

Analysing the Use of Acupuncture in Smoking Cessation

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Abstract

With an increasing population experiencing tobacco dependence, an enormous public health medical cost has been induced due to first-hand, second-hand, and third-hand smoking. A variety of instruments are available to aid in smoking cessation, including standard and adjunct therapies, for which acupuncture constitutes a safe and economic measure. Offering an overview of this traditional Chinese medicine practice, this literature review analyses 27 clinical studies, covering 15,794 participants aged 15-84 years old from Africa, Asia, Europe and North America. The outcomes reveal the effectiveness of acupuncture in minimising cigarette cravings, tobacco consumption, and nicotine dependence, through either a single employment of this method or a combined treatment method. Suggestions for research and practical implications to improve the usefulness of acupuncture in dealing with smoking-related health are given.

Keywords

Cigarette • Complementary and alternative therapy • Nicotine • Traditional Chinese medicine • Tobacco control

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Smoking is the leading cause of preventable mortality (Reitsma et al., 2017), is particularly prevalent in low- and middle-income countries (Britton, 2017), incurs more than 10% of deaths worldwide and attracts over 6 million new smokers annually (World Health Organisation [WHO], 2015). Misunderstandings related to smoking's being perceived as a method of alleviating negative emotions (Ceballos, Wiese, & Hovland, 2009) are a likely cause for increase in the smoking population to exceed 1.1 billion smokers (WHO, 2017). Even worse, direct-to-consumer tobacco marketing (Soneji, Ambrose, Lee, Sargent, & Tanski, 2014) increases the prevalence of cigarette use among teenagers (Hebb, 2014) and pregnant adolescents (Oh, Gonzalez, Salas-Wright, Vaughn, & DiNitto, 2017; Reitan & Callinan, 2017). Prenatal smoking raises the risks of lower birth weight (Talati, Wickramaratne, Wesselhoeft, & Weissman, 2017) and infant behavioural disorders (Talati, Odgerel, Wickramaratne, & Weissman, 2016).

Nicotine consumption is also hazardous to non-smokers through second-hand and third-hand smoking. Referring to involuntary or passive smoking and nicotine exposure, either in private or public places, the former deteriorates health, resulting in cardiovascular diseases (Barnoya & Glantz, 2005), especially among young individuals (Wolfson, McCoy, & Sutfin, 2009). The latter refers to the "residual tobacco smoke that sorbs to indoor surfaces and remains after the majority of the airborne components of the smoke have cleared" (Bahl, Jacob III, Havel, Schick, & Talbot, 2015, p. 1) which may harm children (Burton, 2011) and cause genetic damage (Tuma, 2010). These escalate what WHO calls the "costs of smoking" (WHO, 2011, p. 14).

Cigarette use decreases global brain activity (Brody, 2006), devastates oral health (Liu, Roosaar, Axéll, & Ye, 2016), and induces physical illnesses, including cardiovascular (Schane, Ling, & Glantz, 2010) and pancreas diseases (Nakagawa et al., 2017). This recurrently produces comorbidity with mental illnesses (Lasser et al., 2000; Prochaska, 2011), manifesting in the form of depression (Munafò & Araya, 2010) and anxiety (Dean et al., 2010), due to irritating neurotransmitters such as norepinephrine and serotonin (Allen, Sacco, Weinberger, & George, 2006). Meanwhile, nicotine detrimentally impacts antidepressants (Oliveira, Ribeiro, Donato, & Madeira, 2017), entailing a double-detriment for smokers with mental disorders. Thus, smoking-generated illnesses occupy 1.5%-6.8% of medical expenses (Rezaei, Sari, Arab, Majdzadeh, & Poorasl, 2016), while non-smoking-effectuated costs amount to US\$151 billion (Ekpu & Brown, 2015), producing a huge public health problem.

Governments undertake tobacco control strategies (Pierce, White, & Emery, 2012) that include taxation policies (Chaloupka, Yurekli, & Fong, 2012), health (Collin, 2012) and environmental policies (McNabola & Gil, 2009) and legislation (Chauhan & Setia, 2016; Gruber, 2002). These strategies yield benefits in reducing cigarette sales (Hu, Sung, Keeler, & Marciniak, 2000), lowering the risks of nicotine-related diseases at

any age (Blomster et al., 2016; Gometz, 2011), decreases the harm caused to gestational age infants by pregnant smokers (Kvalvik et al., 2017) and even lowering the chance of death if individuals quit smoking before 40 years of age (Jha et al., 2013). Even though most smokers understand the harms of nicotine and the advantages of tobacco control, successful attempts at quitting are less than 10% (Jain, 2003).

A variety of treatments have been provided, including psychopharmacological measures (Gawali & Vaidya, 2012), among which nicotine replacement therapy (NRT) (Flowers, 2016) has been widely employed to deal with nicotine dependence and nicotine withdrawal symptoms (Wadgave & Nagesh, 2016). Therefore, relevant products (Okoli, Mason, Brumley-Shelton, & Robertson, 2017; Tønnesen, 2015) are available in the market, such as nicotine patches and nasal sprays that, while being efficient (Cepeda-Benito, Reynoso, & Erath, 2004), entail side effects (Mills, Wu, Lockhart, Wilson, & Ebber, 2010). For example, dose-related weight gain (Gross, Johnson, Sigler, & Stitzer, 1995; Jessen, Toubro, & Astrup, 2003) and addiction (Etter, 2007) may result from nicotine gum use, while toxicants in electronic cigarettes increase risks to both ex-smokers and non-smokers (Pisinger, 2015) and produce environmental harm (Callahan-Lyon, 2014). In addition to these, behavioural training (Busch et al., 2017; Grossman, Donaldson, Belton, & Oliver, 2008) offers appealing positive indicators to overcoming tobacco (Selvamary, Narayanan, Doss, & Kumar, 2016), and is effective (Guimaraes et al., 2014). Complementary and alternative therapies (Muramoto, Matthews, Ritenbaugh, & Nichter, 2015), such as green tea (Azimi et al., 2017), Chinese herbs (Klink, Lin, Elkin, Strigenz, & Liu, 2011) and acupuncture (Cowie et al., 2013), may also be helpful in the smoking cessation process.

