2008; Salahuddin et al., 2012) with nicotine dependence (ND) a highly relapsing chronic disease requiring repeated intervention and multiple attempts to cease smoking (Glover & McRobbie, 2008; Jackson et al., 2015; Johnson, 2011). Nicotine withdrawal syndrome (NWS), ND and tobacco use disorder are mental health diseases (First, 2022; WHO, 2017). 94% of smokers who try to quit smoking in the next 12 months fail, with only 3-6% remain abstinent after six months (Benowitz, 2009; Dai et al., 2024; De Blasi et al., 2014; Jackson et al., 2015; Modir & Muñoz, 2018). This reveals a failure of the current clinical guidelines, 67% of smokers who wish to quit smoking are interested in alternative therapies (Modir & Muñoz, 2018). The World Federation of Acupuncture-Moxibustion Societies (WFAS) recently published Clinical Practice Guidelines for smoking cessation (Chen et al., 2025; Dai et al., 2021; Lee, 2022; Lu et al., 2023; Mi et al., 2025; J.-H. Wang et al., 2019; Zhang et al., 2024). Acupuncture in combination treatment shows promise in recent umbrella reviews (Table 3). The National Acupuncture Detoxication Association (NADA) Acu-Detox Protocol is widely used (25,000 therapists trained in 40 countries) in tobacco cessation despite unsupported evidence reviews, suggesting a disparity between clinical practice, patient experience and research, this conundrum warrants further investigation.

Epidemiology and Aetiology

ND is frequently comorbid with mental illness and other substance use disorders (SUD) (Benowitz, 2009; Glover & McRobbie, 2008; Mi et al., 2025). Smoking is twice as prevalent in those who live with mental illness (e.g. familial or history of major depression; panic disorder, generalized anxiety disorder; ADHD, PTSD) (Johnson, 2011; Kitzman et al., 2023), with smoking linked with 80% of persons who have other SUDs including alcohol abuse (Modir & Muñoz, 2018). Over 60 genes have been identified in candidate gene studies for ND, with estimated inheritability rates ranging from 47-76% for initiation and 62% for persistence (Johnson, 2011).

Nicotine Withdrawal Syndrome

Addiction is a psychobiological disorder (Benowitz, 2009; Johnson, 2011) with cigarette smoking learned and maintained by conditioning. People habitually smoke in specific situations such as: after a meal; with a cup of coffee or alcoholic drink; or with friends who smoke, or when stressed. The association between smoking and these events repeated many times causes the environmental situations to become powerful cues for the urge to smoke (Benowitz, 2009; Glover & McRobbie, 2008; Johnson, 2011; Y.-Y. Wang et al., 2019). Smokers learn to detect internal cues that a negative effect is approaching as drug levels fall within the body. In order to prevent the onset of these negative feelings, the addicted person self-administers the drug, with this process often proceeding without conscious awareness (Johnson, 2011).

NWS is a major cause of the high relapse rate, with quitting is one of the hardest behavioural changes smokers will ever attempt to make (Glover & McRobbie, 2008). Symptoms emerge as blood nicotine levels drop. Reduced levels of nicotine in the brain sets off a domino effect of reduced levels of acetylcholine and neurotransmitters dopamine and serotonin resulting in severe addiction symptoms that can be affective (e.g. anhedonia, dysphoria, anxiety, irritability, depression); somatic (e.g. headaches, increased appetite, decreased metabolic rate, mouth ulcers, nausea, bradycardia, constipation, insomnia, restlessness, tremors, feeling lightheaded); or cognitive (e.g. intense cravings, poor concentration) (De Blasi et al., 2014; Glover & McRobbie, 2008; Jackson et al., 2015; Modir & Muñoz, 2018; Salahuddin et al., 2012).

Pathophysiology of Nicotine Withdrawal Syndrome

Smoking tobacco stimulates the prefrontal cortex and nucleus accumbens reward pathways of the brain (Lu et al., 2009). The dip in activity of reward signals in the brain correlates directly to the craving levels during withdrawal (Modir & Muñoz, 2018). The permanent neuroadaptations that occur from chronic use intensifies withdrawal symptoms and cravings. The relative deficiency of dopamine release following long standing nicotine exposure may account for anhedonia, with tobacco

craving and depression potentially persisting in smokers for many years after they have ceased smoking (Benowitz, 2009).

