Review Article

Current Status and Future Trends of Acceptance and Commitment Therapy (ACT) for Smoking Cessation: A Narrative Review with Specific Attention to Technology-Based Interventions

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Abstract

Background: During recent decades, it has become evident that cigarette smoking has led to an increase in cancer, risk of death, and economic problems or sanitation issues worldwide. Acceptance and commitment therapy (ACT), as a third-wave behavioral therapy, has devoted significant attention to smoking cessation. However, this treatment has been utilized in different formats and protocols. Moreover, addressing its challenges and progress needs examination and integration. Accordingly, the primary aim of this study was to present a narrative review for summarizing and integrating the current data on the effectiveness of ACT on smoking cessation. This study also aimed to investigate the challenges and the future of this field.

Methods: The publications from January 1, 2010 to October 9, 2021 were identified by searching MEDLINE, Embase, Scopus, PsycINFO, and Web of Science electronic databases. The search was performed with the following keywords: "Acceptance AND Commitment Therapy" OR "Acceptance" AND "smoking" OR "tobacco" OR "cigarette" OR "smoker" OR "Nicotine". The inclusion criterion was studies with interventions aimed at reducing smoking cessation in smokers.

Findings: A total of 17 articles were analyzed in this study. The results showed that this treatment has significant effectiveness in smoking cessation and psychiatric comorbidities. Moreover, the role of experiential avoidance in smoking cessation was discussed in detail.

Conclusion: ACT is a suitable psychotherapy module for smoking cessation. However, it needs some upgrades regarding technology. To this end, smartphone applications and AVATAR therapy technologies were discussed with their advantages and solvable disadvantages.

Keywords: Acceptance and commitment therapy, Review, Smoking cessation, Clinical evidence

Introduction

During the last decades, biopsychosocial smoking-related issues have been widely studied. Smoking cigarettes could result in premature death (for an average of 12 years). This premature death could be due to different reasons like cancer or heart problems. Moreover, smoking leads to more than six million deaths worldwide, independent of cultural or socioeconomic conditions of smokers. In addition, smoking might pose a significant risk to oral or dental hygiene, lungs, heart, pancreas, and stomach or cause asthma, cancer, or other severe conditions.[1,2]

Based on previous studies, the prevalence of cigarette smoking in 2015 was 25% in men and 5% in women.[3,4] Smoking prevalence in the Iranian population varies from 12% to 38% in men and from 0.6% to 9.8% in women.[3]

There have been various biopsychosocial treatment methods for smoking cessation; however, smoking cessation and abstinence stability rates have been lower than 10%.[5-7] As the most commonly used psychological treatment for various psychological disorders, cognitive behavioral therapy (CBT) has some limitations in treating cigarette smoking. For instance, this method does not

treat comorbid disorders as a therapeutic objective when treating smokers. In addition, applying thought-challenging methods is exceptionally troublesome for the risky decision-making behavior of smokers. Therefore, alternative treatments should take these factors into account and resolve them.[6,8]

Acceptance and commitment therapy (ACT) is a promising treatment method. As a transdiagnostic treatment, ACT aims to resolve the relevant problems (such as lack of flexibility). Moreover, it consists of various cognitive and experiential elements that equip the patients with a wide range of skills. Accordingly, recent studies have mostly focused on examining the effectiveness of ACT on smoking in different formats and settings.[2,6,9]

ACT is a third-wave behavioral therapy that attempts to prepare individuals for better functioning in everyday life by integrating acceptance and mindfulness. Unlike CBT, ACT does not aim at modifying the style of thinking, feeling, or living. Its main objective is to strengthen the psychological flexibility in life. Relational frame theory, as an underlying factor, can be seen in every element of this therapy.[10] In this theory, language is known as action which connects different stimuli (people, memories, emotions, etc.) and changes our attitudes and understandings. Acceptance as one of the main components of this treatment is accompanied by five psychological flexibility factors including cognitive defusion, being present, self as context, values, and committed action.[7] Acceptance is being open to unwanted, goal-oriented experiences (in smoking, craving-related thoughts, feelings, memories, etc.). Cognitive defusion is the ability to differentiate thoughts from thought-related experiences. Thoughts are similar to glasses on the eyes, which do not represent the external happenstance (thoughts are only thoughts). Values lead the actions and have been chosen freely in line with aims and goals.[7,11]

Committed action consists of a set of actions for achieving precise and freely chosen values. Flexible present-focused attention means being connected to the experiences of the present moment and continuous tracing of the present experiences. Self as context is the ability to differentiate the feelings and thoughts from the self as the observer of the feelings and thoughts.[11] The combination of these six basic procedures (ACT hexaflex) is presented in Figure 1.

Since ACT is a procedure-based treatment, the fundamental concept of psychological flexibility is the main guideline for applying this intervention. Like the underlying theory of treatment, therapeutic interventions are based upon the six procedures mentioned earlier. Instead of thought challenging or thought modifying, these methods base the therapy on experience and utilize techniques such as exposure and metaphors as well as mindfulness exercises like mindful living. This treatment involves functional analysis as well. It is essential to mention that these interventions and therapeutic attitudes are applied in a supportive and active therapeutic atmosphere, and this therapeutic alliance leads to more substantial effects of the treatment. ACT has been applied in group or individual settings, webs, and also phone applications. The technologies will be discussed later in this paper.[7,11,12]

An example of individual ACT sessions for smoking cessation is presented in Table 1. It is essential to mention that this treatment has very similar elements for different target populations; however, it is flexibly utilized for every particular context and disorder.

To the best of the researchers' knowledge, no review study has been conducted so far to examine the effectiveness of ACT in smoking cessation. Moreover, there were two main limitations in the review studies that investigated the effectiveness of ACT in substance abuse. Firstly, these investigations were on a wide range of drugs and substances, and none of them were profoundly or closely examined. Secondly, these studies were carried out more than six years ago. During the past six years, the effectiveness of ACT in smoking cessation has been investigated in various populations and using various smartphone application-based, web-based, or phone-based methods. Therefore, it is essential to review the effectiveness of this treatment method.

