Current Oncology Reports (2020) 22: 58
https://doi.org/10.1007/s11912-020-00915-w

INTEGRATIVE CARE (C LAMMERSFELD, SECTION EDITOR)

# Cognitive Behavioral and Mindfulness-Based Interventions for Smoking Cessation: a Review of the Recent Literature

Christine Vinci [1]

Published online: 16 May 2020


## Abstract

**Purpose of Review** Cigarette smoking is the primary cause of cancer and is the leading preventable cause of morbidity and mortality. Cognitive behavioral therapy (CBT) is one of the most well-established and efficacious interventions for smoking cessation. The study of mindfulness-based interventions (MBIs) has increased exponentially in recent years, showing efficacy for smoking cessation as well. This review highlights research from the past 5 years examining CBT and MBIs for smoking cessation.

**Recent Findings** Both CBT and MBIs are efficacious for special populations (e.g., low SES; pregnant smokers) and have shown initial efficacy when delivered via mhealth/ehealth. CBT has shown efficacy when combined with another behavioral treatment (e.g., ACT).

**Summary** Continued research is needed on CBT and MBIs that have high potential for scalability. Understanding whether they are beneficial for certain populations (e.g., cancer survivors), along with determining for whom CBT vs MBIs are most effective, is also needed.

**Keywords** Smoking cessation · CBT · Mindfulness-based interventions

## Introduction

Cigarette smoking is the leading preventable cause of morbidity and mortality in the United States [1, 2]. It is also the primary cause of cancer development, and it accounts for 30% of all cancer deaths [1, 2]. Although tobacco use has declined over the past 50 years, smoking prevalence was 14% in the US among adults in 2017 [3]. Current smokers are more likely to have lower income, no insurance, and lower levels of education than non-smokers [3]. For instance, prevalence rates are highest among those with an annual household income of less than $35,000 (26%), those with no insurance (31%), and those with a GED [42.6%; [3]]. Furthermore, certain vulnerable populations have high rates of smoking compared to the national average. For instance, those with serious mental illness (41%) and those with a disability/limitation [25%; [3]] are more likely to be current smokers than their counterparts. Thus, developing and testing effective cessation interventions remain a public health priority, particularly for underserved populations.

This paper will describe the adult smoking cessation literature from the past 5 years (2014–2019) as it pertains to cognitive behavioral treatment (CBT) and mindfulness-based interventions (MBIs). The goals are to synthesize the literature to better understand the current state of the science and to highlight future avenues for research. The primary focus will be on rigorous tests of these interventions (i.e., randomized clinical trials), although other designs are included when relevant (e.g., single-arm studies).

## Cognitive Behavioral Therapy

Cognitive behavioral therapy (CBT) is a therapeutic approach for treating problematic behaviors that primarily focuses on identifying and changing maladaptive thought and behavior patterns [4]. When CBT is provided for smoking cessation, it often includes problem solving and coping skills rooted in relapse prevention theory, along with cognitive restructuring for maladaptive thoughts [5]. These skills are combined with

This article is part of the Topical Collection on *Integrative Care*

✉ Christine Vinci
christine.vinci@moffitt.org

[1] Moffitt Cancer Center, Health Outcomes and Behavior, 4115 E Fowler Ave, Tampa, FL 33617, USA

recommendations from the Clinical Practice Guideline: Treating Tobacco Use and Dependence [e.g., providing nicotine replacement therapy, identifying triggers for relapse, managing negative mood [6]]. CBT is considered a more intensive intervention than brief counseling, as participants often meet with a provider over multiple sessions for 50 min to 2 h (if in a group setting). Intervention intensity is positively associated with smoking cessation [6].

Upon a recent review of the CBT literature over the past 5 years for smoking cessation, several common themes arose that will be highlighted here, including a focus on special populations (e.g., those diagnosed with severe mental illness, people living with HIV), combining CBT with other behavioral interventions (e.g., contingency management), and mhealth.

## Special Populations

Recent studies of CBT tend to focus on interventions for specific populations. Many of these studies include vulnerable populations, given the extremely high smoking rates in some of these groups, along with unique circumstances that call for more tailored interventions (e.g., people living with HIV). For instance, among individuals diagnosed with schizophrenia disorders, the smoking prevalence is greater than 60% [7]. As such, recent research has focused on developing and testing CBT interventions for special populations, which are summarized below.

Evins et al. (2014) conducted a randomized controlled trial that was double blind for individuals diagnosed with schizophrenia and bipolar disorders [8]. Participants were recruited from 10 different community mental health centers across six states. All participants ($N = 247$) were initially provided with varenicline for smoking cessation and CBT for 12 weekly, 1 h sessions. After this initial treatment period, those who demonstrated at least 14 days of continuous abstinence were then randomized to either (1) continue varenicline + CBT or (2) placebo medication + CBT. Results at the 52-week follow-up showed that tobacco abstinence was 60% in the varenicline group vs 19% in the placebo group. Thus, it was concluded that CBT alone (without medication) is not as effective as combined medication + CBT, which is consistent with larger literature for this population [9]. Other recommendations to increase smoking cessation among those with severe mental illness include developing ways to increase motivation to quit [9].

