



An investigation into the effects of a short-term mindfulness intervention on stress and cigarette smoking in young adults.

Charlotte Emma Stewart

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### ABSTRACT

Cigarette smoking among young adults is increasing, with a recent survey showing that more than half of the UK's 20-24 year olds are nicotine dependant (ASH, 2013). There is emerging evidence that mindfulness practice has the potential to reduce smoking in young adults (Bowen & Marlatt 2009; Tang & Posner, 2013; Davis *et al.*, 2013), possibly through stress reduction (Davis *et al.*, 2007). Eight-teen young adult smokers were randomly assigned to either a mindfulness condition or an active control condition to investigate whether a short-term mindfulness intervention would reduce stress and smoking and improve trait mindfulness over a three week period. The mindfulness condition experienced significant increases in trait mindfulness and significant reductions of self-reported stress and smoking from pre-post intervention. No significant changes in any of the variables were found for the control condition. The current study therefore offers promising results for the efficacy of short-term mindfulness interventions for young adult smokers.

KEY  
WORDS:

TRAIT  
MINDFULNESS

STRESS

SMOKING

SHORT-TERM  
INTERVENTION

## Introduction

Cigarette smoking is the primary preventable cause of mortality and morbidity worldwide, associated with approximately 5 million deaths each year (Jha *et al.*, 2006). Smoking rates are reported highest among young adults, with a recent survey proclaiming that 58% of the UK's 20-24 year olds are nicotine dependant (ASH, 2013). Thus, it is not surprising that many of the chronic diseases related to smoking are more common among those who develop nicotine dependence at a young age (Doll *et al.*, 2004). It is therefore anticipated that smoking cessation early in life could be undoubtedly valuable in terms of reduced mortality (Edwards, 2004). Nevertheless, there has been only a slight progression in the growth of interventions targeted to young adult smokers (Rutter, 1990; Piper, 2000), which have had limited success (Fiore *et al.*, 1990). Fortunately, there is emerging potential for complementary therapies, particularly mindfulness, which is becoming increasingly recognised for its ability to enhance recovery from smoking addiction.

One of the most frequently cited descriptions of mindfulness is the awareness that occurs through “paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally” (Kabat-Zinn, 1994, p.4). Whereas Brown & Ryan (2003) see mindfulness as a single component, comprising of receptive attention to and awareness of current experiences and events, others posit that mindfulness is a multifaceted state (Bishop *et al.*, 2004). Though encouraged for centuries as a part of Buddhist traditions, the application of mindfulness to psychological health and well-being in Western Psychology is a relatively new phenomenon, largely beginning in the 1970's (Kabat-Zinn, 1982). It is theorised that mindfulness can increase moment-by-moment awareness of internal and external experiences, which contribute to emotional distress and maladaptive behaviour (Bishop *et al.*, 2004). Typically, it is taught using a variety of meditation exercises that encourage individuals to focus on the task at hand, thus attention is not entangled in the past or future and we are not rejecting what is occurring at the present moment (Germer, 2005).

The most widely used method of mindfulness training is mindfulness-based stress reduction (MBSR), an 8 week stress reduction programme, developed by Jon Kabat-Zinn, now taught in over 200 institutions worldwide (Siahpush & Carlin, 2006). MBSR is deep-rooted in principles of mind-body medicine and offers itself to anyone who wishes to learn to develop his or her own health (Kabat-Zinn, 1990). The MBSR course typically requires participants to commit to 8 weekly 2.5 hour long classes and one 7-hour 'day of mindfulness' usually at the 6 week mark. Participants are also expected to complete 45 minutes of daily formal practice for the entire 8 week program, those of which include, the body scan, sitting meditation and hatha yoga (Carlson & Garland, 2005). The theoretical premise on which MBSR was developed is that with repeated training in mindfulness meditation, individuals will be more able to accept and escape from dysfunctional patterns of thinking and behaviour (Keng, Smoski & Robins, 2011).

Many studies have found that self-report measures of trait mindfulness significantly increase with mindfulness training. Particularly, Keng, Ekblad & Brantley (2012) found that an 8-week MBSR programme significantly increased trait mindfulness and decreased absent-mindedness from pre-post intervention. Recently, the utility of

mindfulness in treating addictions has been assessed (Brewer et al., 2009; Bowen et al., 2009), and more specifically smoking (Davis et al., 2007; Bowen & Martlett, 2009; Brewer et al., 2011; Tang, Tang & Posner, 2013; Davis et al., 2013).