Acupuncture, a traditional Chinese medical practice, has been used for over three millennia, as documented in ancient Chinese medicinal scripts (Liang et al., 2013) such as the A-B Classic of Acupuncture and Moxibustion (Li & Zhang, 2015). Slender needles are inserted to (Hicks, 2005) a depth of 4-25mm at 6-12 out of 361 acupoints (specific stimulation points) in 14 meridians (Lee, LaRicca, & Newberg, 2004) along the body that connect to corresponding organs (Zeng, Salvage, & Jenner, 2013) ranging from a few seconds to a few minutes in order to reactivate or restore *qi* (energy) (Field, 2009) for curing and preventing illnesses (Motl, 2002), resulting in a balanced health state and longevity (Kaptchuk, 2002). It can impel nerve endings and invoke brain activity (White & Ernst, 2004). Hence, it has already been utilised in Western medical applications as an adjunct therapy (MacPherson & Thomas, 2007), with research evidence dating from the 1970s (Zhuang, Xing, Li, Zeng, & Liang, 2013). It was initially adopted to treat pain in the USA (Barnett, Shale, Elkins, & Fisher, 2014) because it is particularly striking for analgesia (Kong, Schnyer, Johnson, & Mackey, 2013) and has also demonstrated potency towards different diseases, including stroke (Li & Wang, 2013), obesity (Belivani et al., 2013; Cheng, 2018a),

dementia (Cheng, 2018b), Parkinson's disease (Cheng, 2017b), autism (Cheng, 2017a) and drug addiction (Cui, Wu, & Li, 2013). This method has been observed to be safe (Vincent, 2001) with minimal side effects (Tan, Molassiotis, Wang, & Suen, 2014) in the hands of trained acupuncturists, even for children (Yang, Hao, Zhang, & Guo, 2015), and is also cost-effective (Kim, Lee, Chae, Park, & Lee, 2012).

Additionally, ear (or auricular) acupuncture is often adopted to stimulate acupoints along the ear, reflecting the existing networks between bodily functions in this microsystem (Round, Litscher, & Bahr, 2013) and has also displayed its effectiveness in various interventions such as weight control (Ito, Yamada, Kira, Tanaka, & Matsuoka, 2015) and anxiety (Klausenitz et al., 2016). Tongue acupuncture applies this technique to tongue acupoints to enhance blood circulation and energy flow throughout the body (Shi et al., 2014) for various disorders such as burning mouth syndrome (Scardina, Ruggieri, Provenzano, & Messina, 2010), post-stroke dysphagia (Cai, Ma, Gao, & Gao, 2015) and autism (Wong, Sun, & Yeung, 2014).

Aside from traditional application, technology has been introduced to the practice of acupuncture, including the use of electricity and light. Electro-acupuncture (Lin & Chen, 2012) enhances the stimulation of acupoints through electronic connections to the needles (Mayor, 2007), for a spectrum of diseases such as facial paralysis (Liu, He et al., 2015), and knee pain (Mata et al., 2015). Laser acupuncture (Quah-Smith, Sachdev, Wen, Chen, & Williams, 2010) is acupoint stimulation by laser beam, an electromagnetic wave, without harmful heat to produce physiological benefits (Wu, Kuo, Hung, & Hu, 2016), including neonatal abstinence syndrome (Raith et al., 2015) and sciatica (Liu, Wu, Hung, Lin, & Hu, 2014).

Practiced by either inserting off-of-target acupoints or at an incorrect depth, the effectiveness of sham acupuncture, a placebo or a fake intervention (Lopes-Júnior et al., 2016), is debatable. In comparison with genuine acupuncture, some studies show that it works (Zotelli, Grillo, & da Luz Rosario de Sousa, 2016) while others indicate that opposite (Kong, Spaeth, et al., 2013).

Acupuncture is always partnered with other traditional Chinese approaches, such as moxibustion (Matsumoto, Ishizaki, Namura, Yamamura, & Yano, 2008) and massage. A stick of burning moxa wool used to stimulate acupoints (Deng & Shen, 2013), moxibustion is a safe and effective method (Xu, Deng, & Shen, 2014) to improve autonomic nervous system activity (Zhao et al., 2011) that enhances health, in cases of fatigue (Shu et al., 2016). Acupoint massage improves illnesses, including stress (Lee, 2016), sleep quality (Yue, Cao, Zhou, & Xu, 2016), and hypertension (Guo, Fu, Jiang, & Xu, 2015).

Despite limited evidence concerning the effects of acupuncture on nicotine withdrawal (Balbani & Montovani, 2005; Napierkowski, 2012; White, Rampes, Liu, Stead, &

Campbell, 2011), this use of acupuncture in the USA began in the late 1980s (Dharmananda, 1999). A series of relevant research (Feng & Chen, 2010) testifies to possible increases in serotonin, a chemical controlling nicotine, in the brain tissue and plasma (Cabioglu, Ergene, & Tan, 2007). This literature review analyses the available empirical studies on this issue, offering an overview of its effectiveness in quitting cigarettes, and subsequently suggests how acupuncture can better contribute to smoking cessation.