Smoking prevalence among those diagnosed with substance use disorders is high, and although many people successfully quit using other substances, they often continue smoking cigarettes [10–12]. Quitting smoking has been shown to be beneficial for those in substance use disorder treatment [12]. In a recent systematic review of smoking cessation interventions for those in substance use treatment, results indicated that CBT + nicotine replacement therapy improved smoking cessation outcomes at 6 months [13]. Future research is needed to determine how to better engage patients in quit smoking treatment, as well as how to best integrate smoking cessation into existing substance use disorder treatment.

Individuals living with HIV have a higher prevalence of smoking compared to those without HIV [14]. And, HIV individuals who smoke have lower adherence to antiretroviral medication and poorer health outcomes than non-smokers [15–17]. In an effort to develop an integrated treatment targeting smoking cessation, anxiety, and depression among those living with HIV, O'Cleirigh et al. [18••] tested a 9-week intervention where participants ($N = 72$) were randomized to either QUIT (1 psychoeducational session + 8 CBT sessions) or ETAU (1 psychoeducation session + 4 brief, weekly check-in sessions). Those in the QUIT intervention had significantly higher abstinence rates at end of treatment (59%) and 6 months post-quit (46%) than the ETAU group (9% and 5%, respectively). Results point to the importance of creating and testing transdiagnostic interventions for smoking cessation among those living with HIV.

Despite being just as interested in quitting smoking and making just as many attempts to quit, racial/ethnic minorities are less likely to be successful in their quit attempts than Caucasians [19]. Recent research suggests that group-based CBT might be particularly beneficial for African Americans and Hispanics in reducing distress and improving abstinence outcomes [20, 21]. Participants ($N = 234$) received 8 weeks of group-based CBT + the nicotine patch [21]. Results indicated that African Americans and Hispanics reported greater decreases in stress when compared to Caucasians and that reductions in stress and depression were associated with increased abstinence. These results suggest that group-based CBT may be particularly beneficial for racial/ethnic minorities. A larger, randomized clinical trial is currently ongoing to determine whether these results are replicated when compared to an active comparison group [20].

## Combination Treatment

A consistent theme observed when reviewing recent publications of CBT for smoking cessation has been a focus on combining CBT with other behavioral treatment approaches, suggesting that CBT may be even more effective alongside another treatment. We briefly summarize current research in this area, specifically focusing on studies that combined CBT with another behavioral intervention (vs pharmacotherapy).

Contingency management (CM) is a behavioral treatment that typically provides financial incentives for abstinence, and although generally effective as a stand-alone treatment [22], it has recently been combined with CBT for smoking cessation [23, 24]. Ninety-two treatment-seeking smokers were

randomly assigned to CM + CBT vs CBT alone [24]. CM consisted of an escalating payment schedule for tobacco abstinence; CBT consisted of 6 weeks of group-based counseling. Results showed that those in CM + CBT had higher abstinence than CBT at post-treatment (95.3% vs 59.2%), the 1-month follow-up (72.1% vs 34.7%), and the 6-month follow-up (51.2% vs 28.6%).

About 7.2% of women continue to smoke during pregnancy, and among those who quit during pregnancy, relapse postpartum is high [25–27]. During pregnancy, negative affect has been identified as factor related to continued smoking [28•]. Thus, pregnant smokers ($N = 70$) were randomized to one of two groups: (1) emotion regulation treatment (ERT) + CBT or (2) a control group of health and lifestyle + CBT [28•]. At both the 2- and 4-month follow-ups, the ERT + CBT condition had higher abstinence rates and smoked fewer cigarettes per day compared to the control group. It was thus concluded that adding a negative affect component to traditional CBT was useful for pregnant smokers attempting to quit.

## mHealth

Utilizing technology to deliver intervention content has the ability to increase the reach of a given treatment. Existing reviews and meta-analyses indicate that smoking cessation delivered via technology (e.g., phone application, SMS) is generally effective [29–32]. To date, CBT delivered via phone or computer for other mental health conditions has been tested, with promising results [33–35]. Research has begun to evaluate CBT for smoking cessation delivered via phone application, as described in more detail below.

To qualitatively evaluate a CBT phone application for smoking cessation, 29 participants were randomized to either a CBT phone app or the National Health Service (NHS) phone app [36]. Both apps used gamification to engage users. Interviews were conducted pre- and post-1 week of app use. Participants in the CBT condition were overall more positive about the app than those in the NHS group. CBT participants also reported greater motivation to quit smoking and a greater willingness to continue using the app. These preliminary findings indicate that the CBT app is feasible and acceptable to individuals interested in quitting smoking; future research is needed to determine the efficacy of CBT for smoking cessation delivered via phone application.