A mechanism postulated for the use of mindfulness training in smokers is that mindfulness can be used as a cognitive skill to manage the urges, cravings and emotional distress that accompany nicotine addiction. By teaching individuals to merely just observe aversive mind and body states instead of reacting to them, mindfulness training may help individuals detach themselves from any physically unpleasant withdrawal sensations or negative emotions and thoughts (Bowen et al., 2011).

Furthermore, there is evidence to suggest that mindfulness-based interventions may be effective in reducing stress, a trigger for tobacco use (Carmody & Baer, 2008 & Shapiro et al., 2005). Specifically, research by Tang et al., (2007) found that, compared to a control group, participants in a short-term mindfulness intervention experienced significant reductions in stress. This is consistent with other research that suggests mindfulness is an effective way to alleviate stress in a student population (Keng et al., 2011 & Warnecke et al., 2011).

Stress is believed to decrease self-control, increase impulsivity and consequently increase the risk of cigarette smoking (Ansell Gu & Sinha, 2012). A significant correlation between stress, smoking rate and relapse rate has been well documented. Particularly studies on personality (Caplan, Cobb & French, 1975), financial stress (Siahpush & Carlin, 2006) and social stress (Niaura et al., 2002). Thus, supporting the assumption that mechanisms related to stress are critical in the development of addictions (Brady & Sinha, 2005).

The transactional theory (Lazarus & Folkman, 1984) understand stress as the "relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus & Folkman, 1984, p.19). Events in people's lives are not themselves naturally stressful but it is an individual's primary appraisal of a situation (judging it as good, bad, neutral or threatening) in conjunction with their secondary appraisal (availability of ones coping resources) which governs how they experience a particular event (Lazarus & Folkman. 1984). Mindfulness may work by reducing negative cognitive appraisals of certain events and experiences. Less defensive, more willing exposure to threatening situations are encouraged and as a result lower levels of perceived stress are produced. In addition, it is hypothesised that mindfulness may produce an improved ability to adaptively cope with stressful situations (Weinstein, Brown & Ryan, 2009). It is therefore possible that mindfulness training may be effective in reducing cravings and smoking through stress reduction.

Davis et al., (2007) conducted the first study to test the feasibility of an 8-week MBSR intervention for smokers. Measures of self-reported mindfulness, stress and smoking were taken at one day, eight days and 6 weeks post quit. At the 6 week post quit visit, 10 of the 18 subjects had achieved smoking abstinence, demonstrated substantial decreases in perceived stress and a significant increase in self-reported mindfulness. Overall, the results from this MBSR pilot study demonstrate encouraging findings for smoking cessation, perhaps through stress reduction. However, a principal limitation to the interventions effectiveness is the absence of a

control group. Ideally, a control condition that was structurally similar to the mindfulness intervention should have been implemented.

A recent study by Brewer *et al.*, (2011) endeavoured to address the flaws of such research. Eighty-eight nicotine dependant adults, who smoked an average of 20 cigarettes per day, were randomly assigned to 4 weeks of mindfulness training (MT) or the American Lung Association's Freedom from Smoking (FFS) treatment. Both treatments were delivered twice weekly over the four week period in a group format, participants were also provided with a meditation practice CD and home practice was suggested. Self-report measures and carbon monoxide testing showed a significant greater rate of reduction in cigarette use in those who received MT, compared to those in the FFS intervention, at the end of the intervention and at follow up. Thus, support is provided for the greater benefits of mindfulness training compared to the current standard treatments for smoking cessation.

As previously mentioned, there is currently a shortage of interventions for young adult smokers. However, Davis *et al.*, (2013) recently explored the effects of mindfulness training as a treatment for smoking addiction in 18-28 year olds. Participants were randomly assigned to receive mindfulness training for smokers (MTS), or interactive learning for smokers (ILS). MTS incorporated similar techniques to MBSR but also included direct training on how to use mindfulness to manage urges, withdrawal symptoms and stressful situations. Both interventions lasted six weeks consisting of six- 2 hour weekly classes, daily home practice was also assessed. Post-intervention assessments revealed that MTS compared to ILS participants showed significantly greater number of days abstinent and scored significantly higher on the Frieburg Mindfulness Inventory (FMI) (Walach *et al.*, 2006). However, a major limitation in this study was high attrition at every phase, recruitment, retention and follow up. One possible reason for this is that young adult smokers are not very interested in lengthy treatments such as those offered in this study (Davis *et al* 2013).

Importantly, Bowen & Marlatt (2009) investigated the effects of a brief (90 minutes) mindfulness intervention for smoking cessation with undergraduate smokers. In comparison to the control group, those who received mindfulness training smoked significantly fewer cigarettes over a 7-day follow up period. Results therefore suggest that it may be possible to reduce smoking with only a few hours of mindfulness training.

