ORIGINAL ARTICLE

Mindfulness-based therapy for smoking cessation and mental health: a randomised controlled trial

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ABSTRACT

Introduction: Effective smoking cessation programmes are essential for assisting smokers in quitting, indirectly lowering mortality and morbidity associated with smoking. Numerous studies have indicated positive outcomes when using mindfulness treatment (MT) to treat psychological or behavioural health issues. Although to date, no study has looked at the effectiveness of online MT for quitting smoking while addressing mental health, particularly among the Asian population. Therefore, this study compares the efficiency of online MT to traditional counselling therapy (CT) in aiding smoking cessation programmes while also addressing mental health.

Materials and Methods: A randomised control study with a two-group, single-blind design and baseline evaluation was selected. Social media sites were used to advertise for participants, who were then admitted after meeting the requirements. Participants who met the eligibility requirements were randomly split into two groups. Each group received a total of three sessions of online therapy (MT or CT), once every two weeks, as well as one phone call per week as reinforcement. At the beginning and end of the intervention, participants completed questionnaires (1st week and 5th week). Generalized Estimating Equation (GEE) statistical analysis was used to analyse all the variables.

Results: The MT group experienced a statistically significant decrease in cigarette consumption (β: -3.50, 95% Wald CI: -4.62, -2.39) compared to the CT group over time. Furthermore, the MT group demonstrated significant improvements in their scores for the AAQ-2, anxiety, stress, depression and mindfulness compared to the CT group.

Conclusion: Online MT is more successful at assisting smokers in lowering their daily cigarette intake and supporting their mental health during the smoking cessation process. Further longitudinal comparisons of the effectiveness of online MT should be undertaken using online platforms in future studies.

KEYWORDS:
Smoking cessation, quit smoking, mental health, mindfulness, stress, psychological inflexibility, experiential avoidance

INTRODUCTION

More than 8 million people are estimated to die each year from the tobacco epidemic, with 1.2 million of those deaths attributed to second-hand smoke and 20% of the world's population being smokers.[1,2] An estimated 80% of tobacco smokers reside in low- and middle-income nations, and the impact there is considerably greater according to the World Health Organization.[3] Additionally, smoking is particularly difficult to stop due to the addictive ingredient it contains as well as the habitual behaviour of smoking.[4] The majority of solutions depend on behavioural therapies that teach patients how to avoid triggers, lessen bad moods, distract attention from cravings, promote good affective states, lessen stress, establish social support systems, or replace smoking with alternative activities.[5] Unfortunately, less than 5% of the smokers who try to stop each year succeed.[6] The low success rate may be due to the constant presence of smoking cues, such as positive and negative triggers, which make avoidance practically impossible.[7,8] Furthermore, there is substantial evidence that seeking is caused by smoking mainly due to the psychophysical qualities of nicotine, which is one of the reasons nicotine addictions itself is one of the reasons a person craves cigarettes.[9]

Individuals who try to quit smoking and attend physicians are always more focused on smoking abstinence but neglect the mental roller-coaster journey the individual is going through during the duration of smoking cessation. Many people claim that smoking tobacco reduces their stress levels, helps them deal with mental health issues like depression or anxiety, and gives them a sense of relaxation or pleasure.[10] It might, occasionally, feel as though we are robbing them of one of their "greatest pleasures" when we talk about quitting smoking.[11] This is because nicotine contains inside cigarettes, stimulates the body to release numerous pleasureful neurotransmitters.[12,13] Hence, when a person quits smoking, the nicotine level starts to deplete in the system, creating mental health issues such as anxiety, stress and depression. Therefore, addressing mental health issues associated together with smoking cessation is crucial to ensure success in the programme.

By focusing on the aforementioned factors, namely addiction and craving, positive and negative triggering factors, and teaching them to take action, mindfulness therapy (MT) may

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be an effective behavioural treatment to stop smoking. MT has demonstrated great efficacy in psychological disorders involving pain, anxiety and depression.[14] Its primary goal is to sustain and regulate a person's current experience and their sense of acceptance of the sign and symptoms caused by smoking cessation.[15] As a result, rather than experiencing the withdrawal symptoms take control of them, the person will be able to perceive their mental state and acknowledge these changes in their mind and body, which helps them quit smoking and helps in regulating mental health status as well.[16-18]

Reductions in substance usage, such as cocaine, alcohol, marijuana, opiates, amphetamines and cigarettes, were strongly associated with MT.[17,19] However, these experimental plans lacked addressing MT's effectiveness in addressing mental health issues associated with smoking cessation. Therefore, it has been hoped that additional randomised controlled trials will be carried out to examine the effectiveness of MT helps in coping with mental health issues in the journey of smoking cessation. This is especially true in Malaysia, where non-directive counselling strategies are currently used in settings, and studies on mindfulness and quitting smoking in relation to managing mental health issues are lacking. A change in therapeutic practice in Malaysian settings would be made possible by high-quality studies on the effectiveness of MTs conducted in Malaysian populations. Therefore, this study's primary goal was to compare the effectiveness of MT to counselling therapy (CT) through a randomised controlled trial study that was intended to help people quit smoking and aid their mental health.