Bricker and colleagues have developed a phone application that primarily includes content consistent with acceptance and commitment therapy (ACT), but also includes elements of CBT [37–39]. ACT is a behavioral treatment that encourages individuals to change their relationship with thoughts (as opposed to changing content, as in CBT) via experiential exercises (e.g., meditations) and metaphors. ACT also incorporates an individual's values into behavior change. The initial RCT [37] evaluating the ACT + CBT app (SmartQuit) indicated that participants randomized to SmartQuit used the app more often and had higher rates of abstinence when compared to NCI's QuitGuide app (13% vs 8%). Individuals were less likely to use the SmartQuit app if they were female, had lower levels of education, heavier smoking status, and depression [39]. Finally, the most used features of the app were CBT-based [e.g., developing a quit plan, tracking smoking behavior [38]]. App features that were predictive of cessation included tracking ACT skills practice, viewing the quit plan, and tracking the practice of letting urges pass. Results from this collection of studies provide evidence that the SmartQuit app is not only beneficial regarding smoking cessation, but also provides great information regarding who is most likely to use the app, and what features are most beneficial. Future research is needed to increase engagement among those less likely to use the app.

## Mindfulness-Based Interventions

Mindfulness-based interventions (MBIs) for smoking cessation aim to increase an individual's awareness of their environment, thoughts, emotions, and physical sensations as related to craving [40–42]. An integral part of these interventions include helping the participants cultivate the ability to "sit with" discomfort, which usually manifests via craving for a cigarette. Individuals are asked to practice mindfulness meditations on 6 of 7 days each week. Most in-person MBIs are group-based and delivered over an 8-week period for 2 h each week. In this paper, we focus on MBIs, and not interventions that include mindfulness as a component of a larger set of intervention techniques (e.g., ACT). Overall, recent meta-analyses and systematic reviews have indicated that MBIs for smoking cessation are effective [40–42]. Similar to the literature on CBT, common themes arose regarding recent findings for MBIs and smoking cessation, specifically MBIs for special populations and mhealth/ehealth.

## Special Populations

We know that low SES individuals experience greater exposure to chronic stressors and negative life events with less access to beneficial resources, often resulting in poorer health outcomes [43–45]. Low SES is also a potent predictor of difficulty quitting smoking [46–50]. Several recent RCTs published on MBIs focus on low SES populations [51–53, 54••], which is likely because mindfulness is theorized to reduce reactivity to stress, and may even be most beneficial for those who experience high levels of stress [55, 56]. Two studies that focused on low SES populations compared a MBI for smoking cessation to active comparison groups—quitline treatment [51] and the American Lung Association's Freedom from Smoking (FFS) treatment [ [52] modified to match the MBI in contact time]. The MBI resulted in

significantly higher abstinence rates when compared to quitline treatment at the 24-week follow-up [38.7% vs 20.6% [51]]. When compared to FFS, the MBI condition had higher abstinence rates at the 26-week follow-up (25% vs 17.8%), although these differences were not significant [52]. In the largest RCT of MBIs for smoking cessation to date, Vidrine et al. [54••] compared MBI vs CBT vs usual care (UC) in a sample of low SES individuals ($N = 412$). Results indicated no significant group differences on abstinence outcomes. Nonetheless, among those who were smoking at the last treatment session, participants in the MBI group were most likely to regain abstinence 1 week later and at the 26-week follow-up. These findings suggest that the MBI was more beneficial than CBT or UC at aiding in recovery from a smoking lapse and that this might have been because mindfulness assisted in the interpretation of what a lapse meant (e.g., weakened a strong negative reaction to lapse such that individuals did not resume regular smoking).

Among a sample of smokers with mild intellectual disability, participants ($N = 51$) were randomly assigned to either a MBI or treatment as usual [TAU; [57]]. The MBI was modified for this population and included three main components: intention to quit smoking, mindful observation of thoughts, and meditation on the soles of the feet. Results indicated that those in the MBI had higher rates of abstinence than TAU through the 1-year follow-up period, and among those who continued to smoke, cigarettes smoked per day were lower in the MBI than TAU through follow-up. The authors posited that the MBI might have increased emotion regulation skills, resulting in higher abstinence rates. Future research is needed to carefully measure such mechanisms to determine active ingredients of MBIs for this population.

### mhealth/ehealth

Over the past several years, MBIs delivered via mhealth and ehealth have been examined and include interventions delivered via website [52], text-messaging [53], and phone application [58••, 59, 60]. Ideally, delivering MBIs via these technologies should increase the reach of effective treatments. In a pilot study to assess the efficacy of a web-based mindfulness training, 26 low SES smokers were provided with an 8-week intervention that primarily consisted of watching videos about mindfulness skills, followed by phone calls by a smoking cessation coach to answer questions. At the 4- and 6-month follow-ups, smoking abstinence was 23.1% and 15.4%, respectively. Participation in the treatment was reasonable, although future research should consider ways to increase engagement for similar web-based MBIs, given the potential reach of this intervention modality.