The primary objective of the present narrative review was to provide a picture of the current state of ACT in the treatment of cigarette smoking. Despite the lack of review studies, the results of interventional studies have repeatedly indicated the effectiveness of this treatment in smoking cessation.[6,13] However, the topic is more complicated than just repeating this result. Smoking has a high rate of comorbidity with psychiatric disorders, such as depression and anxiety as well as psychotic disorders.[6] The results of the studies also confirmed such disorders both caused and were caused by smoking.[6] However, it can be concluded that to quit and reduce smoking, effective interventions should, along with smoking cessation, also target other psychiatric problems associated with smoking. However, the nature and details of these interventions are not desirable. It is also unclear which variables should be taken as comorbidity variables. Thus, the primary purpose of the present study was to address the gaps between research findings and the implementation of ACT in actual clinical practice.

Methods

In line with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a systematic search was undertaken on PubMed/MEDLINE, Web of Science, Scopus, and the first five pages of Google Scholar electronic databases for peer-reviewed and original publications between January 1, 2010, and
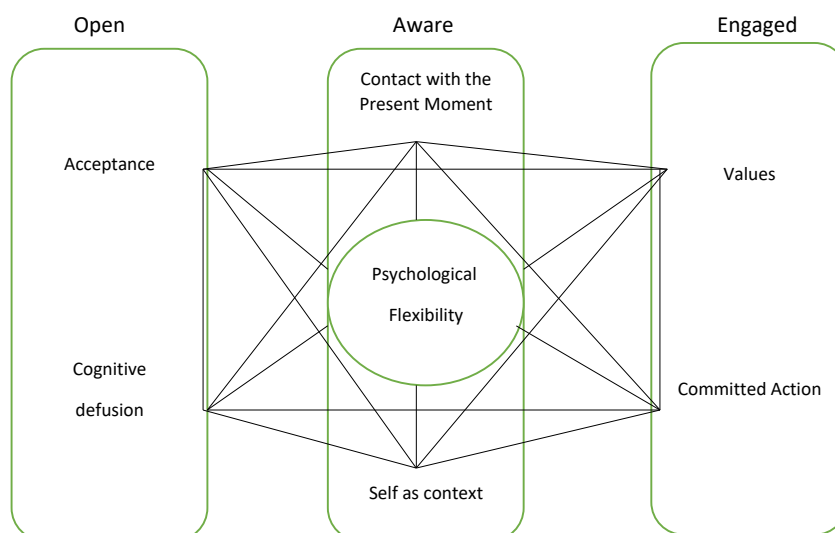
Figure 1. ACT hexaflex

Table 1. An example of individual ACT sessions for smoking cessation

Session	ACT
preliminary session	Communicating with the participants and getting to know them (In this session, the main objectives are to build rapport, resolve ambiguities, and fill in demographic questionnaires and pre-test surveys)
1	Discussing the disadvantages of controlling life (short term advantages vs. long term disadvantages), directing attention to the experience by understanding "creative hopelessness", and doing exercises like body scan
2	Reviewing the previous sessions and getting feedback from the participants, discussing and evaluating their feelings and experiences, assessing their willingness to change, investigating patients' expectations of treatment, developing creative helplessness, summarizing the materials discussed, and giving homework
3	Cognitive defusion Introducing metaphors such as clouds in the sky, observing thoughts as thoughts
4	Reviewing the contents of the previous sessions, identifying patients' values and focusing on these values, paying attention to their power of choice, teaching mindfulness techniques, emphasizing living in the present moment (here and now), summarizing the material discussed at the end of the session, reviewing assignments to ensure learning, and giving homework
5	Introducing the concept of committed action, using metaphors in discussions with participants, bringing coherence to life through challenges with the participants, and doing mindfulness exercises
6	Evaluating and following activities in support of values
7	Evaluating and following activities in support of values
8	Moving forward

October 9, 2021. To ensure comprehensiveness, the search was performed with the following keywords: "Acceptance AND Commitment Therapy" OR "Acceptance" AND "smoking" OR "tobacco" OR "cigarette" OR "smoker" OR "Nicotine". In this review article, all the studies using dual diagnosis treatments were included. After collecting all studies based on search results, exclusion criteria were applied. The exclusion criteria were (A) sample sizes with ten or fewer participants, (B) the combination of ACT with another treatment in one protocol, (C) non-English articles, (D) brief report studies without containing the results of smoking reduction or cessation, (E) having applied selected parts of the treatment and not the whole protocol, and (F) not having mentioned the cessation rate or smoking reduction in post-test. Accordingly, 3296 articles were found on indexes. After collecting the studies and checking the repetitions, 1138

papers were eliminated because of duplications, and 2158 papers remained. Thereafter, 2103 papers were removed since they did not match the current research aims. In the last stage, 35 articles were eliminated according to the exclusion criteria. Finally, a total of 20 articles were investigated as presented in Figure 2.

Results

Empirical evidence of ACT for smoking cessation

A summary of the information about the results, methods, and other prominent parts of the studies on the effectiveness of ACT in smoking cessation are presented in Table 2. The implications and conclusions about the effectiveness of ACT will be discussed in the following parts. It is essential to mention that the studies that combined the elements of ACT with other treatment methods as a psychological intervention were
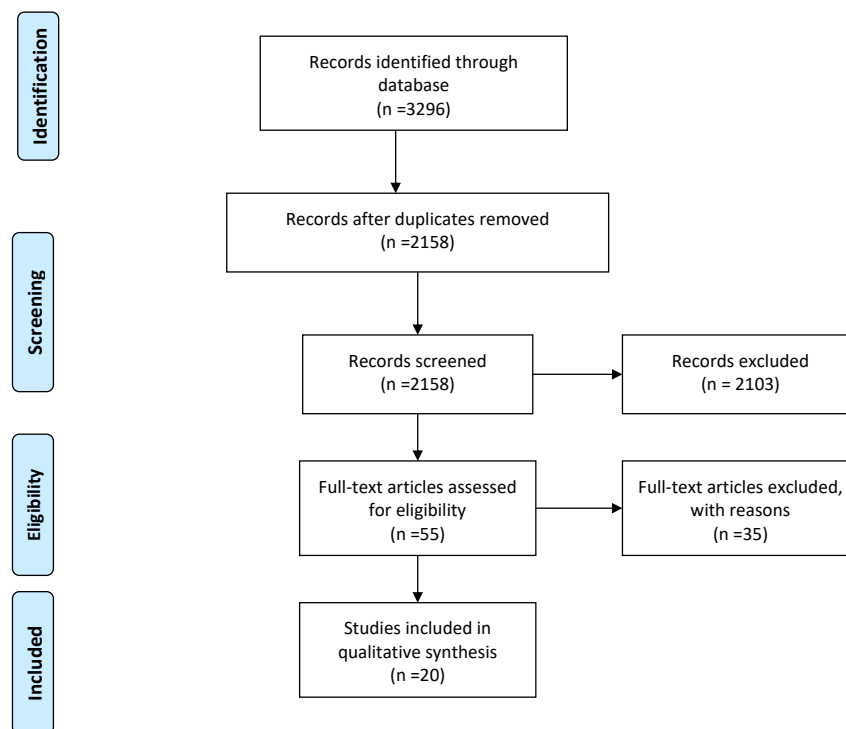
Figure 2. The papers selection process