MATERIALS AND METHODS

This study, a single-blind, randomised control trial, took place between July 2 and September 3, 2022. The study were carried out in Malaysia and before being enrolled in the trial, every participant provided online informed consent.

G-Power software 3.1 were used to estimate sample size.[20] The sample size estimate was based on the references that were available and related to MT in smoking cessation,[21–23] as there hasn't been a study that included MT as a smoking cessation aid in Malaysia. An earlier study conducted in Hong Kong served as the basis for the final pooled effect size, which was 0.475.[24] The final computation tabulated 44 participants with a critical F value of 4.15, a significance level of 0.05 and a power of 0.90. Participants were attracted via social media channels and adverts that promoted and offered behavioural treatments for quitting smoking. Adults aged 18 to 60 were required to meet the following inclusion criteria: they had to be able to understand Malay and English to a some degree, they had to be current residents of Malaysia, and the intensity of smoking should be moderate and severe according to pack year calculation. As for the exclusion criteria, they were as follows: having participated in or been enrolled in any other smoking cessation programme run by a private or public healthcare facility (quit smoking clinics) within the previous three months, using any form of nicotine replacement therapy (including e-cigarettes), currently using any form of psychoactive medication, having a serious or unstable medical or mental condition. Additionally, a study by Magill et al. was used to inspire a few actions that were taken to prevent contamination.[25] One of the steps was for each group to have therapy from a different therapist, which made sure that the therapist does not reveal information about another therapy and that it was monitored through the session recordings. The therapist received training in either mindfulness or counselling, but not in both, depending on the group to which they are assigned. Moreover, every participant was given instructions on how to keep the information they have learned in therapy sessions to themselves; any who fail to abide by this guideline were warranted to be expelled from the programme. Furthermore, concealed from the participants is the type of intervention being taught. Finally, participants who agreed to participate and met the eligibility requirements were randomly assigned to groups A (Mindfulness) and B (Counselling) using computer-generated randomisation software.

The intervention was conducted by licensed clinical psychologists and the counselling therapy is based on the Malaysian Clinical Practice Guidelines Treatment of Tobacco Use Disorder 2016. Meanwhile, MT was based on acceptance and commitment therapy. We employed the "being in the present moment" skills and used breathing and grounding exercises with the clients. Emphasis was put on focusing on the present moment with openness, flexibility, kindness and acceptance of the difficult emotions experienced.

The study began with baseline screening of participants using a series of questionnaires to determine their smoking status, mental status and mindfulness state. Based on this initial data, participants were evaluated for eligibility. The intervention and control groups then underwent three therapy sessions, with a 2- week gap between each session, conducted online using Google Meet. The intervention group received MT, while the control group received CT. The therapists also phoned each participant over the 2-week interval to reinforce the lessons. A series of questionnaires were administered again a week after the third session ended to track the progress towards quitting smoking, and again after 5 weeks. At the end of the study, participants who had stopped smoking tobacco were the main outcome. Using the chi-square test, the abstinence rate was compared between the groups. Meanwhile, the secondary result involved using standardised dual language questionnaires to assess the levels of mindfulness, experiential avoidance, psychological rigidity, depression, stress and anxiety. The number of cigarettes smoked each day was analysed using Generalized Estimating Equation (GEE).

Ethics approval was obtained from the Universiti Malaysia Sabah Ethical Board (Code: JKEtika 2/21 – 9) and registered in the Chinese Clinical Trial Registry (ChiCTR) (ID: ChiCTR2200056204).

RESULTS

A total of 110 people volunteered to participate in the study, but 61 had to be withdrawn due to their ineligibility. The 49 participants who met the eligibility requirements were randomly assigned to one of two groups: MT (Group A = 25) or CT (Group B = 24).

Table I: Categorical baseline data and cigarette smoking abstinence rate at the end of the study result

Variables	Category	Group		N = 49 (%)	Chi²	*p* value
		MT (%)	CT (%)			
Sex	Male	24 (53.3)	21 (46.7)	45 (91.8)	-	0.349**
	Female	1 (25.0)	3 (75.0)	4 (8.2)		
Education level	Degree and above	9 (47.4)	10 (52.6)	19 (38.8)	0.176	0.916*
	Diploma and above	6 (54.5)	5 (45.5)	11 (22.4)		
	SPM	10 (52.6)	9 (47.4)	19 (38.8)		
Medical illness	None	17 (51.5)	16 (48.5)	33 (67.3)	-	1.000**
	Chronic illness (one or more)	8 (50.0)	8 (50.0)	16 (32.7)		
Household income	T20	7 (53.8)	6 (46.2)	13 (26.5)	1.060	0.589*
	M40	11 (57.9)	8 (42.1)	19 (38.8)		
	B40	7 (41.2)	10 (58.8)	17 (34.7)		
Type of cigarettes	Filtered	22 (47.8)	24 (52.2)	46 (93.9)	-	0.235**
	Non-filtered	3 (12.0)	0	3 (6.1)		
Abstinence rate at the end of the study	Quit smoking	4 (66.7)	2 (33.3)	6 (12.2)	-	0.667**
	Still smoking	21 (48.8)	22 (51.2)	43 (87.8)		