Research Method

The acquisition strategy of this review searched 27 major digital databases in ProQuest (a crucial electronic source), including the British Nursing Index, MEDLINE, PsycARTICLES, PsycINFO, and two Chinese databases: the China National Knowledge Infrastructure (CNKI) and Taiwan Electronic Periodical Services (TEPS), which consist of prominent Chinese academic journals. The samples came from the keywords *acupuncture* and *smoking* OR *tobacco* OR *cigarette* OR *nicotine*, which resulted 23 papers and from the keywords “針灸” and “戒煙” in the Chinese databases, which resulted 86 papers.

Following the selection criteria, twenty-seven works (n=15 in English, n=12 in Chinese) published prior to 2017 were reviewed. The inclusion criteria included: (i) acupuncture-led projects, (ii) peer-reviewed and scholarly journals (including Online First publications), and (iii) clinical studies (quantitative, qualitative, mixed research). The exclusion criteria ruled out duplications, literature reviews, book reviews, dissertations, editorials and commentaries.

Findings and Discussion

The 27 reviewed projects (Table 1) published from 1985-2016 were carried out in mainland China (n=6), Hong Kong (n=4), Korea (n=3), the UK (n=3), the USA (n=3), France (n=2), Austria (n=1), Morocco (n=1), Norway (n=1), Singapore (n=1), Switzerland (n=1) and Taiwan (n=1) and involved a total of 15,794 participants aged 15-84, with more than 8,261 males and 3,907 females (two projects failed to report sex ratios). Most of these projects were conducted in the form of either 30-minute (n=10) or 20-minute sessions (n=5) that totalled of 6 sessions (n=3), 5 sessions (n=2), or 10 sessions (n=2), along with 13 follow-up studies ranging from one month to five years.

Table 1
Analysis of the 27 Reviewed Studies

Source	Research objective(s)	Method design			Results	Research location
		Sample size	Data collection	Intervention		
Liu, Fang, et al. (2016)	To investigate the immediate effects and central mechanism of acupuncture on smoking.	40 participants (n=37 male, n=3 female), aged 18-70.	Functional magnetic resonance imaging (fMRI), Minnesota Nicotine Withdrawal Scale (MNWS), Questionnaire of Smoking Urges (QSU-Brief).	Assigned to smoking (n=20; n=19 male, n=1 female), and non-smoking (n=20; n=18 male, n=2 female) groups. 30-minute sessions, unspecified number of total sessions.	Acupuncture could reduce the cravings for smoking, which was likely to be related with regulating 'prefrontal cortex-anterior cingulate' circuit and improving the activity of cerebellum and visual cortex, achieving the aim of smoking abstinence.	China.
Liu, Yang, et al. (2016)	To examine the effects of acupuncture on smoking cessation.	4,480 smokers (n=2,923 male, n=1,557 female), aged 18-75.	Fagerstrom Test for Nicotine Dependence (FTND). Measurements at the 8 th , 26 th , and 52 nd weeks.	20-minute sessions, 8 weeks; unspecified total number of sessions.	Abstinence rate: 36.9% at Week 8, 22.2% at Week 26, and 18.8% at Week 52.	Hong Kong.
Wang, Liu, Zhang, et al. (2016)	To examine the effects of acupuncture and psychological treatment on smoking cessation.	2,051 smokers (n=1,368 male, n=683 female), aged 18-75.	Fagerstrom Test for Nicotine Dependence. Measurements at 8 th , 26 th , and 52 nd weeks.	20-minute sessions, 6 sessions a month, 8 months, total of 48 sessions. Psychological treatment: 10-minute sessions, total of 48 sessions.	The effectiveness of acupuncture-smoking cessation was most significant in the smokers over 60. The effects depended on age, gender, educational background and the level of tobacco dependence.	Hong Kong.
Wang, Liu, Wu, et al. (2016)	To investigate the effects of acupuncture on quitting tobacco.	2,940 smokers, aged 18-72. Unspecified sex ratio.	A prospective multicenter observational study. Measurements at the 1 st , 2 nd , 8 th , 26 th , and 52 nd weeks. Follow-up after 10 months.	30-minute sessions, 2 sessions per week, total of 16 sessions in 8 weeks; follow-up on the 9 th -52 nd weeks. Ear and body acupuncture, and electroacupuncture.	Abstinence rate: 34% at Week 8 and 18.4% at Week 52.	Hong Kong.
Liu, Yang, et al. (2015)	To evaluate the effects of acupuncture on smoking cessation.	2,051 smokers (n=1,368 male, n=683 female). Unspecified age range.	Measurements at 1 st and 52 nd weeks after treatment. Fagerstrom test for nicotine dependence.	20-minute session, 3 sessions a week, total of 24 sessions in 8 weeks.	Abstinence rate at 1-week follow-up: 33.54%. Abstinence rate at 52-week follow-up: 16.97%.	Hong Kong.