More recently, Tang and Posner (2013), also examined the effectiveness of a short-term mindfulness based intervention for young adult smokers. After only 2 weeks of mindfulness training (5hrs in total), objective Carbon monoxide (CO) breath testing and the self-report Fagerstrom Test for Nicotine Dependence (FTND) (Heatherton *et al.*, 1991) showed a significant smoking reduction for the mindfulness group but not for the control group. Importantly, those in the mindfulness condition also reported significant changes in self-reported mindfulness from pre intervention to post intervention (2 weeks post-quit). This study provides promising results for the effectiveness of short-term mindfulness interventions for smoking reduction.

Overall, past research (Davis *et al.*, 2007; Bowen & Martlett, 2009 Brewer *et al.*, 2011; Tang, Tang & Posner, 2013; Davis *et al.*, 2013) has demonstrated preliminary evidence for the efficacy of mindfulness training as a treatment for nicotine addiction, perhaps through stress reduction (Davis *et al.*, 2007; Keng *et al.*, 2011; Lynch *et al.*,

2011 & Warnecke *et al.*, 2011). However, few mindfulness based interventions have shown promise for smoking cessation in young adults (Bowen & Marlatt, 2009; Davis *et al.*, 2013; Tang, & Posner, 2013). What's more, as the majority of existing interventions are both lengthy and costly, additional studies which assess the usefulness of short term interventions are warranted.

The current study therefore aimed to further investigate the efficacy of a less time-consuming mindfulness intervention for young adult smokers. A field experiment was employed to compare the effects of a 3-week mindfulness-based intervention to an active control condition. Self-report measures of mindfulness, stress and smoking were used to assess changes from pre intervention to post intervention (7-days post-quit).

It was firstly hypothesised that participants in the mindfulness intervention would report a significant increase in trait mindfulness from week 1 to week 4. Secondly, it was hypothesised that the mindfulness condition would report a significant decrease in stress from week 1 to week 4. Thirdly, it was hypothesised that participants in the mindfulness intervention would report a significant reduction in smoking from week 1 to week 4. No significant changes in any of the variables from week 1 to week 4 were expected for the control condition.

## **Methodology**

### **Study Design**

The study followed a randomized, controlled, pre-test, post-test, 2x2 mixed field experiment. The independent between-subjects variable was group type (mindfulness vs. Control) and the independent within-subjects variable was assessment time (week 1 and week 4). The dependant variables were scores in mindfulness, stress and smoking as measured by self-report questionnaires.

### **Study Population and Recruitment**

A power analysis calculated using G\* Power, 3.1.3 (Faul *et al.* 2007) determined that a minimum of 36 participants were needed overall, with a medium effect size, power of .80 and an alpha value of .05.

Inclusion criteria required subjects to be 18-29 years of age, smoke 10+ cigarettes/day and report an interest in quitting smoking. Study inclusions are reflective of previous mindfulness smoking interventions (Davis *et al.*, 2007; Brewer *et al.*, 2011; Davis *et al.*, 2013)

Participants were recruited using opportunity sampling around a University Campus with the help of informative posters. Advertisements used the statement 'Quit Smoking Study' without reference to a mindfulness intervention and included a contact email address (see appendix 1). Those interested attended an orientation session, after which participants were randomly allocated to either the experimental or control condition. Other studies have followed similar procedures in their recruitment process (Davis *et al.*, 2007 & Davis *et al.*, 2013).

A total of 18 participants completed treatment and testing (7-days post-quit assessment), including (n = 9) for the mindfulness condition and (n = 9) for the control condition.

## Materials

### Self-report Questionnaires (Appendices 3-8).

The Fagerstrom Test for Nicotine Dependence (FTND) (Heatherton, Kozlowski, Frecker & Fagerstrom, 1991) is the most commonly used way to rapidly assess nicotine dependence (Fagerstrom, Heatherton & Kozlowski, 1990) and has been used as a proxy measure of smoking reduction in mindfulness-based interventions (Tang, Tang & Posner, 2013). The 6 item questionnaire shows good overall internal consistency ( $\alpha = .61$ ) (Heatherton, Kozlowski, Frecker & Fagerstrom, 1991) and correlates well with biological measures of smoking severity (Heatherton *et al.*, 1991). Participants are asked to respond to the questions using a 5-point Likert scale (0 = never, 1 = sometimes, 2 = most of the time, 3 = always), with 7 to 10 points = highly dependent; 4 to 6 points = moderately dependent; less than 4 points = minimally dependent.