*Chi-Square test
** Fisher's Exact test

Table II: Numerical baseline data result

Variables	MT (Mean Rank)	CT (Mean Rank)	MT (Sum Ranks)	CT (Sum Ranks)	Mann-Whitney U	*p* value
Age	23.92	26.12	598.0	627.0	273.0	0.588
No. cigarette	25.94	24.02	648.5	576.5	276.5	0.629
MAAS	24.40	25.63	610.0	615.0	285.0	0.764
AAQ – 2	23.46	26.60	586.5	638.5	261.5	0.440
DASS – Depression	26.02	23.94	650.5	574.5	274.5	0.606
DASS – Anxiety	26.88	23.04	672.0	533.0	253.0	0.340
DASS – Stress	25.04	24.96	626.0	599.0	299.0	0.984
Pack Year	23.76	26.29	594.0	631.0	269.0	0.535

Table III: Association of mindfulness and counselling groups between all variables over time

Variables	Time	Mean		df	Wald Chi²	*p* value
		MT (SD)	CT (SD)			
No. cigarettes smoked	Baseline	16.52 (4.16)	16.04 (4.32)	1	37.78	<0.001
	1st reading	11.72 (3.57)	14.00 (5.23)			
	2nd reading	6.64 (4.46)	13.17 (6.41)			
MAAS	Baseline	60.28 (23.78)	62.88 (20.85)	1	36.47	<0.001
	1st reading	72.56 (12.26)	62.96 (20.78)			
	2nd reading	85.36 (4.70)	63.08 (20.59)			
AAQ-2	Baseline	21.68 (13.71)	24.58 (12.58)	1	10.40	0.001
	1st reading	16.72 (9.28)	23.29 (10.64)			
	2nd reading	11.12 (5.81)	21.42 (9.21)			
DASS- anxiety	Baseline	5.36 (2.81)	4.71 (2.77)	1	33.75	<0.001
	1st reading	4.04 (2.57)	5.38 (2.67)			
	2nd reading	3.52 (2.73)	5.33 (2.78)			
DASS- stress	Baseline	5.24 (3.22)	5.50 (2.52)	1	25.74	<0.001
	1st reading	4.16 (2.64)	12.42 (4.20)			
	2nd reading	3.88 (2.49)	9.50 (5.53)			
DASS - depression	Baseline	5.52 (4.17)	5.08 (3.48)	1	39.68	<0.001
	1st reading	3.92 (3.12)	5.50 (3.55)			
	2nd reading	3.28 (2.82)	5.58 (3.54)			

Table IV: Associated effect of mindfulness therapy and counselling therapy between all the variables over time

Variables (reference = MT)	β	95% Wald Confidence Interval		p-value
		Lower	Upper	
No. cigarettes smoked	-3.50	-4.62	-2.39	<0.001
MAAS	12.44	8.40	16.47	<0.001
AAQ-2	-3.70	-5.94	-1.45	0.001
DASS- anxiety	-1.23	-1.65	-0.82	<0.001
DASS- stress	-2.68	-3.72	-1.65	<0.001
DASS – depression	-1.37	-1.79	-0.94	<0.001