The neurophysiological withdrawal effects are mediated through nicotinic acetylcholine receptors (nAChRs). Nicotine has multiple mechanisms (excitatory, inhibitory, modulatory) impacting neurotransmitters dopamine, norepinephrine, serotonin, glutamate, GABA, endogenous opioid peptides and cannabionoid-1 receptors (Jackson et al., 2015). Inhaled nicotine is transported to the brain in 10-20 seconds (Klein, 2022) stimulating a rapid increase in dopamine interfering with the dopaminergic reward system in the central nervous system producing pleasurable sensations (Johnson, 2011; White, 2013). The more you smoke, the more nicotine you need to feel good. At high doses, nicotine can block nAChrs, resulting in low blood pressure and changes in the body's capacity to release adrenaline.

Addiction changes the brain, with daily smoking initiating physical changes in brain chemistry and, eventually, structure (Glover & McRobbie, 2008; Y.-Y. Wang et al., 2019). A decrease in neuropeptide Y during nicotine withdrawal is associated with anxiety. Although nicotine's noradrenergic and dopaminergic effects manifest poor attention, impaired information processing, decreased working memory and affective regulation (e.g. impulse control), addiction can be firmly established in the prefrontal cortex. Tolerance and withdrawal symptoms are physiological signs of dependence, with smokers continuing to smoke even when faced with negative consequences and diminished reward. Chronic use of drugs of abuse appears to cause a generalized decrease in dopaminergic neurotransmission and increase in levels of corticotropin-releasing factor associated with the activation of central stress pathways (Johnson, 2011).

Conventional Treatments

Current smoking cessation therapy guidelines recommend a combination of behavioural and pharmacological therapies which reach smoking cessation rates of 5-35% dependent on the commitment to counselling (Benowitz, 2009; Hersi et al., 2024; Johnson, 2011; Mitra et al., 2023; Zhang et al., 2024). The 5A, 5R, PRIME

smoking cessation programs and Quitlines help smokers recognise high risk situations and smoking triggers; and teach behavioural modification such as refusal skills to help them resolve the temptation (Chen et al., 2025; De Blasi et al., 2014; Glover & McRobbie, 2008). Drug treatments such as nicotine replacement therapy (NRT) including Varenicline and Bupropion, have limited use in quitting due to their high cost, side effects and low popularity (Hersi et al., 2024; Zhang et al., 2024). NRTs often cause allergies, skin irritation, dizziness and headaches which contribute to relapse, and may lead to non-ischemic chest pain and palpitations (Benowitz, 2009; Dai et al., 2021; Hersi et al., 2024; Mi et al., 2025; Mitra et al., 2023). Nausea, flatulence and abnormal dreams occur in up to 30% of smokers who take Varenicline, and there are reports of increased depression symptoms, occurrence or increase in suicide ideation and difficulties with coordination (Hersi et al., 2024; Johnson, 2011). Bupropion is an anti-depressant contraindicated for smokers with a history of head trauma, or family or personal history seizure with its adverse effects including the worsening of anxiety, insomnia, dry mouth or tremors, and elevated liver enzyme levels which may accumulate and lead to toxicity (Hersi et al., 2024; Johnson, 2011). NicVax vaccines are undergoing clinical trials to slow entry or prevent nicotine crossing the blood brain barrier (Benowitz, 2009; Johnson, 2011).

Chinese Medicine (CM) Perspective

Lee hypothesised acupuncture normalizes hyper-reactive or hypo-reactive states of the mesolimbic dopamine system in drug addiction, analogous to the Yin and Yang theory of acupuncture (Kitzman et al., 2023). Addiction is recent in CM history developed from the work of Hsiang-Lai Wen, a neurosurgeon in Hong Kong in 1972 who serendipitously discovered that ear acupuncture abated physical withdrawal symptoms from opium (Carter, 2017; Kitzman et al., 2023; Stuyt & Voyles, 2016). From the symptoms and pathophysiology, NWS corresponds with Zangfu patterns e.g. Heart Shen disturbance, Spleen (anxiety, taste), Lungs (smell, Lung Heat), Kidneys (brain, Jing) and Liver (depression, emotional regulation). Inflammation involves internal heat pathologies and habituation as a fixed behaviour may present as Liver Qi, Blood stagnation or Phlegm. Chronic addiction mixes deficiency and excess patterns involving heat clearing and Qi/Yin nourishing treatments. Ear

acupuncture points were described as an acupuncture microsystem in the Ling Shu, curiously, acupuncture's efficacy appears not to be based on point location or TCM differential diagnosis (White, 2013; White et al., 2014).