Recently, text message support was added to an in-person MBI for smoking cessation to determine whether text messages would improve cessation outcomes [53]. Participants ($N = 71$) were randomly assigned to MBI vs MBI + text message support. The MBI in this study was a group-based, in-person smoking cessation treatment over 8 weeks. Text messages were system-initiated on a daily basis, and participants could also text to receive strategies as needed. Results indicated no group differences on cessation. However, participants who were living below the poverty line had worse cessation rates if in the MBI condition (vs MBI + text messaging). It was concluded that since individuals living below the poverty line are likely to experience greater stressors in their day-to-day lives, receiving ongoing support via text message may be particularly useful for this group.

Phone applications focused on mindfulness for smoking cessation are also being developed, although this research is in its infancy. A recent RCT randomized participants to either an experience sampling group (check-ins up to 6 times per day) vs experience sampling + mindfulness training [58••, 59]. Both groups received all treatment via phone app. Results indicated no differences between groups on smoking cessation at the 6 month follow-up. Both groups had a reduction in cigarettes per day and craving. However, the relationship between craving and cigarettes per day lessened over time for those in the mindfulness group, which could aid in long-term cessation. Future research with a longer follow-up period is needed to fully determine the impact of this phone application on smoking cessation.

Initial feasibility results were presented for a study examining a combined mindfulness + CM intervention delivered via smartphone application [60]. Participants ($N = 8$) completed an intervention that provided mindfulness training, ecological momentary assessments, and financial compensation for video-confirmed abstinence. Pilot results indicated that participants were engaged in the intervention components and rated the mindfulness practices as helpful for mood management and quitting smoking. An ongoing RCT is being conducted to fully test the impact of this intervention.

## Discussion

Overall, CBT and MBIs for smoking cessation in the past 5 years primarily emphasize research with special populations and mhealth/ehealth. An additional theme, primarily within CBT, has been to combine evidenced-based interventions (e.g., CBT + CM). Although this review highlighted CBT and MBIs, it should be noted that many smoking cessation interventions are not CBT or MBI in isolation, but instead are theoretically driven and might combine various approaches. For example, Vidrine et al. [61] developed a text messaging intervention that aimed to increase self-efficacy, health knowledge, motivation to quit, coping skills, and support. Tailored text messages were sent based on smoking status, health history and concerns, and coping skills. Although informed by

existing approaches such as CBT and motivational enhancement, this study did not employ a traditional CBT. In a series of cessation studies examining a text messaging intervention for pregnant smokers, social cognitive theory was used to develop the text messages [62, 63]. Another example would be Just-in-Time Adaptive Interventions (JITAIs), which use decision rules based on real-time data (e.g., wearable sensors; responses to a daily question) that send intervention strategies to an individual at specific moments in time, often varying in timing, type, and content [64–66]. Although these interventions may utilize aspects of CBT or MBIs, they do not follow the traditional formats of these therapies [67–71]. Given the increase in technology-delivered interventions, it is likely that we will continue to see such trends in the literature.

### Future Research

Future smoking cessation research needs to emphasize scalability, given that the current landscape of smokers consists of vulnerable populations that can be difficult to reach. Mhealth/ehealth presents a perfect opportunity to engage such populations in their quit attempts. As technology-based interventions continue to develop, additional research is needed to understand the best way to deliver and engage individuals, as the existing literature on CBT and MBIs have been delivered via in-person treatment. JITAIs might be particularly beneficial, as researchers are able to target specific moments in time (e.g., stress; proximity to tobacco outlet) that might decrease the likelihood of a smoking lapse or relapse. Such interventions can be tailored to a given population (e.g., low SES; pregnant smokers), which has the potential to greatly enhance smoking cessation among these groups. Nonetheless, many mhealth/ehealth interventions pull from various theoretical approaches and are tailored to the user; thus, we are less likely to see many "pure" CBT or MBIs delivered in this manner. Another low-cost option with the potential for high scalability is a well-studied series of self-help booklets designed to help smokers quit [72]. These booklets were based on CBT, and primary outcomes revealed that booklets mailed to participants over a period of 18 months were effective at increasing smoking abstinence (30% at 24 months). Future research is needed to understand the ideal way to disseminate these booklets, especially within medical settings.

Similar to Vidrine et al., [54••] research to directly compare CBT vs MBIs is needed. It is very likely that these interventions are more/less beneficial for certain individuals. For instance, many of the studies reported here found that MBIs were most useful for certain sub-groups (e.g., those living in poverty) or at certain times during the quit attempt (e.g., lapse recovery).