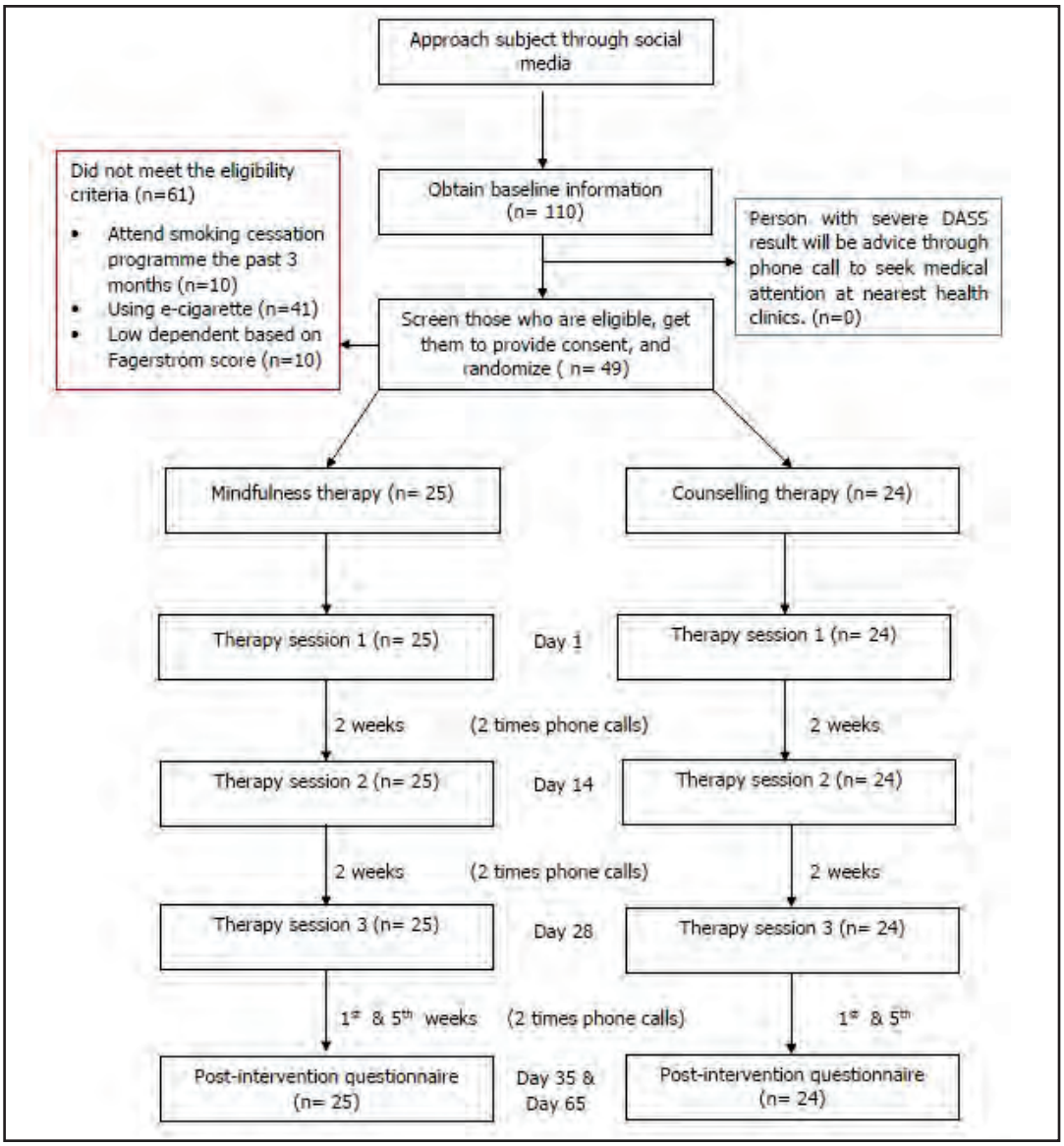

Fig. 1: Study protocol

Both the groups had similar characteristics in terms of sex, age, education level, history of chronic illnesses, family income, cigarette smoking habits, pack year, number of cigarettes smoked per day, Mindful, Attention, Awareness Scale (MAAS), The Acceptance and Action Questionnaire (AAQ-2) score, and Depression, Anxiety and Stress Scale (DASS). All the sociodemographic (sex, education level, chronic medical illness history, household income, type of cigarettes smoked, and pack year) variables tested did not differ significantly differ between the participants of both groups (Tables I and II). Male participants were higher than female participants (8.2%) with a margin of 91.8%. In addition, both the groups smoked almost about the same number of cigarettes per day according to analysis show in Table II.

The MT group had an abstinence rate of 16% (n=4) at the end of the study, while the CT group had an abstinence rate of 8.3% (n=2); however, the p-value was 0.667. The number of cigarettes smoked per day was considerably lower in the MT group at the end of the study compared to the CT group, with a significant p-value of <0.001. Furthermore, there was a significant difference between the MT and the CT group on the MAAS test, with a significant *p* value of < 0.001. At the end of the trial, AAQ-2 score in the MT group (11.12 ± 5.81) improved more than the CT group (21.42 ± 9.21), with a *p* value of 0.001. Even though both the groups' stress levels were normal, we were still able to observe that the CT group experienced higher levels of stress during the smoking cessation phase than the MT group, with a significant p-value of < 0.001. Similar findings seen in the DASS score of anxiety and depression whereby the mental status of the participants in the MT group were under controlled compared to the participants in the CT group.