Acu-Detox Protocol

The WHO (1996) and NIH (1997) have accepted acupuncture as a treatment for drug abuse (Chen et al., 2025; Motlagh et al., 2016). The Acu-Detox protocol is a model of treatment where 3-5 auricular points (Figure 1) are needled within a group therapy setting (Stuyt & Voyles, 2016). Acupuncture can be a useful nonverbal and non-confrontational intervention to help patients be more present and mindful in group therapy (Stuyt, 2014; Stuyt & Voyles, 2016).

Discussion

Current clinical guidelines recommending a combination of behavioural and drug therapies are not achieving desired abstinence rates. Acupuncture is widely used to treat tobacco cessation despite unsupportive reviews (Table 4) (Hersi et al., 2024; White et al., 2014). This is practice based evidence suggesting a disparity between clinical practice, patient experience and research (Carter, 2017; Chang et al., 2013; Stuyt, 2014; Stuyt & Voyles, 2016; White, 2013; Zhang et al., 2025). The findings of the umbrella reviews are limited by the unresolved RCT design challenges of blinding, placebo and sham acupuncture (Liu et al., 2015; Mi et al., 2025; J.-H. Wang et al., 2019). The Acu-Detox protocol as a group therapy makes it impossible to blind practitioners or participants or apply sham acupuncture (Carter, 2017; Stuyt & Voyles, 2016). Pragmatic comparative trials are required where acupuncture plus behavioural and drug treatment for tobacco cessation can be compared to behavioural and drug treatment alone (Carter, 2017; McDonald, 2019; Stuyt & Voyles, 2016; White et al., 2014).

Most participants in the trials were healthy smokers. Future trials could consider the recruitment of smokers with comorbidities of anxiety, depression or PTSD. Bier's trial found acupuncture combination therapy was most effective with the population most

addicted (Bier et al., 2002). The Acu-Detox protocol was more effective with populations often considered to be the most difficult to treat e.g. Stuyt's Acu-Detox intervention with 440 SUD clients with borderline personality disorder undergoing treatment at 'smoke-free' facilities. There was significant improvement in anger, concentration, sleep, energy and pain management, improved tobacco cessation and sobriety for those who received Acu-Detox treatment (Stuyt, 2014; Stuyt & Voyles, 2016).

The dosage and frequency of acupuncture interventions requires further research with tobacco cessation seeming to require frequent (e.g. daily) repetition or continuous stimulation (ear seeds/pellets can be patient stimulated) (White et al., 2014). Comparative studies could explore different behavioural and pharmacological therapy combinations with or without acupuncture.

Most studies measured the 6-month abstinence rate or Fagerstrom test, however, the Acu-Detox protocol has been found to reduce craving and withdrawal symptoms such as anger, anxiety and depression, improving sleep, quality of life and spirituality, - unmeasured in evidence reviews (Carter, 2017; Lu et al., 2023; White, 2013).

Outcome measures such as Cotinine level in serum, urine or saliva (Lu et al., 2023) or tobacco cessation indexes (Minnesota Nicotine Withdrawal Scale (MNWS), Heaviness of Smoking Index (HSI), Questionnaire on Smoking Urges (QSU)) would improve validity and reliability in future trials. The Acu-Detox protocol was found to reduce readmissions into hospital rehabilitation stays, and improve adherence to outpatient programs (Carter, 2017). Only 18% of patients who received Acu-Detox were readmitted compared to 36% of patients who did not receive Acu-Detox in a study of 8011 clients from Boston detoxication program in 1999 (Stuyt & Voyles, 2016).

Mechanisms of Acupuncture

The literature identified novel theories meriting further exploration. Acupuncture therapy may attenuate the taste of tobacco as smokers reported that after

acupuncture, cigarettes tasted worse and that they had a perversion to the smell of tobacco smoke. This sensation-desire-behaviour model warrants further inquiry (Dai et al., 2021; He et al., 2001).

Rat models and fMRI studies have found that acupuncture may modify the nicotine-induced locomotor activity and neural activity in the nucleus accumbens, suppressing the reinforcing effects of nicotine by modulating mesolimbic dopamine neurons, serotonin, opioid and amino acids (including GABA) to relieve withdrawal symptoms or suppress the craving for cigarettes (Lee, 2022; Lu et al., 2023; White, 2013; Zhang et al., 2024), in addition, opioid release stimulated by acupuncture may help restore the release of dopamine (Motlagh et al., 2016; White et al., 2014).