Table 2. Published and forthcoming papers on ACT for smoking cessation

First Author Publication Year Country	Target variables	Treatment arm (n); Delivery period	Population	Results
Heffner et al[24] 2021 USA	Abstinence	Avatar-led digital Acceptance and Commitment therapy (n=22) (EQQUAL program) Delivery period: 6 weeks	Sexual and gender minority young adult smokers	Treatment was accepted easier in the intervention group. The level of abstinence (which was biochemically confirmed) in the intervention group was three times higher than in the control group in sexual and gender minority young adult smokers.
Mak et al[17] 2021 Hong Kong	Quit rates Experiential avoidance	Acceptance and Commitment Therapy (n=65) Social Support (n=65) Delivery period: 10 weeks	Smokers with schizophrenia	The results showed that the quit rates in the ACT group were higher than in the social support group. However, this difference was not significant (six months follow-up: 12.3% vs. 7.7%, $P>0.05$, one-year: 10.8% vs. 7.7%, $P>0.05$). Moreover, this study found significantly greater improvements in experiential avoidance and less reliance on emotion regulation strategies in the ACT group.
Mak et al[25] 2020 China	Abstinence	Acceptance and Commitment Therapy + self-help materials on smoking cessation (n=70) Self-help materials on smoking cessation as the control group (n=74)	The general population of smokers	At the 12-month follow-up, there was no significant difference in the prevalence of 7-day self-reported quit rates between the intervention group (24.3%) and the control group (21.6%). Participants in ACT were more motivated to complete treatment than control group. In addition, this group showed higher values of psychological flexibility than control group.
O'Connor M[26] 2020 USA	Cessation Nicotine dependence Positive mental health	Behavioral support group (n=50) ACT group (n=50) ACT together with an application for cessation (n=50) Delivery period: 6 weeks	The general population of smokers	After a 6-month follow-up, there was no significant difference in smoking cessation rate between the three groups. However, after post-test, the group with the compound program had a higher cessation rate than the group with the behavioral support program. It is essential to mention that there were no significant differences between the three groups in positive mental health.
Heffner JL[14] 2020 USA	Mental health symptoms	Web-delivered Acceptance and Commitment Therapy (WebQuit Plus, n=25) Smokefree.gov (n=26)	Treatment-seeking adult smokers with bipolar disorder	During post-test, the WebQuit Plus group had a higher cessation rate than the Smokefree.gov group. Nevertheless, no significant difference was detected in the follow-up assessment. However, the WebQuit Plus group had a higher tendency to continue the intervention.
Karekla[23] 2019 Cyprus	Smoking cessation	Avatar-led based Acceptance and Commitment Therapy (n=49, 64.3%=females) Delivery period: 6 weeks	Young college students	The group that completed the therapy had a higher cessation rate than the group that did not complete all therapy sessions. Moreover, the patients who had partly participated in the program had a reduction in smoking. The participants under study described the program as acceptable and satisfying.
Watson NL[21] 2019 USA	Cessation Symptoms of Depression and Anxiety Disorders	Web-based ACT U.S. standard web-based smoking interventions	Smokers with and without affective disorders	Compared to the group without anxiety disorders, all six subgroups with anxiety disorders showed significantly higher satisfaction with their assigned Web treatment program but had shorter enrollment times than the group without anxiety disorders.

Table 2. Continued.