Table 1
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Source	Research objective(s)	Method design			Results	Research location
		Sample size	Data collection	Intervention		
Ma and Xue (2014)	To compare the effects of acupuncture and sham acupuncture on smoking cessation. To examine the changes of sialic acid and C-reactive proteins after treatments.	110 smokers (n=91 male, n=19 female), aged 37-45.	Tests for sialic acid and C-reactive protein.	Randomly allocated to acupuncture (n=68) and sham acupuncture (n=68) groups. 8 weeks, unspecified session duration and number of total sessions.	Abstinence rate: 34% in acupuncture group, 13% in sham acupuncture group. Significant reductions in sialic acid and C-reactive protein in acupuncture group; and no significant reductions in sialic acid and C-reactive protein in sham acupuncture group.	China.
Chang et al. (2013)	To compare the effects of acupuncture, nicotine replacement therapy, and counselling on smoking cessation.	169 smokers (n=149 male, n=20 female). Unspecified age range.	Measurements: at follow-up 1-week, 1-month, 3-month, and 6-month. Unspecified assessment tools.	Allocated to acupuncture (n=68; n=59 male, n=9 female), nicotine replacement therapy (n=13; n=10 male, n=3 female), and acupuncture with nicotine replacement therapy (n=88; n=80 male, n=8 female) groups. 30-minute sessions, unspecified number of total sessions.	Abstinence rate at 6-month follow-up: 29% in acupuncture group, 0% in nicotine replacement therapy group, 38% in acupuncture with nicotine replacement therapy group.	USA.
Kang et al. (2013)	To compare the effects of acupuncture and sham acupuncture on reducing cravings for smoking-related visual cues. To look into the neural mechanisms of acupuncture effects on smoking cessation.	25 male smokers. Unspecified age range.	Fagerstrom test for nicotine dependence, questionnaire on smoking urges-brief (QSU-Brief), fMRI.	Randomly distributed to acupuncture (n=12) and sham acupuncture (n=13) groups. 6-minute sessions, total of 2 sessions.	Acupuncture alleviates cue-induced cravings during the initial abstinence phase of smoking cessation. The regulatory actions of acupuncture treatment are associated with the following brain areas: the mPFC, the premotor cortex, the amygdala, the hippocampus, and the medial thalamus.	Korea.
Wang and Song (2013)	To compare the effects of acupuncture and combined treatment on smoking cessation.	60 smokers (n=31 male, n=29 female), aged 39-55.	Unspecified.	Randomly assigned to acupuncture (n=30; n=16 male, n=14 female; aged 39-55) and acupuncture with the moxibustion (n=30; n=15 male, n=15 female; aged 40-55) groups. Acupuncture: 30-minute sessions, total of 30 sessions. Moxibustion: 14-minute sessions, total of 30 sessions.	Abstinence rate: 73.3% in acupuncture group, 93.3% in acupuncture with the moxibustion group.	China.

Table 1
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Source	Method design				Results	Research location
	Research objective(s)	Sample size	Data collection	Intervention		
Luo, Gao, Fan, Yang, and Liang (2011)	To examine the effects of acupuncture on smoking cessation.	32 smokers (n=27 male, n=5 female), aged 17-60.	Unspecified.	30-minute sessions, total of 15 sessions.	Abstinence rate: 43.7%. Smoking reduction: 46.9%.	China.
Song (2010)	To investigate the effects of acupuncture, massage, and psychoeducation on smoking cessation.	90 smokers (n=42 male, n=48 female), aged 20-65.	Unspecified.	Acupuncture: 30-minute sessions, total of 8 sessions. Massage: 15-minute sessions, unspecified number of total sessions.	Abstinence rate: 82.2%. Smoking reduction: 10%.	UK.
Kerr, Lowe, and Spielholz (2008)	To examine the effects of low level laser stimulation to ear and body acupuncture on smoking cessation.	340 smokers (n=192 male, n=148 female). Unspecified age range.	A double-blind, randomised controlled trial and semi-structured interviews. Unspecified measurements.	Randomly assigned to groups A, B, and C. Group A (n=121): laser acupuncture on days 1, 3 and 7 of the programme and one sham treatment on day 14. Group B (n=130): laser acupuncture on days 1, 3, 7 and 14. Group C (n=89): sham acupuncture on days 1, 3, 7 and 14. 14-minute sessions, total of 4 sessions.	All 3 groups experienced significant withdrawal symptoms. Members of groups A and B achieved a higher rate of non smoking than those of Group C. Group B (4 acupuncture treatments) was more effective than Group A (4 acupuncture and 1 sham acupuncture treatments).	UK.
Wu, Chen, Liu, Lin, and Hwang (2007)	To compare the effects via ear acupuncture and sham acupuncture of ear acupuncture on smoking cessation.	118 smokers (n=100 male, n=18 female). Unspecified age range.	A prospective, randomised, controlled trial. Block randomisation method. Follow-up after 6 months.	Randomly located to treatment (ear acupuncture) (n=59; n=48 male, n=11 female), and control (sham acupuncture) (n=59; n=52 male, n=7 female) groups. 8 weeks, unspecified session duration and number of total sessions.	Both groups showed a significant decrease in tobacco consumption: after interventions, 27.1% in treatment group, and 20.3% in control group, while during the follow-up, this decrease was 16.6% in the treatment group and 12.1% in the control group. The treatment group experienced a significant decrease in nicotine withdrawal symptoms. No major side effects.	Taiwan.

Table 1
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Source	Research objective(s)	Method design			Results	Research location
		Sample size	Data collection	Intervention		
Kang, Shim, Kim, and Youn (2005)	To assess the effects of ear acupuncture on tobacco consumption. high schools, aged 15-19.	238 male smokers in 2 high schools, aged 15-19.	CAGE score, Fagerstrom Tolerance Questionnaire score (FTQ).	Divided into Groups A (n=159) and B (n=79) for different ear acupoints. 4 weeks, unspecified session duration and number of total sessions.	Abstinence rate: 0.6% in Group A, and 0% in Group B. The change in the taste of tobacco and the intensity of the desire to smoke were not significantly different between the two groups, but members of Group A showed a greater tendency towards reduction in attributing a positive taste to tobacco and in the intensity of their desire to smoke. However, there was a significant tendency in terms of reduced cigarette consumption, positive taste attributed to tobacco and the intensity of the desire to smoke in the case group, indicating that auricular acupuncture in smoking cessation has some effect.	Korea.
Park et al. (2005)	To examine the role of <i>DRD2 Taq1 A</i> polymorphism related to the effects of acupuncture on smoking cessation.	231 male smokers. Unspecified age range.	Genetic analysis.	96-second sessions, total of 3 sessions.	Great association of <i>DRD2 Taq1 A</i> polymorphism with the effects of acupuncture on smoking cessation.	Korea.
Gao (2004)	To examine the effects of acupuncture on smoking cessation.	20 smokers (n=5 male, n=15 female), aged 27-57.	Unspecified.	30-minute sessions, total of 5 sessions in 2 weeks.	Abstinence rate: 90%.	Austria.