Despite much ongoing research with special populations, additional work is needed to further understand the impact of CBT and MBIs among certain groups (e.g., racial/ethnic minorities). Furthermore, some populations currently have no cessation interventions that have been deemed effective. One such example is among cancer survivors, as a recent meta-analysis indicated that the collective literature indicates that no existing cessation interventions are effective [73]. Most of the behavioral change techniques within these studies were based on either CBT or motivational interviewing. Several other strategies that were not employed in these studies are recommended (e.g., facilitate action plans, changing routine) that are largely consistent with CBT. It does not appear that MBIs have been examined among cancer survivors, so this presents an additional potential avenue for future research.

## Conclusion

Continued research to develop and deliver the most efficacious smoking cessation interventions is needed. In the past 5 years, studies of CBT and MBIs have focused on cessation for special populations and the delivery of treatment via mhealth/ehealth. Furthermore, CBT has also been integrated with other established behavioral treatments. Overall, the existing literature suggests that both CBT and MBIs are effective quit smoking treatments. Nonetheless, continued research is needed to further develop and refine existing treatments, and understanding whether certain populations might benefit from one treatment approach over another (CBT vs MBI) is warranted.

**Funding Information** This manuscript was supported by funding from the National Center for Complementary and Integrative Health (R34AT009689).

### Compliance with Ethical Standards

**Conflict of Interest** Christine Vinci declares that she has no conflict of interest.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

## References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. American Cancer Society. Cancer facts and figures 2014. Atlanta: American Cancer Society; 2014.
2. U.S. Department of Health and Human Services. The health consequences of smoking—50 years of progress: a report of the surgeon

general. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014.
3. Centers for Disease Control and Prevention. Current cigarette smoking among adults—United States, 2017. Morb Mortal Wkly Rep. 2018; 67(44):1225–1232.
4. Nathan PE, Gorman JM. A guide to treatments that work: Oxford University Press; 2015.
5. Marlatt GA, Donovan DM. Relapse prevention: maintenance strategies in the treatment of addictive behaviors: Guilford Press; 2005.
6. Fiore MC, Jaén CR, Baker TB, Bailey WC, Benowitz N, Curry S, et al. Clinical practice guideline. Rockville: US Department of Health and Human Services. Public Health Service; 2008. p. 1196–9.
7. Šagud M, Mihaljević-Peleš A, Mück-Šeler D, Pivac N, Vuksan-Ćusa B, Brataljenović T, et al. Smoking and schizophrenia. Psychiatr Danub. 2009;21(3):371–5.
8. Evins AE, Cather C, Pratt SA, Pachas GN, Hoeppner SS, Goff DC, et al. Maintenance treatment with varenicline for smoking cessation in patients with schizophrenia and bipolar disorder: a randomized clinical trial. JAMA. 2014;311(2):145–54.
9. Cather C, Pachas GN, Cieslak KM, Evins AE. Achieving smoking cessation in individuals with schizophrenia: special considerations. CNS drugs. 2017;31(6):471–81.
10. Baca CT, Yahne CE. Smoking cessation during substance abuse treatment: what you need to know. J Subst Abus Treat. 2009;36(2):205–19.
11. Cookson C, Strang J, Ratschen E, Sutherland G, Finch E, McNeill A. Smoking and its treatment in addiction services: clients' and staff behaviour and attitudes. BMC Health Serv Res. 2014;14(1):304.
12. McCarthy WJ, Collins C, Hser Y-I. Does cigarette smoking affect drug abuse treatment? J Drug Issues. 2002;32(1):61–79.
13. Thurgood SL, McNeill A, Clark-Carter D, Brose LS. A systematic review of smoking cessation interventions for adults in substance abuse treatment or recovery. Nicotine Tob Res. 2016;18(5):993–1001.
14. Mdodo R, Frazier EL, Dube SR, Mattson CL, Sutton MY, Brooks JT, et al. Cigarette smoking prevalence among adults with HIV compared with the general adult population in the United States: cross-sectional surveys. Ann Intern Med. 2015;162(5):335–44.
15. Crothers K, Goulet JL, Rodriguez-Barradas MC, Gibert CL, Oursler KAK, Goetz MB, et al. Impact of cigarette smoking on mortality in HIV-positive and HIV-negative veterans. AIDS Educ Prev. 2009;21(3_supplement):40–53.
16. Feldman DN, Feldman JG, Greenblatt R, Anastos K, Pearce L, Cohen M, et al. CYP1A1 genotype modifies the impact of smoking on effectiveness of HAART among women. AIDS Educ Prev. 2009;21(3_supplement):81–93.
17. Lifson AR, Neuhaus J, Arribas JR, van den Berg-Wolf M, Labriola AM, Read TR, et al. Smoking-related health risks among persons with HIV in the strategies for management of antiretroviral therapy clinical trial. Am J Public Health. 2010;100(10):1896–903.
18.•• O'Cleirigh C, Zvolensky MJ, Smits JA, Labbe AK, Coleman JN, Wilner JG, et al. Integrated treatment for smoking cessation, anxiety, and depressed mood in people living with HIV: a randomized controlled trial. JAIDS J Acquir Immune Def Synd. 2018;79(2): 261–8 **Participants living with HIV (N=72) were randomized to either QUIT (1 psychoeducational session + 8 CBT sessions that targeted smoking cessation, anxiety, and depression) or ETAU (1 psychoeducation session + 4 brief, weekly check-in sessions). Those in the QUIT intervention had significantly higher abstinence rates at end of treatment and 6 months post-quit than the ETAU group.**
19. Centers for Disease Control and Prevention. Quitting smoking among adults - United States, 2001–2010. Morbidity Mortal Weekly Rep. 2011;60(44):1513–9.
20. Hooper MW, Lee DJ, Simmons VN, Brandon KO, Antoni MH, Unrod M, et al. Reducing racial/ethnic tobacco cessation disparities via cognitive behavioral therapy: design of a dualsite randomized controlled trial. Contemp Clin Trials. 2018;68:127–32.
21. Webb Hooper M, Kolar SK. Distress, race/ethnicity and smoking cessation in treatment-seekers: implications for disparity elimination. Addiction. 2015;110(9):1495–504.
22. Carroll KM. Lost in translation? Moving contingency management and cognitive behavioral therapy into clinical practice. Ann N Y Acad Sci. 2014;1327(1):94.
23. Japuntich SJ, Lee LO, Pineles SL, Gregor K, Joos CM, Patton SC, et al. Contingency management and cognitive behavioral therapy for trauma-exposed smokers with and without posttraumatic stress disorder. Addict Behav. 2019;90:136–42.
24. Secades-Villa R, García-Rodríguez O, López-Núñez C, Alonso-Pérez F, Fernández-Hermida JR. Contingency management for smoking cessation among treatment-seeking patients in a community setting. Drug Alcohol Depend. 2014;140:63–8.
25. Centers for Disease Control and Prevention. Current cigarette smoking among adults - United States, 2005–2015. Morbid Mortal Weekly Rep. 2016; 65(44):1205–1211.
26. Fang WL, Goldstein AO, Butzen AY, Hartsock SA, Hartmann KE, Helton M, et al. Smoking cessation in pregnancy: a review of postpartum relapse prevention strategies. J Am Board Fam Pract. 2004;17(4):264–75.
27. Rockhill KM, Tong VT, Farr SL, Robbins CL, D'Angelo DV, England LJ. Postpartum smoking relapse after quitting during pregnancy: pregnancy risk assessment monitoring system, 2000–2011. J Women's Health. 2016;25(5):480–8.
28.• Bradizza CM, Stasiewicz PR, Zhuo Y, Ruszczyk M, Maisto SA, Lucke JF, et al. Smoking cessation for pregnant smokers: development and pilot test of an emotion regulation treatment supplement to standard smoking cessation for negative affect smokers. Nicotine & Tobacco Research. 2017;19(5):578–84 **Pregnant smokers (N=70) were randomized to one of two groups: 1) emotion regulation treatment (ERT) + CBT, or 2) a control group of health and lifestyle + CBT. The ERT + CBT condition had higher abstinence rates and smoked fewer cigarettes per day compared to the control group at follow-ups.**
29. Ghorai K, Akter S, Khatun F, Ray P. mHealth for smoking cessation programs: a systematic review. J Personal Med. 2014;4(3):412–23.
30. Haskins BL, Lesperance D, Gibbons P, Boudreaux ED. A systematic review of smartphone applications for smoking cessation. Transl Behav Med. 2017;7(2):292–9.
31. Scott-Sheldon LA, Lantini RC, Jennings EG, Thind H, Rosen RK, Salmoirago-Blotcher E, et al. Text messaging-based interventions for smoking cessation: a systematic review and meta-analysis. JMIR mHealth uHealth. 2016;4(2):e49.
32. Whittaker R, McRobbie H, Bullen C, Rodgers A, Gu Y. Mobile phone-based interventions for smoking cessation. Cochrane Database Syst Rev. 2016;4.
33. Andrews G, Cuijpers P, Craske MG, McEvoy P, Titov N. Computer therapy for the anxiety and depressive disorders is effective, acceptable and practical health care: a meta-analysis. PLoS One. 2010;5(10):e13196.
34. Grist R, Cavanagh K. Computerised cognitive behavioural therapy for common mental health disorders, what works, for whom under what circumstances? A systematic review and meta-analysis. J Contemp Psychother. 2013;43(4):243–51.
35. Watts S, Mackenzie A, Thomas C, Griskaitis A, Mewton L, Williams A, et al. CBT for depression: a pilot RCT comparing mobile phone vs. computer. BMC Psychiatry. 2013;13(1):49.