First Author Publication Year Country	Target variables	Treatment arm (n); Delivery period	Population	Results
McClure JB[13] 2018 USA	Abstinence Acceptance of Cravings	ACT (n=224) CBT (n=226) Delivery period: 8 weeks	Adult smokers in Washington State	After a one-year follow-up, there was no significant inter-group difference in abstinence and cravings.
Vilardaga[20] 2019 USA	Positive and Negative Syndrome Smoking behavior	The patients received both the Learn to Quit (LTQ) and NCI QuitGuide (QG) programs. The program was randomly assigned to the individuals (n=7). Delivery period: 30 days	Smokers with serious mental illness	The LTQ was more helpful than NCI, but NCI was more popular. In addition, participating in the LTQ program reduced all participants' positive and negative syndrome scale scores. LTQ is a safe and valuable program for improving cessation skills in patients with severe psychiatric problems.
Bricker JB[27] 2018 USA	Cessation	WebQuit Online Smoking Cessation program (intervention group) (N=1318) Smokefree.gov online website (Control) n=1319)	Treatment-seeking adult smokers	Both treatments had the same one-month abstinence after one year.
Singh S[18] 2017 New Zealand	Cessation Craving	The innovative Suit® application with ACT-based content was given to people as time series. (N=10). Quit date varied from at least two weeks to six months	Treatment-seeking adult smokers	Even though craving had no significant change during different phases, smoking reduced significantly; 3 of the participants did not smoke at all for more than one year.
Davoudi M[6] 2017 IRAN	Cessation Depression Anxiety	ACT (n=35) CBT (n=35) Delivery period: 8 weeks	Treatment-seeking adult smokers	Compared to the CBT group, the ACT group had significant improvements in depression and anxiety. Moreover, ACT led to a significant improvement in smoking cessation.
Bricker JB[28] 2017 USA	Smoking cessation Smoking reduction	Acceptance and commitment therapy smartphone application (n=99) Delivery period: 30 days	Treatment-seeking adult smokers	In this study, a new version of an ACT-based application was compared to the research results of another study by the same researchers on the same population. It was concluded that compared to the previous application, the new version led to a considerable growth in the abstinence rate. Moreover, it significantly decreased the smoking rate in other populations.
Heffner JL[15] 2015 USA	Smoking cessation	ACT in-person (n=10) Telephone-based ACT (n=6) Delivery period:10 weeks	Treatment-seeking adult smokers with bipolar disorder	In this study, there was no comparison to highlight any significant differences. On the whole, the group which received individual therapy in-person had a cessation rate of seven days or more. However, during the 30-day-follow-up period, the cessation rate was the same for both groups. During the therapy, the group that participated in the sessions in person had more days of abstinence and were more receptive and enthusiastic.
Jones HA[16] 2015 USA	Cessation Anxiety and depression	WebQuit. web-based treatment (ACT) (n=47) Smokefree.gov web-based treatment Control) (n=47) Delivery period:30 days	Smokers with depressive symptoms	On the whole, there was no significant difference between groups in the 30-day cessation rate or depressive symptom reduction. However, in the ACT group, the descriptive data indicated a higher cessation rate and a more significant improvement in depressive symptoms. Furthermore, the patients who used the WebQuit reported higher levels of satisfaction about program than control group.
Kelly MM[12] 2015 USA	PTSD symptoms Smoking cessation	ACT (n=19) Delivery period:10 weeks	Smoking Veterans with PTSD	In this one-group study, compared to baseline, the percentage of quitting was 37% after the end of the therapy and 16% after the 3-month follow-up. Moreover, PTSD symptoms were significantly fewer in comparison with the baseline.
Bricker JB[19] 2014 USA	Quit rates Depressive symptoms Cravings	Telephone-based ACT + NRT (n=60) Telephone-based CBT + NRT(n=60)	South Carolina State adult smokers	The ACT group continued treatment for a longer period than participants in CBT. In the ACT group, for both depressive and non-depressive patients, the 30-day and 6-month cessation rates were significantly higher. ACT leads to resisting cravings in smokers more significantly.
Bricker JB[29] 2014 USA	Cessation Craving	Mobile-based acceptance and commitment therapy (n=80) (National Cancer Institute's application for smoking cessation (QuitGuide) (n=84)) Delivery period: 8 weeks	Treatment-seeking adult smokers	While QuitGuide participants used their application 15.2 times on average, SmartQuit participants used their application for an average of 37.2 times. The total smoking rates for SmartQuit and QuitGuide were 13% and 8% percent, respectively (OR=2.7; 95% CI=0.8–10.3). In line with the theory of change in ACT, for the ones who had low scores (under the median) on Acceptance of cravings experiences during baseline (n=88), the quit rates were 15% and 8% in SmartQuit and QuitGuide, respectively (OR=2.9; 95% CI=0.6– 20.7).
Bricker J[22] 2013 USA	Cessation	Web-based ACT (WebQuit) (n=111) Smokefree.gov-the U.S. standard web-based smoking interventions (n=111)	Treatment-seeking adult smokers	Compared with the control group (Smokefree.gov), the intervention group (ACT) showed higher user receptivity and short-term cessation, and promising evidence of ACT-based mechanisms of change.
Bricker JB[30] 2010 USA	Quit rates	Telephone-based ACT (n=14) Delivery period: 5 sessions	Adult smokers	According to the results of this study, the cessation rate was 29% seven days after the end of the intervention, and the same rate continued until the 12-month follow-up.

excluded. The studies that only introduced the protocol and intended to publish the article in the future were also eliminated.

Generally, ACT has been applied to a wide range of smokers, such as the general population of smokers, treatment-seeking adult smokers with bipolar disorder, smokers with affective disorders, smokers with serious mental illness, and smoking veterans with post-traumatic stress disorder (PTSD).[6,12,14-16] ACT has shown significant effectiveness in smoking cessation and reducing cravings than waiting-lists, twelve-step programs, and psychoeducation. It has also shown promising results in various projects, including the smartphone application-based (smart Suit®), telephone-based, individual face-to-face, and web-based ones.

The results of comparing CBT and ACT in smokers can be summarized into six classes:

First: One study showed that the ACT group had significant improvements in smoking cessation than the CBT group.[6] However, one study showed there was no significant inter-group difference in abstinence and craving.[13] Thus, more studies are required to resolve these discrepancies.

Second: Compared to the CBT group and other psychological interventions, the ACT group had significant improvements in reducing depression,[16] anxiety,[6] bipolar disorder,[15] schizophrenia,[17] and PTSD[12] symptoms in smokers.

Third: There is no difference between CBT and ACT in reducing craving. ACT cannot reduce craving in smokers.[13,18,19] However, ACT focuses on accepting pleasant and unpleasant emotions, feelings, and thoughts rather than changing them. Hence, in ACT, patients accept triggers. These efforts cause a reduction in impulsivity and craving.[13]

Fourth: WebQuit.org is the most effective web-based ACT treatment compared with other treatment methods which are based on CBT[20] and Psychoeducation (Quit Guide).[21] Moreover, this intervention correlated with a higher tendency to continue the intervention.[14]

Fifth: Every time the participants open WebQuit.org website, they stayed significantly longer time and found the website more satisfying. After the 3-month follow-up assessments, it was found that more than twice of the participants on this website got rid of smoking, and 80% of the effect was mediated by ACT which increases the total Acceptance of physical, cognitive, and emotional cues in smoking.[22]

Sixth: Patients in ACT groups, most likely, will continue treatment until the end.[6,23]

Discussion

ACT was as effective as other standard treatments, and in most cases, it was even more effective. According to the results of this study, the patients found ACT more pleasing, acceptable, and accessible even when other treatments were as effective as ACT. The patients who could not quit smoking successfully reported a reduced daily smoking rate in many cases; therefore, it could be stated that they were, to some extent, treated.