The regression analysis results, presented in Table IV, demonstrated that the MT group experienced a significant decrease in cigarette consumption of 3.5 cigarettes per day (95% Wald CI: -4.62, -2.39) compared to the CT group over time. This reduction is statistically significant, as indicated by a p-value of <0.001. The analysis also indicates that the MT group showed significant improvements in their AAQ-2 score,

anxiety, stress and depression, with an average reduction of 3.70 (95% Wald CI of –5.94 to -1.45, *p* value 0.001), 1.23 (95% Wald CI of -1.65 to -0.82, *p* value < 0.001), 2.68 (95% Wald CI of -3.72 to -1.65, *p* value < 0.001), and 1.37 (95% Wald CI of -1.79 to – 0.94, *p* value < 0.001), respectively, compared to the CT group over time, after adjusting for time period and intervention groups. Moreover, the MT group demonstrated a significant average increase of 12.44 (95% Wald CI of 8.40 to 16.47, *p* value < 0.001) in their MAAS score compared to the CT group. These findings suggest that the MT intervention can effectively reduce cigarette consumption while preserving mental health status.

DISCUSSION

MT is a systematic programme that teaches individuals how to control their attention and self-control while maintaining an attitude of acceptance and openness to external and internal stimuli.[26,27] Given that the main clinical symptoms of any addiction are intoxication, bingeing, craving and withdrawal. MT may be beneficial as a coping mechanism because it helps people become aware of their intoxication as well as control their bingeing, craving, and withdrawal, which together act as a bulwark against negative emotions and stress reactivity.[27]

This is the first clinical trial in Malaysia to test online MT to aid in smoking cessation. In clinical practice, psychologists may use MT as an integrated part of a smoking cessation programme. However, this is the first time looking at outcomes of an independent mindfulness intervention in an experimental study design. Even though the abstinence rate difference between the MT group and the CT group was statistically insignificant, MT nonetheless showed numerically better abstinence results. The large decrease in daily cigarette consumption is a crucial step in the process of quitting smoking. Researchs suggest that those who smoke fewer cigarettes per day are more likely to succeed in quitting.[28,29] Furthermore, cutting back on cigarette consumption is strongly linked to lower death rates, lower rates of lung cancer and lower rates of respiratory illnesses.[29] MT has shown potential benefits in treating addictions such as cigarette smoking by making the individual more aware, more open to experience, more flexible and more able to remain in the present moment instead of diverting attention to cigarette smoking as a form of experiential avoidance.[30] This is corroborated by a significant increase in the MAAS score in the MT group compared to the CT group in our study. Mindfulness techniques cultivate non-judgemental, non-reactive, present-centred attentional techniques. Moreover, there are additional benefits in increasing metacognitive awareness of cognition, emotion, experience, and perception.[31] This is consistent with mindfulness principles whereby we do not force the participants to resist the urge of smoking. Instead, we focus on improving self-control to handle the urge to smoke with flexibility by adopting mindfulness principles, without necessarily resorting to cigarettes.

Our study also observes a significant reduction in AAQ-2 scores among the participants in the MT group compared to the CT group. AAQ-2 measures the degree of psychological inflexibility and experiential avoidance.[24] This demonstrates that, in comparison to CT, MT not only encourages smokers to be more mindful but also encourages them to be more psychologically adaptable and receptive to psychological situations. This will help the smokers to accept difficult feelings or thoughts without them triggering smoking, but they will be more flexible to adopt different coping mechanisms. Furthermore, the literature indicates that smokers who avoid smoking-related distress or experiences are more likely to experience difficulties quitting, including pre-cessation risk factors (such as perceptions of greater barriers to successful cessation, perceptions of more failed prior quit attempts, perceptions of more severe problematic symptoms while quitting, and perceptions of more negative-reinforcing outcomes of smoking) and post-cessation outcomes (i.e., increased likelihood of cessation failure).[32,33]

One significant barrier to successfully quitting smoking is anxiety, which is a common withdrawal symptom throughout the cessation phase.[34] It can exacerbate withdrawal symptoms, boost smoking motivation, diminish the effectiveness of medication, and make it harder to stop smoking.[35] Also, those who fail to stop smoking while through a smoking cessation programme see a slight rise in long-term anxiety, which becomes a significant obstacle in subsequent attempts to stop.[36] As a result, managing anxiety is essential for a successful smoking cessation. According to our study, mindfulness practise can successfully reduce anxiety during quitting attempts. As a result, it is a helpful aid for those trying to stop smoking.

Stress is one of the obstacles to quitting smoking, according to studies.[37,38] This is due to the fact that numerous studies have found that smokers frequently smoke to relieve stress.[39–41] In addition, a study from Korea found a substantial correlation between stress levels and the inability of smokers to successfully quit,[37] suggesting that smokers who experience stress may find it difficult to stop and have a high risk of relapsing.[36,42,43] In order to increase the success rate of the smoking cessation programme, it is essential to address stress. Since our study was able to show that the MT group experienced a considerable reduction in stress compared to the CT group's fluctuating stress level during the smoking cessation phase. The observed fluctuating stress levels in the CT group may be attributed to various reasons, but it is widely recognised that during the early stages of smoking cessation or reduction, stress levels can rise due to the depletion of the pleasure sensation caused by nicotine. In contrast, the MT group appears to have effectively managed this stress effect, suggesting that MT is a more effective approach. Furthermore, MT has been shown in numerous studies to aid in stress reduction, which will be an important tool in addressing general mental health during the quitting smoking phase.[44,45]