Table 1
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Source	Method design				Results	Research location
	Research objective(s)	Sample size	Data collection	Intervention		
Bier, Wilson, and Shakleton (2002)	To compare the effects of acupuncture and education on smoking cessation.	141 smokers (n=70 male, n=71 female), aged 26-81.	A quasi-factorial design. Beck Depression Inventory, Zung Self-Rating Anxiety Scale, visual analogue scale (VAS) score. Measurements at 3 rd , 6 th , 12 th , 15 th , and 18 th months.	Randomly assigned to acupuncture (n=38), acupuncture with 5-week education (n=45), and sham acupuncture with 5-week education (n=58) groups. 30-minute sessions, 5 sessions per week, total of 20 sessions.	Abstinence rate: 10% in acupuncture group, 40% in acupuncture with 5-week education group, and 22% in sham acupuncture with 5-week education group. Smoking decrease rate: 49% in acupuncture group, 53% in acupuncture with 5-week education group, and 40% in sham acupuncture with 5-week education group.	USA.
Wu (2002)	To investigate the effects of acupuncture and ear acupuncture on smoking cessation.	78 smokers (n=29 male, n=49 female), aged 20-68.	Unspecified.	20-minute sessions, 2 sessions per week, total of 10 sessions.	Abstinence rate at the 18 th month: 20% in acupuncture group, 40% in acupuncture with 5-week education group, and 22% in sham acupuncture with 5-week education group. Smoking decrease rate at the 18 th month: 20% in acupuncture group, 52% in acupuncture with 5-week education group, and 31% in sham acupuncture with 5-week education group.	Switzerland.

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Source	Research objective(s)	Method design			Results	Research location
		Sample size	Data collection	Intervention		
He, Medbo, and Høstmark (2001)	To examine the long-term effects of ear acupuncture on cigarette consumption.	44 smokers (n=16 male, n=28 female); 38 at the 8 th month follow-up (n=14 male, n=24 female); 33 at the 5 th year follow-up (n=11 male, n=22 female). Unspecified age range.	Measurements: post-test, 8 th month, 5 th year.	Randomly divided to acupuncture and sham acupuncture groups. 2 sessions per week, for 3 weeks, total of 6 sessions.	Abstinence rate: 75% in acupuncture group, 39% in sham acupuncture group. Abstinence rate after the 8 th month: 44% in acupuncture group, 35% in sham acupuncture group. Abstinence rate after the 5 th year: 28% in acupuncture group, 14% in sham acupuncture group.	Norway.
Lian (2000)	To test the effects of acupuncture on smoking cessation.	186 smokers (n=180 male, n=6 female), aged 18-84.	Unspecified.	15-20 minutes per session, total of 5 sessions.	Abstinence rate: 77.2%.	China.
Luo and Sun (1999)	To test the effects of acupuncture on smoking cessation.	52 smokers (n=17 male, n=35 female), aged 19-72.	Unspecified.	30-minute sessions, total of 10 sessions.	Abstinence rate: 93.5%.	China.
Waite and Clough (1998)	To test the effects of ear acupuncture on smoking cessation.	78 smokers (n=43 male, n=35 female), aged 23-69.	A single-blind, randomised placebo-controlled trial. Fagerstrom Tolerance Questionnaire score. Measurement at 6 months after treatment.	Randomly assigned to treatment (n=40; n=22 male, n=18 female; aged 24-67) and placebo (n=38; n=21 male, n=17 female; aged 23-69) groups. 20-minute sessions, unspecified number of total sessions. Cow seed plaster for 2 weeks.	Abstinence rate: 12.5% in treatment group, 0% in placebo group.	UK.

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Analysis of the 27 Reviewed Studies

Source	Method design				Results	Research location
	Research objective(s)	Sample size	Data collection	Intervention		
Clavel-Chapelon, Paoletti, and Benhamou (1997)	To compare the effects of acupuncture and gum on smoking cessation.	996 smokers (n=548 male, n=448 female). Unspecified age range.	A randomised controlled trial. Follow-up at the 4 th year.	Randomly distributed to active acupuncture and gum (n=268), placebo acupuncture and active gum (n=213), active acupuncture and placebo gum (n=272), and total placebo (n=243) groups. Unspecified session duration and total number of sessions.	Abstinence rate at 1 month: 26.5% in active acupuncture and gum group, 25.8% in placebo acupuncture and active gum group, 17.7% in active acupuncture and placebo gum group, 20.6% in total placebo group. Abstinence rate at 1 year: 11.2% in active acupuncture and gum group, 10.9% in placebo acupuncture and active gum group, 6.5% in active acupuncture and placebo gum group, 10.3% in total placebo group.	France.
Xu (1997)	To test the effects of acupuncture on smoking cessation.	51 smokers (n=17 male, n=34 female), aged 19-55.	Measurements at pre-test and the 6 th month.	25-minute sessions, unspecified number of total sessions. Ear acupuncture: 6 sessions.	Abstinence rate at 4 years: 6.1% in active acupuncture and gum group, 6.2% in placebo acupuncture and active gum group, 5.1% in active acupuncture and placebo gum group, 7.3% in total placebo group. Abstinence rate: 100% after treatment, and 66.7% at follow-up period. Smoking reduction: 17.6% at follow-up period.	USA.
Lu (1996)	To look into the effects of acupuncture and ear acupuncture on smoking cessation.	42 smokers (n=34 male, n=8 female), aged 24-70.	Unspecified.	Acupuncture: 45-minute sessions, total of 2-10 sessions. Ear acupuncture: 3-5 10-minute daily sessions, total of 2-10 sessions.	Abstinence rate: 80.9%. Smoking reduction: 19%.	Morocco.