In a study by McClure et al, as presented in Table 2, the results showed non-significant differences between the ACT and CBT groups.[13] However, the study conducted by Davoudi et al[6] showed that the ACT group had significant improvements in depression and anxiety compared to the CBT group. Moreover, ACT led to a significant improvement in smoking cessation. Therefore, it can be concluded that ACT is as effective as or even better than CBT.

Furthermore, the results indicated that ACT is applicable and beneficial to different smokers, such as depressed smokers, smokers with schizophrenia, anxious smokers, and smokers with bipolar disorders. Moreover, this treatment has led to an increase in the rate of smoking cessation in PTSD patients. A significant point in these results is that ACT simultaneously reduced smoking and psychiatric symptoms. In other words, this therapy could be applied as a transdiagnostic treatment. While CBT is generally known as treatment as usual (TAU), it is not a dual diagnosis treatment. Moreover, modifying cognitions is not always a suitable solution since it is very difficult for patients with lower socioeconomic status to modify and challenge their thoughts. What was mentioned could explain why ACT seems more acceptable to patients with lower socioeconomic status.[9]

If more studies with new scales confirm the current results on ACT, it could be concluded that ACT is firstly accepted as TAU and later as a gold standard. ACT is developing in other fields of health psychology; however, detailed, controlled, and creative studies on ACT are still required.

ACT is a kind of behavioral psychotherapy which aims to determine the mechanisms through which experiential avoidance (EA) affects unhealthy behaviors such as smoking or alcohol abuse. Experiential avoidance is the effort to avoid experiencing bodily sensations, thoughts, emotions, effects, and other internal experiences of a behavior despite observing its adverse outcomes. Although experiential avoidance has been mentioned in other types of psychotherapy implicitly or directly, ACT presents a theoretical framework and a clinical explanation for indicating how this avoidance leads to smoking, how this avoidance could be prevented, and how the internal experiences could be accepted.

Experiential avoidance indicates an affect-regulatory process though which individuals do not want to experience or keep being in contact with negative inner experiences, such as thoughts, feelings, memories, bodily sensations, and images. Thus, they try to keep under control the number of times the experiences occur or the

way or context in which they take place.[31] Notably, the more significant types of EA related to smoking are being more reliant on cigarettes and affect-regulatory smoking experiences.[32] Besides, in anxious or depressed smokers, the experiential avoidance specific to smoking indirectly results in particular behaviors showing dependency on smoking, such as trying to quit a number of times and specific procedures that affect cognition, such as finding more obstacles in quitting smoking.[33,34] Furthermore, the experiential avoidance specific to smoking is linked with more significant negative effects, desires, and nicotine withdrawal when beginning the therapy for quitting smoking.[35] Moreover, in experiences of internal disturbances (negative affect and withdrawal symptoms) while trying to quit, smokers that are highly avoid due to experience are more probable to have reducing their smoking rates, even after the therapy for quitting smoking, compared to smokers having fewer amounts of EA.[36] Results showed that EA was negatively associated with internal discomfortness on smoking cessation. However, ACT improved mental adaptability by helping smokers to accept their negative experiences.[7] Thus, ACT aimed to identify avoidant behaviors.

The ACT trials clinically controlled to quit smoking are discussed here to highlight the functions of avoidance in the research findings. Gifford et al paralleled ACT with nicotine replacement therapy (NRT) in 76 individuals dependent on nicotine.[1,7,13] The participants stated that they tried to quit four times on average over the two previous years. The ACT aims to find emotional, cognitive, and physical avoidance by promoting acceptance, skills that help differentiate oneself, experience-based orientation, and behavior-based activation with a particular focus on smoking-related behaviors. The therapy consisted of seven 50-minute individual sessions and seven 90-minute group sessions over seven weeks. Certain skills were discussed including being aware of both internal and external stimulations, being aware of the attempts to control or avoid inner experiences, finding the obstacles to quit smoking, and using mindfulness to enhance the stimuli awareness and encourage adaptability.[31,37] Exposure would increase the probability of withdrawal. Accordingly, a timetable for smoking was used to expand the time interval between the signals for smoking and the responses to smoking based on habits. Even though there was no contrast between the two groups after the therapy, the results showed that the participants in the ACT group reached better results in smoking rates out of doing it in an abiding manner after one year.[7,34,35]

A new point of view on technology-based treatment
Digital interventions are more efficient than face-to-face methods in some aspects (e.g., accessibility) because they could assist and serve more patients at a lower cost.[27,28] By providing easier access (anywhere, anytime) and comfort

(being anonymous and independent), these interventions are also beneficial to patients who are unable or unwilling to participate in sessions due to being busy. With the growing interest in smartphones, many tasks, including paperwork, educational responsibilities, or bank-related tasks, are easily and comfortably done using smartphone applications. New technologies are constantly creating new opportunities and challenges in the lives of psychiatric patients. Therefore, it is no surprise that more than 1000 phone applications are related to smoking cessation.[18,27,28]

During recent years, some ACT-based applications were made on smoking cessation. SmartQuit is one of these applications that teaches techniques to resist cravings and avoid rapid and impulsive reactions to cravings. In this application, the patient firstly designs a cessation program based on some questions. The questions ask for personal information, measure smoking-related attitudes and habits, and evaluate a wide range of smoking-related problems. The application suggests a cessation date that is not fixed and can be changed. Eight short exercises with repetitions are presented. During these exercises, the patients are assisted in accepting their cravings and acting on specified values. For instance, in one of the exercises, the patients get familiar with tug-of-war using a monster metaphor. The monster on the other side of the rope is craving. When the patient resists ten cravings and does not act on them, he/she receives a badge. The same rule applies to each of the eight completed tasks. The patients can also share their experiences in the application. It is also possible to get supplementary information by touching the Ask a Coach icon. After reviewing the clinical trials and updating the application, the second version was made available with some changes. In the new version, all the exercises are open, and the patient can progress at any speed. Furthermore, other exercises were added to the eight main exercises. There were also a number of other major changes in the updated version. This application has been superior to other applications and its second version has also been more beneficial than its first version and has been more effective in smoking cessation.[26,28,38]