36. Tudor-Sfetea C, Rabee R, Najim M, Amin N, Chadha M, Jain M, et al. Evaluation of two mobile health apps in the context of smoking cessation: qualitative study of cognitive behavioral therapy (CBT) versus non-CBT-based digital solutions. JMIR mHealth uHealth. 2018;6(4):e98.
37. Bricker JB, Mull KE, Kientz JA, Vilardaga R, Mercer LD, Akioka KJ, et al. Randomized, controlled pilot trial of a smartphone app for smoking cessation using acceptance and commitment therapy. Drug Alcohol Depend. 2014;143:87–94.
38. Heffner JL, Vilardaga R, Mercer LD, Kientz JA, Bricker JB. Feature-level analysis of a novel smartphone application for smoking cessation. Am J Drug Alcohol Abuse. 2015;41(1):68–73.
39. Zeng EY, Vilardaga R, Heffner JL, Mull KE, Bricker JB. Predictors of utilization of a novel smoking cessation smartphone app. Telemed e-Health. 2015;21(12):998–1004.
40. de Souza ICW, de Barros VV, Gomide HP, Miranda TCM, de Paula MV, Kozasa EH, et al. Mindfulness-based interventions for the treatment of smoking: a systematic literature review. J Altern Complement Med. 2015;21(3):129–40.
41. Maglione MA, Maher AR, Ewing B, Colaiaco B, Newberry S, Kandrack R, et al. Efficacy of mindfulness meditation for smoking cessation: a systematic review and meta-analysis. Addict Behav. 2017;69:27–34.
42. Oikonomou MT, Arvanitis M, Sokolove RL. Mindfulness training for smoking cessation: a meta-analysis of randomized-controlled trials. J Health Psychol. 2017;22(14):1841–1850.
43. Adler NE, Ostrove JM. Socioeconomic status and health: what we know and what we don't. Ann N Y Acad Sci. 1999;896(1):3–15.
44. Businelle MS, Kendzor DE, Reitzel LR, Costello TJ, Cofta-Woerpel L, Li Y, et al. Mechanisms linking socioeconomic status to smoking cessation: a structural equation modeling approach. Health Psychol. 2010;29(3):262–73.
45. Gallo LC, de los Monteros KE, Shivpuri S. Socioeconomic status and health: what is the role of reserve capacity? Curr Dir Psychol Sci. 2009;18(5):269–74.
46. Barbeau EM, Krieger N, Soobader MJ. Working class matters: socioeconomic disadvantage, race/ethnicity, gender, and smoking in NHIS 2000. Am J Public Health. 2004;94(2):269–78.
47. Centers for Disease Control and Prevention. Current cigarette smoking among adults - United States, 2005–2012. Morb Mortal Wkly Rep. 2015;63(02):29–34.
48. Chiang K, Borrelli B. Income predictors of smoking cessation among Hispanics. J Health Psychol. 2014;19(7):869–76.
49. Kendzor DE, Businelle MS, Costello TJ, Castro Y, Reitzel LR, Cofta-Woerpel LM, et al. Financial strain and smoking cessation among racially/ethnically diverse smokers. Am J Public Health. 2010;100(4):702–6.
50. Vinci C, Guo L, Spears CA, Li L, Etcheverry PE, Lam CY, et al. Socioeconomic indicators as predictors of smoking cessation among Spanish-speaking Mexican Americans. Ethn Health. 2019;24(7):841–853.
51. Davis JM, Goldberg SB, Anderson MC, Manley AR, Smith SS, Baker TB. Randomized trial on mindfulness training for smokers targeted to a disadvantaged population. Subst Use Misuse. 2014;49(5):571–85.
52. Davis JM, Manley AR, Goldberg SB, Stankevitz KA, Smith SS. Mindfulness training for smokers via web-based video instruction with phone support: a prospective observational study. BMC Complement Altern Med. 2015;15(1):1.
53. Spears CA, Abroms LC, Glass CR, Hedeker D, Eriksen MP, Cottrell-Daniels C, et al. Mindfulness-based smoking cessation enhanced with mobile technology (iQuit mindfully): pilot randomized controlled trial. JMIR mHealth uHealth. 2019;7(6):e13059.
54.•• Vidrine JI, Spears CA, Heppner WL, Reitzel LR, Marcus MT, Cinciripini PM, et al. Efficacy of mindfulness-based addiction treatment (MBAT) for smoking cessation and lapse recovery: a randomized clinical trial. J Consult Clin Psychol. 2016;84:824–38 **The largest RCT to date (N=412) examining MBI vs CBT vs TAU for smoking cessation among low SES individuals. Results indicated no significant group differences, but that those in the MBI group were more successful at recovering from a lapse.**
55. Brown KW, Weinstein N, Creswell JD. Trait mindfulness modulates neuroendocrine and affective responses to social evaluative threat. Psychoneuroendocrinology. 2012;37(12):2037–41.