Table 1
Analysis of the 27 Reviewed Studies

Source	Research objective(s)	Method design			Research location
		Sample size	Data collection	Intervention	
Tan, Sin, and Huang (1987)	To examine the effects of laser acupuncture at 2.5, 3mW with different durations on reducing cigarette consumption.	480 male smokers, aged 30-50.	Unspecified.	Laser acupuncture: 1-3 minutes per session, total of 6 sessions in 3 weeks.	Overall success rate: 80%. Singapore.
Clavel, Benhamou, Company-Huertas, and Flamant (1985)	To compare the effects of acupuncture and gum on smoking cessation.	651 smokers. Unspecified sex ratio and age range.	A randomised controlled trial. Measurements at pre-test and 13th month.	Randomly located to acupuncture (n=224), gum (n=205), and control (n=222) groups. 30-minute sessions, unspecified number of total sessions. Nicotine gum: total of 150 pieces. All groups joined 3 1-hour group therapy sessions in the 1st month.	Abstinence rate: 19% in acupuncture group, 22% in gum group, 8% in control group. Abstinence rate at the 13 th month: 8% in acupuncture group, 12% in gum group, 3% in control group. France.

This review lists the results of nicotine consumption management techniques using different methods of acupuncture, discusses the mechanism and evaluates combined treatment and comparison studies.

Recently, one study detailed the effectiveness of using acupuncture against tobacco dependency with 4,480 smokers, aged 18-75 years, all of whom received 20-minute sessions over eight weeks (Liu, Yang et al., 2016) and attended follow-up evaluation sessions at the 8th, 26th and 52nd weeks with abstinence rates of 36.9%, 22.2% and 18.8% respectively. Comparable results with another 2,051 participants who completed 24 20-minute sessions reported abstinence rates of 33.5% at the 1st post-treatment week and 16.9% at the 52nd week (Liu, Yang et al., 2015). One small project with 32 smokers aged 17-60 years uncovered an abstinence rate of 43.7% and a reduction rate of 46.9% (Luo et al., 2011). Earlier studies supported these findings with better abstinence rates, namely at 93.5% (Luo & Sun, 1999), 90% (Gao, 2004), 80.9% (Lu, 1996), 80% (Tan et al., 1987) and 77.2% (Lian, 2000).

In addition, ear acupuncture is frequently applied to smoking cessation since it is able to increase endorphins, as they manage nicotine dependence (Xu, Feng, Zhang, & Ma, 2015). Seventy-eight participants finished 10 20-minute sessions, showing a 48.7% abstinence rate and a 51.3% smoking reduction rate (Wu, 2002). Similar outcomes were supported by other studies, namely Waite and Clough (1998) and Xu (1997). Dissimilar to these, Kang et al. (2005) denied the usefulness of acupuncture in tobacco control following a study of 238 15-19 years old male smokers in high schools, who completed treatment sessions spanning four weeks at different ear acupoints. Despite a rather low abstinence rate participants reported a reduction in cigarette consumption, in their attributing a positive taste to tobacco and in the intensity of their desire to smoke. However, the researchers admitted that the low success rate was possibly connected to low motivation and involuntary participation by students due to their being referred to the study by their teachers.

Mechanism of Acupuncture in Treating Smoking

Nicotine dependency is caused by multiple factors (Cornuz & Willi, 2008). A craving for smoking and a related impulsivity connect to the brain (Potvin, Tikász, Dinh-Williams, Bourque, & Mendrek, 2015) and nervous activity of the dorsolateral superior frontal gyrus, anterior cingulate cortex and medial frontal gyrus, the latter affecting cognitive control over addictive behaviour (Ding et al., 2014; Keihani et al., 2017; Yamamoto, Woo, Wager, Regner, & Tanabe, 2015), and cigarette consumption (Galván et al., 2013; Janes, Farmer, Peechatka, de B. Frederick, & Lukas, 2015; Liu, Claus, Calhoun, & Hutchison, 2014). One recent research project assigned 20 smokers and 20 non-smokers to two groups where they received 30-minute sessions of manual and electro-acupuncture (Liu, Fang et al., 2016). The results illustrated the

effect of acupuncture on participants' reducing cravings to smoke. This reduction was possibly the result of increased regulation in the prefrontal cortex-anterior cingulate circuit, as a disrupted prefrontal cortex is associated with addiction (Goldstein & Volkow, 2011). Nevertheless, the sample size was too small to generalise.

One pilot study in which 25 male smokers were randomly distributed into acupuncture (n=12) and sham acupuncture (n=13) groups examined the neural mechanisms generated by acupuncture for smoking cessation (Kang et al., 2013). The participants completed two 6-minute sessions where needles were inserted solely at acupuncture point HT7 (Shenmen), known for emotional regulation following smoking withdrawal (Motlagh, Ibrahim, Rashid, Seghatoleslam & Habil, 2016). Different outcomes were observed through functional magnetic resonance imaging (fMRI) (Table 2). Acupuncture was found to relieve cue-induced cravings during the initial abstinence phase and to mitigate responses to smoking stimuli in the medial prefrontal cortex (mPFC for executive functions), premotor cortex, amygdala, hippocampus and medial thalamus, all of which play a crucial role in governing subjective cravings for nicotine. Notwithstanding, a coarse research design, including a small sample size, short treatments and the absence of any follow-up, detracted from the findings. Therefore, the results were difficult to use as comparison.