Another new technology in this field is avatar-based ACT. In this technology, treatment is delivered via videos, games, movies, and other avatar-based interactive elements. In fact, in this method, the coach is the avatar that combines games and videos to provide an interactive environment. So far, only one study has examined the effectiveness of avatar-based ACT in smoking cessation.[39] The population of this study included smoking students who admitted at the end of the study that the games, videos, and other side elements were more interesting, motivating, and beneficial than the coach-based intervention. The participants suggested a more reality-based user experience and more interactive avatars for future updates. Moreover, about half of the participants

believed that the six-session structure of the therapy was suitable and enough. However, there is insufficient information about the mechanism and elements of this treatment method, and therefore, it is not possible to analyze the structure of the sessions accurately. On the whole, in this method, the concept of Acceptance is taught after using examples and videos by the avatar coach. Skills like accepting cravings and not acting on such impulses are taught as well. Therefore, new studies are needed to eliminate these shortcomings and produce new results.

All in all, despite the promising mentioned points, utilizing technology in psychotherapy is not error-free. The main problem in this field is the high dropout rate during the intervention. Therefore, it is essential to make it more desirable and accessible and provide a user-friendly interface. Furthermore, according to other studies, having a coach or therapist accessible when needed, empathy, and knowing that an expert is leading the program could provide a social atmosphere for treatment[9,18]. The future direction of these treatments is discussed in the following section.[39]

The future direction of ACT in smoking cessation: a technology-based perspective

The analyzed studies revealed different levels of the effectiveness of ACT based on the research type or the study population. Future studies are recommended to emphasize two main factors including technology-based therapies and evaluation of the core of treatment mechanisms. Thus, future studies could analyze the position of the newly emerged smartphone applications and develop newer and more accurate versions. It is also essential to detect the factors that keep the users more engaged in applications in future investigations. The other issue is offering incentives and money. Future studies could offer incentives according to the demographic variables to motivate the individuals to use the application. For instance, a user who earns 10 000 dollars monthly and buys three 35-dollar packs of cigarettes would not feel very motivated after knowing that he/she can save 150 dollars monthly if he/she can quit. Still, another kind of incentive, like a health index, might motivate them. Therefore, in future studies, after tailoring the incentives, more accurate information about the effectiveness of participating in the program will be provided. The other issue is how the applications are used. It is not precisely clear whether an ACT-based application is superior to educational or cognitive behavioral applications after the end of the intervention or if using ACT-based applications in the follow-up is more advantageous than monthly practicing and reviewing with reminders. It is not clear if these applications increase the motivation or deepen the treatment. It is necessary to find possible answers to these questions.[26,28]

According to the new technology-based studies, smokers are interested in using videos, games, and pictures throughout therapy. For this reason, more ACT-based videos, games, and other visual materials need to be added to the new versions of future applications. In future studies, it is necessary to determine if these applications are helpful in smoking cessation. Another important point to be considered in future investigations is coaching. Given that applications are widely accessible, after a particular number of exercises are done and specific scores are achieved by the user, based on the level and the scores of the user in relevant scales, some group or individual web-conferencing sessions need to be held with an experienced therapist. Furthermore, the content of the applications, the exercises, and therapeutic programs should be based on the profile of smoking quitters and the six main topics of ACT so as to let the program meet the users' needs.[40-43]

One of the novel technology-based treatments used in smoking cessation is Avatar therapy (AT). AT is a new treatment for some psychological problems, especially auditory hallucinations in the spectrum of psychotic disorders.[38] Leff introduced this treatment to reduce the auditory hallucinations in schizophrenic patients suffering from these symptoms even after pharmacotherapy. In AT, computer avatars are designed by the patients to create faces for the voices they hear. Later, the patients could interact with the simulated annoying voice. Guided by the therapist, the patients are gradually encouraged to challenge the voices and have them under control. Each patient visualizes the auditory hallucination and challenges the voice in an interactive environment.[44,45] A picture of the AT was presented on one of the websites of this treatment (http://www.avatartherapy.co.uk/). [39]

This technology used for other psychological problems recently. The effectiveness of these treatment methods could be examined in substance abuse disorders, as crucially important individual or social issues. To improve the social and individual skills, these treatments engage the patients in particular situations using a three-dimensional virtual environment; nevertheless, only a few studies have been carried out in this field. Although these investigations are at the early stages, they will probably receive more attention in the future. As an empirical therapy, ACT could be well suited for the avatar's context due to its therapeutic metaphors and link with meditation and mindfulness. For instance, instead of repeatedly explaining creative hopelessness, the patient could understand it using an avatar. AT could provide an opportunity for future studies to design more effective forms of ACT for smoking. In fact, smokers experience virtual cues about smoking, and thus this virtual condition can be targeted by AT.[39,46]

Furthermore, ACT-based programs could be applied to other smoking populations, including patients with dual psychiatric diagnosis or those who take multiple kinds of

substances or drugs. Moreover, by comparing the scores of the patients who successfully quit smoking and those who experienced slips or relapse, the treatment factors that have had more therapeutic effects could be identified and then utilized as the basis of supplementary interventions. In this way, the following questions could be answered: Do ACT-based applications lead to a reduction in the consumption of other substances taken with cigarettes (such as cannabis)? Do ACT-based programs have the exact therapeutic mechanisms for all kinds of substances? Which techniques are the most beneficial for each kind of substance? Nonetheless, there are still questions with no clear answer, such as those on ACT-based programs' effect size on young adults compared to older adults.

This study had some limitations. The main limitation was that it included only current smokers; hence, the results cannot be generalized to nondaily smokers and second-hand smokers. Moreover, non-English studies were excluded. The authors attempted to access their full text in English by asking the authors through emails but none was available.

Conclusion

The results of this study indicated that ACT is more effective than CBT in general. ACT leads to higher smoking cessation and reduction rates in different populations using various face-to-face, group-based, or technology-based formats. However, finding answers to unanswered questions and solving challenges require several systematic reviews based on future experimental studies.