According to previous research, depression is a common occurrence during smoking cessation programs, and there is a correlation between the two.[46] Even individuals who did not initially meet the criteria for major depression may experience worsened depression during the cessation phase.[47] Moreover, depression has been identified as a crucial predictor of successful smoking cessation, as individuals with

depression were found to have a lower likelihood of achieving smoking abstinence compared to those without depression.[48] Similarly, a 20-year longitudinal study reported that depressive symptoms were associated with a lower likelihood of smoking cessation over a long period.[49] In our study, we found that the MT group demonstrated a significant reduction in DASS-Depression compared to the CT group. Although both groups had normal scores on the depression scale at baseline, we noticed a gradual increase in scores in the CT group, possibly due to nicotine withdrawal symptoms. However, the MT group was able to effectively control their depression during the cessation period.

Overall, an online smoking cessation programme is a feasible and effective approach, as both groups show a promising reduction in the number of cigarettes smoked per day and nicotine reduction. Likewise, other studies have also proved that online-based smoking cessation interventions are effective in helping smokers to quit smoking.[50,51] One of the reasons for this success is that it breaks the burden of the clinical visit[51] which is a major barrier for smokers seeking help. Furthermore, they also can negate the feeling of being stigmatised and fear of failure in online smoking cessation programmes because they are not physically present. Feeling stigmatised causes failures in smoking cessation and results in dropouts from the programme.[52] Indeed, online therapy has its own set of challenges, including technical difficulties, distractions, interruptions, limited nonverbal cues, and scheduling difficulties. However, these challenges can be mitigated through careful planning and implementation of appropriate strategies. For example, the use of reliable software and equipment can help minimise technical difficulties. Additionally, providing participants with clear instructions on how to prepare their environment for online therapy sessions can reduce distractions and interruptions. Overall, while online therapy may present some unique challenges, with proper planning and implementation, it can be an effective alternative to traditional in-person therapy.

LIMITATION AND WAY MOVING FORWARD

Since the study relies on respondents filling out questionnaires, information bias could exist, especially when it comes to self-declared smoking abstinence. Therefore, as evidence of cessation, we can potentially add in future research one monthly trip to the closest quit-smoking clinic to have carbon monoxide (CO) levels measured. In a programme to help people stop smoking, a CO analyser can also be used as a motivating tool.[53] Additionally, due to the resource limitations, we could only concentrate on cigarette smokers and had to turn away 41 e-cigarette users. As a result, because contemporary generations prefer e-cigarettes over traditional tobacco cigarettes, we should include e-cigarette users in the upcoming study as well. In our study, time was also a constraint, so we were unable to conduct a long-duration study. Perhaps in the future, a longer follow-up could be conducted to acquire a better understanding of smokers' coping strategies for quitting.

CONCLUSION

While addressing one of the main barriers, mental health, online mindfulness treatment (MT) is more successful in assisting smokers in quitting compared to the present counselling therapy (CT) widely employed in all smoking cessation clinics in Malaysia. Despite the fact that we were not able to observe effectiveness of MT in achieving smoking abstinence, we were able to demonstrate the efficacy of online MT over CT in reducing the number of cigarettes smoked per day. This accomplishment goes hand in hand with addressing mental health by ensuring they are more alert, flexible, receptive to psychological events and capable of controlling stress, anxiety and depression. Furthermore, online therapy platforms provide significant benefits and are realistic, as both levels demonstrated a reduced number of cigarettes smoked per day. Finally, more follow-ups and research should be undertaken using online platforms to examine the effectiveness of larger-scale and longer-term MTs, especially regards to smoking abstinence.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

COMPETING/CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES

1. Elflein J. Topic: Smoking. Statista, November 25, 2020. [cited November 2020] Accessed from https://www.statista.com/topics/1600/smoking/
2. Ritchie H, Roser M. Smoking. Our World in Data, November 25, 2020. [cited November 2020] Accessed from https://ourworldindata.org/smoking
3. World Health Organization. Tobacco 2020, April 13, 2021. [cited April 2021] Accessed from https://www.who.int/news-room/fact-sheets/detail/tobacco
4. Roh S. Scientific evidence for the addictiveness of tobacco and smoking sessation in tobacco litigation. J Prev Med Public Health. 2018; 51(1): 1-5.
5. 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.
6. FDA C for T. Quitting smoking: closer with every attempt. FDA, November 25, 2020. [cited November 2020] Accessed from https://www.fda.gov/tobacco-products/health-information/quitting-smoking-closer-every-attempt
7. Bevins RA, Palmatier MI. Extending the role of associative learning processes in nicotine addiction. Behav Cogn Neurosci Rev 2004; 3(3): 143-58.
8. Buczkowski K, Dachtera-Frąckiewicz M, Luszkiewicz D, Klucz K, Sawicka-Powierza J, Marcinowicz L. Reasons for and scenarios associated with failure to cease smoking: results from a qualitative study among Polish smokers who had unsuccessfully attempted to quit. Patient Prefer Adherence 2021; 15: 2071-84.
9. Fernandes TM de P, Almeida NL de, Santos NA dos. Effects of smoking and smoking abstinence on spatial vision in chronic heavy smokers. Sci Rep. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5431787/ (accessed 15 Dec 2020)
10. Malone V, Harrison R, Daker-White G. Mental health service user and staff perspectives on tobacco addiction and smoking cessation: A meta-synthesis of published qualitative studies. J Psychiatr Ment Health Nurs 2018; 25(4): 270-82.