Table 2
Outcomes of Motlagh and Colleagues' Project

Item	Acupuncture group	Sham acupuncture group
Related brain regions	Less smoking cue-specific treatment effects.	Greater smoking cue-specific treatment effects.
mPFC	Reduced the percentage of signal change.	Enhanced responses.
Pre-motor cortex	No changes.	Increased the percentage of signal change.
Thalamus, hippocampus, and amygdala	Greater percentage of signal change reduced.	Less percentage of signal change reduced.
Smoking cue-specific treatment effects	Greater.	No significance in activation anywhere in the brain.

Salivary free sialic acid is an indicator of periodontal diseases (Jawzali, 2016) whereas C-reactive proteins indicate potential lung cancer (Bittoni, Focht, Clinton, Buckworth, & Harris, 2015). Both of these conditions are observed at a higher level among smokers. Ma and Xue (2014) randomly allocated 110 adults aged 37-45, equally to acupuncture and sham acupuncture groups. The acupuncture group reported significant decreases in sialic acid and C-reactive proteins. It also marked an abstinence rate of 34%, compared to 13% in the sham acupuncture group.

Adopting genetic analysis, Park et al. (2005) investigated the role of the dopamine D2 receptor (DRD2) *TaqIA* gene polymorphism as a reward pathway of addiction (Yilbaş, Akkişikumsar, & Dilbaz, 2016), related to the effects of acupuncture on

quitting cigarettes. The DRD2*A allele is linked to a reduced density of dopamine receptors, through which people plausibly show addiction. Three 96-second acupuncture sessions were conducted with 231 male smokers, by which the researchers demonstrated the intimate relationship between DRD2 *TaqIA* polymorphism and tobacco cessation.

Combined Treatment

Adopting acupuncture with other Chinese (for example, moxibustion) and Western (for instance, counselling) approaches, combined therapy has become prevalent and has demonstrated encouraging results.

Research conducted with 2,940 smokers aged 18-72 with 16 30-minute acupuncture sessions over a period of eight weeks exhibited a 34% and 18.4% abstinence rate at weeks 8 and 52 respectively (Wang, Liu, Wu et al., 2016). Some participants also received ear acupuncture after suffering from withdrawal symptoms (nausea). However, the dropout rate was as high as 43.5%, and ambiguous data concerning ear acupuncture made it difficult to verify the effects of this combination.

A randomised controlled trial assigned 60 middle-aged smokers (39-55 years old) to two equal groups (Wang & Song, 2013): the first utilising solely acupuncture and the second acupuncture plus moxibustion. While all participants were given 30 30-minute sessions, the latter group also received 30 14-minute sessions for moxibustion, which serves as one of the adjunct therapies for tobacco control (Chang, Hong, & Yi, 2012). Whereas the acupuncture group reached an abstinence rate of 73.3%, the combined therapy group reached one of 93.3%.

Another 90 participants received eight 30-minute acupuncture sessions and 15-minute massages (Song, 2010). The abstinence rate was 82.2% whereas the smoking reduction rate was 10%. This study also illustrates the effects of massage on emotional disorders (Sherman et al., 2010) when ceasing smoking (Hernandez-Reif, Field, & Hart, 1999).

Wang et al. (2016) examined the effects of acupuncture and psychological therapy on smoking termination. In their study, 2,051 participants ranging from 18 to 75 years of age received 48 20-minute acupuncture sessions in addition to 48 10-minute psychological treatment periods, as psychotherapy likely enhances positive affect and lessens negative emotions during cigarette abstinence (Kahler et al., 2014). Their study revealed variations in effectiveness depending on age, gender, educational background and intensity of nicotine dependence as well as a statistical significance among smokers who were over 60 years old.

Comparison Studies

Many comparison studies have substantiated the effects of combined treatment on cigarette abstinence. One such study allocated 68 participants to acupuncture, 13 to nicotine replacement therapy and 88 to a combination of these two methods (Chang et al., 2013). The abstinence rates at the 6th month of follow-up were 29%, 0%, and 38% respectively, revealing a more satisfactory outcome from the combined approach.

A double blind, randomised controlled trial divided participants into three groups (Kerr et al., 2008): (i) group A (n=121) was assigned to four 14-minute laser acupuncture sessions on days 1, 3 and 7 and to sham acupuncture on day 14, (ii) group B (n=130) underwent laser acupuncture on days 1, 3, 7 and 14, and (iii) group C (n=89) had sham acupuncture on days 1, 3, 7 and 14. All groups showed significant withdrawal symptoms. Groups A and B achieved a higher abstinence rate than C, while B achieved better results than A. In spite of positive outcomes, a lack of details concerning research design and treatment process weakened its trustworthiness.

Another randomised 8-week study conducted by White, Resch, and Ernst (1999) with 118 smokers divided equally into two groups, one receiving ear acupuncture and the other sham acupuncture. Both groups reported a decrease in tobacco consumption. Specifically, 27.1% of the ear acupuncture group and 20.3% of the sham acupuncture group reported such as decrease at the post-intervention measurements with 16.6% and 12.1%, respectively, maintain this decrease at the 6th month of follow-up. These results contradicted the notion that there were no significant differences in effects between acupuncture and sham acupuncture. Another longitudinal study carried out by He et al. (2001) followed 33 participants for five years who had been assigned to ear acupuncture and sham acupuncture groups and had completed six sessions, finding abstinence rates to be at 75% for the former group and 39% for the latter group in the post-treatment period. By the 8th month of follow-up, these rates dropped to 44% and 35%, respectively, and then to 28% and 14%, respectively, by the 5th year of follow-up. Although the sample size was small, this 5-year project supported previous studies.