References

1. Luoma JB, Pierce B, Levin ME. Experiential avoidance and negative affect as predictors of daily drinking. Psychol Addict Behav. 2020;34(3):421-33. doi: 10.1037/adb0000554.
2. Davoudi MR, Omidi A, Sehat M. Comparison of anxiety and depression symptoms between male daily smokers and nondaily smokers resident in Kashan city during 2016-2017. Feyz. 2017;21(5):490-7. [Persian].
3. Moosazadeh M, Ziaaddini H, Mirzazadeh A, Ashrafi-Asgarabad A, Haghdoost AA. Meta-analysis of smoking prevalence in Iran. Addict Health. 2013;5(3-4):140-53.
4. Reitsma MB, Fullman N, Ng M, Salama JS, Abajobir A, Abate KH, et al. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990-2015: a systematic analysis from the Global Burden of Disease Study 2015. Lancet. 2017;389(10082):1885-906. doi: 10.1016/s0140-6736(17)30819-x.
5. Jha P. The hazards of smoking and the benefits of cessation: a critical summation of the epidemiological evidence in high-income countries. Elife. 2020;9:e49979. doi: 10.7554/eLife.49979.
6. Davoudi M, Omidi A, Sehat M, Sepehrmanesh Z. The effects of acceptance and commitment therapy on man smokers' comorbid depression and anxiety symptoms and smoking cessation: a randomized controlled trial. Addict Health. 2017;9(3):129-38.
7. Hayes SC, Strosahl KD, Wilson KG. Acceptance and Commitment Therapy. Washington, DC: American Psychological Association; 2009.
8. Ruiz FJ. A review of acceptance and commitment therapy (ACT) empirical evidence: correlational, experimental psychopathology, component and outcome studies. Int J Psychol Psychol Ther. 2010;10(1):125-62.
9. Balandeh E, Omidi A, Ghaderi A. A Narrative Review of Third-Wave Cognitive-Behavioral Therapies in Addiction. Addict Health. 2021;13(1):52-65. doi: 10.22122/ahj.v13i1.298.
10. Powers MB, Zum Vorde Sive Vording MB, Emmelkamp PM. Acceptance and commitment therapy: a meta-analytic review. Psychother Psychosom. 2009;78(2):73-80. doi: 10.1159/000190790.
11. Luoma JB, Hayes SC, Walser RD. Learning ACT: An Acceptance & Commitment Therapy Skills-Training Manual for Therapists. New Harbinger Publications; 2007.
12. Kelly MM, Sido H, Forsyth JP, Ziedonis DM, Kalman D, Cooney JL. Acceptance and commitment therapy smoking cessation treatment for veterans with posttraumatic stress disorder: a pilot study. J Dual Diagn. 2015;11(1):50-5. doi: 10.1080/15504263.2014.992201.
13. McClure JB, Bricker J, Mull K, Heffner JL. Comparative effectiveness of group-delivered acceptance and commitment therapy versus cognitive behavioral therapy for smoking cessation: a randomized controlled trial. Nicotine Tob Res. 2020;22(3):354-62. doi: 10.1093/ntr/nty268.
14. Heffner JL, Kelly MM, Waxmonsky J, Mattocks K, Serfozo E, Bricker JB, et al. Pilot randomized controlled trial of web-delivered acceptance and commitment therapy versus smokefree.gov for smokers with bipolar disorder. Nicotine Tob Res. 2020;22(9):1543-52. doi: 10.1093/ntr/ntz242.
15. Heffner JL, McClure JB, Mull KE, Anthenelli RM, Bricker JB. Acceptance and commitment therapy and nicotine patch for smokers with bipolar disorder: preliminary evaluation of in-person and telephone-delivered treatment. Bipolar Disord. 2015;17(5):560-6. doi: 10.1111/bdi.12300.
16. Jones HA, Heffner JL, Mercer L, Wyszynski CM, Vilardaga R, Bricker JB. Web-based acceptance and commitment therapy smoking cessation treatment for smokers with depressive symptoms. J Dual Diagn. 2015;11(1):56-62. doi: 10.1080/15504263.2014.992588.
17. Mak YW, Loke AY, Leung DYP. Acceptance and commitment therapy versus social support for smoking cessation for people with schizophrenia: a randomised controlled trial. J Clin Med. 2021;10(19). doi: 10.3390/jcm10194304.
18. Singh S, Starkey NJ, Sargisson RJ. Using SmartQuit®, an acceptance and commitment therapy smartphone application, to reduce smoking intake. Digit Health. 2017;3:2055207617729535. doi: 10.1177/2055207617729535.
19. Bricker JB, Bush T, Zbikowski SM, Mercer LD, Heffner JL.

Randomized trial of telephone-delivered acceptance and commitment therapy versus cognitive behavioral therapy for smoking cessation: a pilot study. Nicotine Tob Res. 2014;16(11):1446-54. doi: 10.1093/ntr/ntu102.

20. Vilardaga R, Rizo J, Ries RK, Kientz JA, Ziedonis DM, Hernandez K, et al. Formative, multimethod case studies of learn to quit, an acceptance and commitment therapy smoking cessation app designed for people with serious mental illness. Transl Behav Med. 2019;9(6):1076-86. doi: 10.1093/tbm/iby097.

21. Watson NL, Heffner JL, Mull KE, McClure JB, Bricker JB. Comparing treatment acceptability and 12-month cessation rates in response to web-based smoking interventions among smokers who do and do not screen positive for affective disorders: secondary analysis. J Med Internet Res. 2019;21(6):e13500. doi: 10.2196/13500.

22. Bricker J, Wyszynski C, Comstock B, Heffner JL. Pilot randomized controlled trial of web-based acceptance and commitment therapy for smoking cessation. Nicotine Tob Res. 2013;15(10):1756-64. doi: 10.1093/ntr/ntt056.

23. Karekla M, Savvides SN. Smoking cessation avatar-led acceptance and commitment therapy digital intervention: feasibility and acceptability in young adults. Transl Behav Med. 2021;11(1):198-205. doi: 10.1093/tbm/ibz128.

24. Heffner JL, Watson NL, Serfozo E, Kelly MM, Reilly ED, Kim D, et al. An avatar-led digital smoking cessation program for sexual and gender minority young adults: intervention development and results of a single-arm pilot trial. JMIR Form Res. 2021;5(7):e30241. doi: 10.2196/30241.