11. Taylor GMJ, Baker AL, Fox N, Kessler DS, Aveyard P, Munafò MR. Addressing concerns about smoking cessation and mental health: theoretical review and practical guide for healthcare professionals. BJPsych Adv 2021; 27(2): 85-95.
12. Benowitz NL. Pharmacology of Nicotine: Addiction, smoking-induced disease, and therapeutics. Annu Rev Pharmacol Toxicol 2009; 49: 57-71.
13. Quattrocki E, Baird A, Yurgelun-Todd D. Biological aspects of the link between smoking and depression. Harv Rev Psychiatry 2000; 8(3): 99-110.
14. Brewer JA, Sinha R, Chen JA, Michalsen RN, Babuscio TA, Nich C, et al. Mindfulness training and stress reactivity in substance abuse: results from a randomized, controlled stage I pilot study. Subst Abus 2009; 30(4): 306-17.
15. Bishop SR, Lau M, Shapiro S, Carlson L, Anderson ND, Carmody J, et al. Mindfulness: A proposed operational definition. Clinical Psychology: Science and Practice 2004; 11(3): 230-41.
16. Brewer JA, Bowen S, Smith JT, Marlatt GA, Potenza MN. Mindfulness-based treatments for co-occurring depression and substance use disorders: what Can we learn from the brain? Addiction 2010; 105(10): 1698-706.
17. Chan EY. Mindfulness and smoking frequency: An investigation with Australian students. Addictive Behaviors Reports 2021; 13: 100342.
18. Teasdale JD, Moore RG, Hayhurst H, Pope M, Williams S, Segal ZV. Metacognitive awareness and prevention of relapse in depression: empirical evidence. J Consult Clin Psychol 2002; 70(2): 275-87.
19. Chiesa A, Serretti A. Are mindfulness-based interventions effective for substance use disorders? A systematic review of the evidence. Subst Use Misuse 2014; 49(5): 492-512.
20. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. Behavior Research Methods 2009; 41(4): 1149-60.
21. 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.
22. Gifford EV, Kohlenberg BS, Hayes SC, Antonuccio DO, Piasecki MM, Rasmussen-Hall ML, et al. Acceptance-based treatment for smoking cessation. Behavior Therapy 2004; 35(4): 689-705.
23. 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.
24. Mak YW, Loke AY. The acceptance and commitment therapy for smoking cessation in the primary health care setting: a study protocol. BMC Public Health 2015; 15(1): 105.
25. Magill N, Knight R, McCrone P, Ismail K, Landau S. A scoping review of the problems and solutions associated with contamination in trials of complex interventions in mental health. BMC Med Res Methodol 2019; 19(1): 1-13.
26. Hölzel BK, Lazar SW, Gard T, Schuman-Olivier Z, Vago DR, Ott U. How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. Perspect Psychol Sci 2011; 6(6): 537-59.
27. Tang YY, Yang L, Leve LD, Harold GT. Improving executive function and its neurobiological mechanisms through a mindfulness-based intervention: advances within the field of developmental neuroscience. Child Dev Perspect. 2012; 6(4): 361-6.
28. Begh R, Lindson-Hawley N, Aveyard P. Does reduced smoking if you can't stop make any difference? BMC Med 12; 13: 257.
29. Inoue-Choi M, Hartge P, Park Y, Abnet CC, Freedman ND. Association between reductions of number of cigarettes smoked per day and mortality among older adults in the United States. American Journal of Epidemiology. 2019; 188(2): 363-71.
30. Cavicchioli M, Movalli M, Maffei C. The clinical efficacy of mindfulness-based treatments for alcohol and drugs use disorders: a meta-analytic review of randomized and nonrandomized controlled trials. EAR 2018; 24: 137-62.
31. Lutz A, Slagter HA, Dunne JD, Davidson RJ. Attention regulation and monitoring in meditation. Trends Cogn Sci 2008; 12(4): 163-9.
32. Farris SG, Zvolensky MJ, Schmidt NB. Smoking-specific experiential avoidance cognition: explanatory relevance to pre- and post-cessation nicotine withdrawal, craving, and negative affect. Addict Behav 2015; 44: 58-64.
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.