Clavel et al. (1985) randomly divided participation into acupuncture (n=224), gum therapy (n=205) and control (n=222) groups, finding abstinence rates of 19%, 22% and 8%, respectively, and then 8%, 12% and 3% in the 13th month of follow-up. This was expanded to a longitudinal study with active acupuncture with gum (n=268), placebo acupuncture and active gum (n=213), active acupuncture and placebo gum (n=272) and placebo (n=243) groups (Clavel-Chapelon et al., 1997). The results demonstrated the following (Table 3):

Table 3
Results of Clavel-Chapelon and Team's Study

Group	Abstinence rate at the 1 st month	Abstinence rate at the 1 st year	Abstinence rate at the 4 th year
Active acupuncture with gum	26.5%	11.2%	6.1%
Placebo acupuncture and active gum	25.8%	10.9%	6.2%
Active acupuncture and placebo gum	17.7%	6.5%	5.1%
Placebo	20.6%	10.3%	7.3%

Bier et al. (2002) conducted a quasi-factorial project with 141 smoking adults (aged 26-81), randomly assigning them to (i) acupuncture (n=38), (ii) acupuncture with 5-week psychoeducation (n=45), which according to Huttunen-Lenz, Song, and Poland (2010) helps quit tobacco and (iii) sham acupuncture with 5-week psychoeducation (n=58). Measurements were taken at the 3rd, 6th, 12th, 15th and 18th months, and can be summarised as follows (Table 4):

Table 4
Research Findings of Bier et al.

Measurements	Acupuncture	Acupuncture with 5-week psychoeducation	Sham acupuncture with 5-week psychoeducation
Abstinence rate	10%	40%	22%
Abstinence rate at the 18 th month	20%	40%	22%
Smoking reduction rate	49%	53%	40%
Smoking reduction rate at the 18 th month	20%	52%	31%

Implications

This review reveals methodological and practical implications. Initially, although the reviewed research was empirical and displayed positive marks for using acupuncture in quitting nicotine, much of the research lacks a clear articulation of research design. This review suggests that more scientifically designed studies (Wu, Liu et al., 2015) be completed to ameliorate the rigour of the findings. Second, 10 of the 27 reviewed projects are randomised controlled trials, whose methods of procedure are ambiguous. This review proposes that the trial design be enhanced in future research studies, such as in sample size, details of the randomisation process, their p-values, and their operation (Wu, Wang et al., 2015). Lastly, follow-up evaluation is important for observing not only the immediate effects (Liu, Wang, Wu, & Yang, 2015) but also the long-term effects of acupuncture on smoking cessation, for which 13 reviewed works provide longer measurements ranging from one month to five years. This longitudinal design should continue to ensure acupuncture applications are applied to smoking-related health care.

The common acupoints for treating tobacco addiction in the reviewed projects include LI4 (Hegu), ST36 (Zusanli) and TF4 (Shenmen) (Liu, Wang, Wu, Zhang et al., 2015), together with a newly-found anti-smoking acupoint (Wang, Zhu, Gao, Yang & Wang, 2011), namely, Tim Mee (on the wrist). However, motivation is decisive (Chen, 2010), as nicotine withdrawal syndrome is a barrier that involves physical discomfort, such as weight gain and decreased heart rates (Robinson, Smith, Cederstrom, & Sutherland, 1991), along with emotional instabilities, such as anxiety, irritability and insomnia (McLaughlin, Dani, & De Biasi, 2015). This review suggests combined interventions (Keizer et al., 2012) with innovative approaches, such as mindfulness meditation (Davis, Manley, Goldberg, Stankevitz, & Smith, 2015; Vidrine et al., 2016), yoga (Bock et al., 2012), aromatherapy (Caruthas & Albrecht, 2011), occupational therapy (Chromiak, Scaffa, & Norris, 2014), music therapy (Daniels & Nicoll, 2012) and physical exercise (Horn et al., 2011), in order to cope with the adverse responses of nicotine withdrawal, with peer (Ford, Clifford, Gussy, & Gartner, 2013), family (Hubbard, Gorely, Ozakinci, Polson, & Forbat, 2016), and social (Burns, Rothman, Fu, Lindgren, & Joseph, 2014) support.

The participants in this review cover a broad age range from 15-84 years old. Yet, there is only one study conducted with adolescents and none with pregnant women, whereas the smoking population in these two groups is growing. This review recommends that more clinical projects be conducted to review how acupuncture can help these groups control their tobacco use.

Conclusion

Nicotine obviously harms the health of both smokers and non-smokers, threatening the public health expenditure. Numerous measures are used to quit cigarettes, including complementary and alternative therapies, among which acupuncture plays a significant role. This review, covering 15,794 participants aged 15-84 from Africa, Asia, Europe and North America, supports acupuncture's effectiveness as being a safer and less costly treatment for all age ranges, either through stand-alone utilisation or combined methods. Looking into comparison studies, acupuncture has been shown to be optimal for this purpose. In summary, the outcomes of this review highlight the efficacy of acupuncture in minimising cigarette cravings, tobacco consumption and nicotine dependence. This narrative review also proposes diverse implications for enhancing this application with well-devised, scientific follow-up projects. It demonstrates the potential to expand optional measures for controlling tobacco cravings and to enable current smokers to cease smoking.

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