25. Mak YW, Leung DYP, Loke AY. Effectiveness of an individual acceptance and commitment therapy for smoking cessation, delivered face-to-face and by telephone to adults recruited in primary health care settings: a randomized controlled trial. BMC Public Health. 2020;20(1):1719. doi: 10.1186/s12889-020-09820-0.

26. O'Connor M, Whelan R, Bricker J, McHugh L. Randomized controlled trial of a smartphone application as an adjunct to acceptance and commitment therapy for smoking cessation. Behav Ther. 2020;51(1):162-77. doi: 10.1016/j.beth.2019.06.003.

27. Bricker JB, Mull KE, McClure JB, Watson NL, Heffner JL. Improving quit rates of web-delivered interventions for smoking cessation: full-scale randomized trial of WebQuit.org versus Smokefree.gov. Addiction. 2018;113(5):914-23. doi: 10.1111/add.14127.

28. Bricker JB, Copeland W, Mull KE, Zeng EY, Watson NL, Akioka KJ, et al. Single-arm trial of the second version of an acceptance & commitment therapy smartphone application for smoking cessation. Drug Alcohol Depend. 2017;170:37-42. doi: 10.1016/j.drugalcdep.2016.10.029.

29. 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. doi: 10.1016/j.drugalcdep.2014.07.006.

30. Bricker JB, Mann SL, Marek PM, Liu J, Peterson AV. Telephone-delivered acceptance and commitment therapy for adult smoking cessation: a feasibility study. Nicotine Tob Res. 2010;12(4):454-8. doi: 10.1093/ntr/ntq002.

31. Hayes SC, Wilson KG, Gifford EV, Follette VM, Strosahl K. Experimental avoidance and behavioral disorders: a functional dimensional approach to diagnosis and treatment. J Consult Clin Psychol. 1996;64(6):1152-68. doi: 10.1037//0022-006x.64.6.1152.

32. Watson NL, Heffner JL, McClure JB, Bricker JB.

33. Relationships between social anxiety and smoking-specific experiential avoidance. J Dual Diagn. 2017;13(1):1-5. doi: 10.1080/15504263.2016.1248310.

33. Zvolensky MJ, Farris SG, Schmidt NB, Smits JAJ. The role of smoking inflexibility/avoidance in the relation between anxiety sensitivity and tobacco use and beliefs among treatment-seeking smokers. Exp Clin Psychopharmacol. 2014;22(3):229-37. doi: 10.1037/a0035306.

34. Garey L, Farris SG, Schmidt NB, Zvolensky MJ. The role of smoking-specific experiential avoidance in the relation between perceived stress and tobacco dependence, perceived barriers to cessation, and problems during quit attempts among treatment-seeking smokers. J Contextual Behav Sci. 2016;5(1):58-63. doi: 10.1016/j.jcbs.2015.11.001.

35. Farris SG, DiBello AM, Heggeness LF, Reitzel LR, Vidrine DJ, Schmidt NB, et al. Sustained smoking abstinence is associated with reductions in smoking-specific experiential avoidance among treatment-seeking smokers. J Behav Ther Exp Psychiatry. 2016;51:51-7. doi: 10.1016/j.jbtep.2015.12.003.

36. Minami H, Bloom EL, Reed KM, Hayes SC, Brown RA. The moderating role of experiential avoidance in the relationships between internal distress and smoking behavior during a quit attempt. Psychol Addict Behav. 2015;29(2):400-7. doi: 10.1037/adb0000030.

37. Hernández-López M, Luciano MC, Bricker JB, Roales-Nieto JG, Montesinos F. Acceptance and commitment therapy for smoking cessation: a preliminary study of its effectiveness in comparison with cognitive behavioral therapy. Psychol Addict Behav. 2009;23(4):723-30. doi: 10.1037/a0017632.

38. De Groot F, Morrens M, Dom G. [Acceptance and commitment therapy (ACT) and addiction: a literature review]. Tijdschr Psychiatr. 2014;56(9):577-85.

39. Huckvale M. Avatar Therapy. In: figure, editor. UK: http://www.avatartherapy.co.uk/. 2020.

40. Tzelepis F, Paul CL, Williams CM, Gilligan C, Regan T, Daly J, et al. Real-time video counselling for smoking cessation. Cochrane Database Syst Rev. 2019;2019(10):CD012659. doi: 10.1002/14651858.CD012659.pub2.

41. Amante DJ, Blok AC, Nagawa CS, Wijesundara JG, Allison JJ, Person SD, et al. The 'Take a Break' game: Randomized trial protocol for a technology-assisted brief abstinence experience designed to engage lower-motivated smokers. Contemp Clin Trials. 2020;93:106002. doi: 10.1016/j.cct.2020.106002.

42. Scholten H, Luijten M, Granic I. A randomized controlled trial to test the effectiveness of a peer-based social mobile game intervention to reduce smoking in youth. Dev Psychopathol. 2019;31(5):1923-43. doi: 10.1017/s0954579419001378.

43. Guo JL, Hsu HP, Lin MH, Lin CY, Huang CM. Testing the usability of digital educational games for encouraging smoking cessation. Int J Environ Res Public Health. 2020;17(8):2695. doi: 10.3390/ijerph17082695.

44. Leff J, Williams G, Huckvale M, Arbuthnot M, Leff AP. Avatar therapy for persecutory auditory hallucinations: what is it and how does it work? Psychosis. 2014;6(2):166-76. doi: 10.1080/17522439.2013.773457.

45. Ward T, Craig T, Rus-Calafell M. AVATAR therapy for refractory auditory hallucinations. In: Pradhan B, Pinninti N, Rathod S, eds. Brief Interventions for Psychosis: A Clinical Compendium. London: Springer; 2016.

46. Gordon MS, Carswell SB, Schadegg M, Mangen K, Merkel K, Tangires S, et al. Avatar-assisted therapy: a proof-of-concept pilot study of a novel technology-based intervention to treat substance use disorders. Am J Drug Alcohol Abuse. 2017;43(5):518-24. doi: 10.1080/00952990.2017.1280816.