56. Creswell JD, Lindsay EK. How does mindfulness training affect health? A mindfulness stress buffering account. Curr Dir Psychol Sci. 2014;23(6):401–7.
57. Singh NN, Lancioni GE, Myers RE, Karazsia BT, Winton AS, Singh J. A randomized controlled trial of a mindfulness-based smoking cessation program for individuals with mild intellectual disability. Int J Ment Heal Addict. 2014;12(2):153–68.
58.•• Garrison KA, Pal P, O'Malley SS, Pittman BP, Gueorguieva R, Rojiani R, et al. Craving to quit: a randomized controlled trial of smartphone app–based mindfulness training for smoking cessation. Nicotine Tob Res. 2020; 22(3):324–331; **RCT that found both the experience sampling and mindfulness + experience sampling groups had reductions in cigarettes per day and craving at 6 months follow-up. For those in the mindfulness group, the relationship between craving and cigarettes per day lessened over time, which could aid in long-term cessation.**
59. Garrison KA, Pal P, Rojiani R, Dallery J, O'Malley SS, Brewer JA. A randomized controlled trial of smartphone-based mindfulness training for smoking cessation: a study protocol. BMC Psychiatry. 2015;15(1):83.
60. Minami H, Brinkman HR, Nahvi S, Arnsten JH, Rivera-Mindt M, Wetter DW, et al. Rationale, design and pilot feasibility results of a smartphone-assisted, mindfulness-based intervention for smokers with mood disorders: project mSMART MIND. Contemp Clin Trials. 2018;66:36–44.
61. Vidrine DJ, Frank-Pearce SG, Vidrine JI, Tahay PD, Marani SK, Chen S, et al. Efficacy of mobile phone–delivered smoking cessation interventions for socioeconomically disadvantaged individuals: a randomized clinical trial. JAMA Intern Med. 2019;179(2):167–74.
62. Abroms LC, Johnson PR, Heminger CL, Van Alstyne JM, Leavitt LE, Schindler-Ruwisch JM, et al. Quit4baby: results from a pilot test of a mobile smoking cessation program for pregnant women. JMIR mHealth uHealth. 2015;3(1):e10.
63. Abroms LC, Johnson PR, Leavitt LE, Cleary SD, Bushar J, Brandon TH, et al. A randomized trial of text messaging for smoking cessation in pregnant women. Am J Prev Med. 2017;53(6):781–90.
64. Nahum-Shani, I, Smith, SN, Sping, BJ, Collin LM, Witkiewitz, K, Tewari, A, & Murpy, SA. Just-in-Time adpative interventions (JITAIs) in mobile health: Key components and design principles for ongoing health behavior support. Ann Behav Med. 2018; 52(6): 446–462.
65. Spruijt-Metz D, Nilsen W. Dynamic models of behavior for just-in-time adaptive interventions. IEEE Perv Comput. 2014;3:13–7.
66. Vinci C, Haslam A, Lam CY, Kumar S, Wetter DW. The use of ambulatory assessment in smoking cessation. Addict Behav. 2018;83:18–24.
67. Businelle MS, Ma P, Kendzor DE, Frank SG, Vidrine DJ, Wetter DW. An ecological momentary intervention for smoking cessation: evaluation of feasibility and effectiveness. J Med Internet Res. 2016;18(12): e321.
68. Cerrada CJ, Dzubur E, Blackman KC, Mays V, Shoptaw S, Huh J. Development of a just-in-time adaptive intervention for smoking cessation among Korean American emerging adults. Int J Behav Med. 2017;24(5):665–72.
69. Hébert ET, Stevens EM, Frank SG, Kendzor DE, Wetter DW, Zvolensky MJ, et al. An ecological momentary intervention for

smoking cessation: the associations of just-in-time, tailored messages with lapse risk factors. Addict Behav. 2018;78:30–5.
70. Naughton F. Delivering "Just-In-Time" smoking cessation support via mobile phones: current knowledge and future directions. Nicotine Tob Res. 2017;19(3):379–83.
71. Naughton F, Hopewell S, Lathia N, Schalbroeck R, Brown C, Mascolo C, et al. A context-sensing mobile phone app (Q sense) for smoking cessation: a mixed-methods study. JMIR mHealth and uHealth. 2016;4(3):e106.
72. Brandon TH, Simmons VN, Sutton SK, Unrod M, Harrell PT, Meade CD, et al. Extended self-help for smoking cessation: a randomized controlled trial. Am J Prev Med. 2016;51(1):54–62.
73. Sheeran P, Jones K, Avishai A, Symes YR, Abraham C, Miles E, et al. What works in smoking cessation interventions for cancer survivors? A meta-analysis. Health Psychol. 2019;38(10):855–65.