Conclusions

Tobacco smoking is a significant global public health concern killing 8 million people every year worldwide (Glover & McRobbie, 2008; He et al., 2001; Zhang et al., 2024) with around 900,000 deaths occuring in non-smokers exposed to secondhand smoke (J.-H. Wang et al., 2019). Qualitative research is warranted with patients to explore why the current guidelines of combination treatment are not effective and explore the disparities between clinicians, patients and researchers in acupuncture trials. Future acupuncture trials should follow the STRICTA guidelines to improve design quality. The widespread use of the Acu-Detox protocol opens possibilities of multi-centre trials with different patient cohorts across 40 countries for acupuncture combination treatments. Acupuncture without Borders uses the Acu-Detox protocol as a stress reduction treatment for PTSD in disaster zones, operating in the aftermath of 9/11, Hurricane Katrina, in refugee camps and prisons (Stuyt & Voyles, 2016).

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Appendices

Table 1: Abbreviations

Acronym	Definition
Acu-Detox	Formerly known as the NADA Protocol
ADHD	Attention Deficit Hyperactivity Disorder
BPD	Borderline Personality Disorder
DCM5	American Diagnostic and Statistical Manual of Mental Disorders 5th Edition
FTND	Fagerstrom test
GABA	Gamma-aminobutyric acid
HSI	Heaviness of Smoking Index
ICD-10	WHO International Classification of Disease 10th Edition
MNWS	Minnesota Nicotine Withdrawal Scale
nAChRs	Nicotinic acetylcholine receptors
NADA	National Acupuncture Detoxication Association
ND	Nicotine Dependency
NIH	American National Institutes of Health
NRT	Nicotine Replacement Therapies
NWS	Nicotine withdrawal syndrome
PTSD	Post Traumatic Stress Disorder
QSU	Questionnaire on smoking urges
RCTs	Randomised Control Trials
STRICTA	Standards for Reporting Interventions in Controlled Trials of Acupuncture
SUD	Substance Use Disorder
T/CM	Traditional/Chinese Medicine
TUD	Tobacco Use Disorder
WFAS	World Federation of Acupuncture-Moxibustion Societies
WHO	World Health Organisation

Table 2: Literature Search Terms

Literature search terms
Cochrane Review, systematic review, meta-analys* nicotine dependence + acup*, ear, auricul*, TCM, English language only
nicotine dependence, tobacco cessation, tobacco use disorder, nicotine withdrawal, nicotine addiction
Acup*, Auricul*, Electro-acupuncture, Laser Acupuncture
Excluded: study protocols, animal studies, SR-MAs before 2015

Table 3: Umbrella Reviews

Lead Author	Hersi	Zhang	Lu
Year	2024	2024	2023
Reviews or RCTs	22 Cochrane reviews, 131 analyses	20 RCTs	88 RCTs
Participants	1120 to 4.5M	3532	12434
Databases	Medline, Embase, PsycINFO, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects, CADTH Health Technology Assessment Database	PubMed, Cochrane Library, EMBASE, Web of Science, CNKI, VIP, Sino-Med, Wanfang	CNKI, Wanfang, CQVIP, SINOMED, PubMed, Embase, Cochrane Library

Figure 1: Acu-Detox Protocol

3-5 auricular points: Sympathetic, Shen Men, Kidney, Liver, Lung applied using ear seeds, Pyronex, pellets, filiform needle, or electro-acupuncture

Table 4: Reviews not supportive of acupuncture

Study	*Year*	*Findings not supportive*
Mi	2025	No significant difference between AART and NRT (Mi et al., 2025)
Hersi	2024	Acupuncture has low quality evidence (Hersi et al., 2024)
Zhang	2024	Filiform acupuncture less effective than NRT in achieving short-term cessation (Zhang et al., 2024)
Wang	2019	No statistical significant difference between acupuncture and NRT in abstinence rate, NWS score, Fagerstrom test, HSI, or QSU-Brief scores and less effective as a monotherapy than combined with counselling (J.-H. Wang et al., 2019)
White	2014	Cochrane Review: no consistent, bias-free evidence that acupuncture has a long-term benefit on cessation (White et al., 2014) Acupuncture less effective than NRT, and not shown to be better than counselling
Yeh	2009	Acupuncture at HT7, LU, ST, mouth, endocrine, Tee Mee for 20 mins for 6 weeks showed no significant effect on quitting smoking