34. McHugh RK, Votaw VR, Fulciniti F, Connery HS, Griffin ML, Monti PM, et al. Perceived barriers to smoking cessation among adults with substance use disorders. J Subst Abuse Treat 2017; 74: 48–53.
35. Piper ME, Cook JW, Schlam TR, Jorenby DE, Baker TB. Anxiety diagnoses in smokers seeking cessation treatment: relations with tobacco dependence, withdrawal, outcome, and response to treatment. Addiction 2011; 106(2): 418-27.
36. McDermott MS, Marteau TM, Hollands GJ, Hankins M, Aveyard P. Change in anxiety following successful and unsuccessful attempts at smoking cessation: cohort study. Br J Psychiatry 2013; 202(1): 62-7.
37. Kim YJ. Predictors for successful smoking cessation in Korean adults. Asian Nurs Res (Korean Soc Nurs Sci) 2014; 8(1): 1-7.
38. Stubbs B, Veronese N, Vancampfort D, Prina AM, Lin PY, Tseng PT, et al. Perceived stress and smoking across 41 countries: A global perspective across Europe, Africa, Asia and the Americas. Sci Rep 2017; 7: 7597.
39. Kouvonen A, Kivimäki M, Virtanen M, Pentti J, Vahtera J. Work stress, smoking status, and smoking intensity: an observational study of 46 190 employees. Journal of Epidemiology & Community Health 20051; 59(1): 63-9.
40. Lawless MH, Harrison KA, Grandits GA, Eberly LE, Allen SS. Perceived stress and smoking-related behaviors and symptomatology in male and female smokers. Addict Behav 2015; 51: 80-3.
41. Perski O, Theodoraki M, Cox S, Kock L, Shahab L, Brown J. Associations between smoking to relieve stress, motivation to stop and quit attempts across the social spectrum: A population survey in England. PLOS ONE 2022; 17(5): e0268447.
42. Dupont P, Reynaud M, Aubin HJ. [Stress and smoking in treatment-seeking smokers]. Rev Med Liege 2012; 67(4): 195–201.
43. Kim O, Kim JH, Jung JH. Stress and cigarette smoking in Korean men with diabetes. Addict Behav 2006; 31(5): 901-6.
44. Bartlett L, Buscot MJ, Bindoff A, Chambers R, Hassed C. Mindfulness is associated with lower stress and higher work engagement in a large sample of MOOC participants. Frontiers in Psychology. https://www.frontiersin.org/articles/10.3389/fpsyg.2021.724126 (accessed 15 Feb 2023)
45. Sharma M, Rush SE. Mindfulness-based stress reduction as a stress management intervention for healthy individuals: a systematic review. J Evid Based Complementary Altern Med 2014;19(4): 271-86.
46. Lembke A, Johnson K, DeBattista C. Depression and smoking cessation: Does the evidence support psychiatric practice? Neuropsychiatr Dis Treat 2007; 3(4): 487-93.
47. Catley D, Harris KJ, Okuyemi KS, Mayo MS, Pankey E, Ahluwalia JS. The influence of depressive symptoms on smoking cessation among African Americans in a randomized trial of bupropion. Nicotine Tob Res 2005; 7(6): 859-70.
48. Stepankova L, Kralikova E, Zvolska K, Pankova A, Ovesna P, Blaha M, et al. Depression and smoking cessation: evidence from a smoking cessation clinic with 1-year follow-up. Ann Behav Med 2017; 51(3): 454-63.
49. Ranjit A, Latvala A, Kinnunen TH, Kaprio J, Korhonen T. Depressive symptoms predict smoking cessation in a 20-year longitudinal study of adult twins. Addictive Behaviors 2020; 108: 106427.

50. Kant R, Yadav P, Bairwa M. Effectiveness of the internet-based versus face-to-face interaction on reduction of tobacco use among adults: a meta-analysis. Cureus 2021; 13(11): e19380.
51. Kato A, Tanigawa T, Satake K, Nomura A. Efficacy of the ascure smoking cessation program: retrospective study. JMIR Mhealth Uhealth 2020; 8(5): e17270.
52. Lozano P, Thrasher JF, Forthofer M, Hardin J, Shigematsu LMR, Arillo Santillán E, et al. Smoking-related stigma: a public health tool or a damaging force? Nicotine Tob Res 201825; 22(1): 96-103.
53. Vasthare. Carbon monoxide breath analyzers and its role in tobacco cessation: A narrative review of literature. 2018. January 26, 2023. [cited January 2023] Accessed from https://www.jioh.org/article.asp?issn=0976-7428;year=2018;volume=10;issue=2;spage=71;epage=76;aulast=Vasthare