The Freiburg Mindfulness Inventory (FMI) (Walach *et al.*, 2006) is a 14 item, widely used questionnaire designed to measure trait mindfulness. Items are rated on a 4 point Likert scale (1 = rarely, 4 = almost always), with a high total score representing a high level of mindfulness, the maximum score being 56 and the lowest 14. The scale demonstrates acceptable internal consistency with a Cronbach's alpha of .86 (Walach *et al.*, 2006) and has served as a useful tool in previous mindfulness-based interventions for smoking cessation (Davis *et al.*, 2007; Davis *et al.*, 2013).

The Perceived Stress Scale (PSS) (Cohen, Kamarck & Mermelstein, 1983) is a 10 item scale that measures affective reactions to stressors. The scales shows good internal consistency ( $\alpha = .76$ ) and has been used in numerous studies to measure the influence of mindfulness training on stress (Teasdale 2004; Marcus *et al.*, 2003). The PSS allows for responses on 5-point Likert scale (0 = never and 4 = very often) with higher score totals representing higher levels of stress, the highest score being 40 and the lowest being 0. The scale shows good internal consistency ( $\alpha = .76$ ) (Cohen, Kamarck & Mermelstein, 1983) and has been used in numerous studies to measure the influence of mindfulness training on stress (Davis *et al.*, 2007; Keng *et al.*, 2011; Warnecke *et al.*, 2011).

The Toronto Mindfulness Scale (TMS; Lau *et al.*, 2006) is a 13-item scale used to measure participant's engagement with the mindfulness meditation practice. It comprises two subscales (observing and decentering) which are rated on a 5-point Likert scale from 0 (not at all) to 4 (very much). Higher total scores indicate a higher state of mindfulness, the highest score being 52 and the lowest score 0. The TMS has good overall consistency with a Cronbach's alpha of .91 (Lau, 2006).

The Timeline Followback (TLFB) calendar (Sobell & Sobell, 2000) is a valid and reliable method of testing smoking abstinence in both adults and adolescents (Colby *et al.*, 2005). Participants were asked to log cigarette consumption via TLFB for 7 days after the quit day. Participants were also provided with an adapted version of the TLFB and were asked to record the number of minutes of 'formal' mindfulness practiced each day. Both calendars were not used in this study to analyse smoking reduction or compliance with meditation but were used as motivators to encourage participants to quit smoking and complete the meditation exercises at home.

Permission was obtained for the use of all questionnaires.

## Recordings and Podcasts

### Group

### sessions

Participants in the mindfulness condition listened to recordings from Jon Kabat-Zinn's Guided Mindfulness Meditation (Kabat-Zinn, 2005). Week one was Track 1 – What Is Mindfulness from series 1 and Track 1- Breathscape from Series 3. Week two provided Track 1- The Body Scan from series 1.

Short video clips from Davis *et al.*, (2013) 'Mindfulness Training for Smokers' (MTS) were also included in each session. Week one was Part 1 Video 4 - Mindfulness of Urges and week two was Part 3 Video 2- Mindfulness of Smoking Triggers.

The intervention was representative of other mindfulness interventions for smoking cessation, such as Davis *et al.*, (2013), who incorporated MBSR recordings with MTS materials. Permission for the use of all materials was obtained for experimental use prior to the onset of the study (See Appendix 9).

The control group listened to tobacco-related podcasts from the 'Centre for Addiction and Mental Health' website. Week one was 'Quitting Smoking is a Journey' and 'Smoking Cessation in Addiction Treatment'. Week two was Part 1- 'Responds to Student's Thoughts about Smoking' and Part 2- 'Responds to Students Thoughts about Smoking' from the Teens & Tweens Series. Health information has been validated by Farrelley, Niederdeppe & Yarsevich (2003) who found that it can raise awareness and improve attitudes about tobacco use in young adults.

Overall, the mindfulness and control groups listened to recordings for the same length of time which was approximately 80 minutes over the two group sessions.

### Homework

For the third week of the intervention, both conditions were provided with a range of materials for home use. For mindfulness participants these included Part 3 Video 3 - A Moment of Mindfulness, Part 2 Video 1 - Mindfulness Meditation, a '15 minute guided meditation' and a '30 minute guided meditation', from MTS (Davis *et al.*, 2013). The control condition were provided with health educational audio-recordings; 'How Many People Die from Smoking Each Year', 'Why is Smoking Bad For You- The Reasons Why' ' What Diseases Can You Get From Smoking' and finally 'How Does Smoking Hurt Your Lungs- the truth' (Burrows, N/D).

### Procedure

Participants were randomly assigned to a mindfulness condition or a control condition and a quit date was provided. Both interventions lasted three weeks with identical schedules. Firstly, participants attended two group sessions, once a week for two weeks in which they listened to a range of recordings. For the third week of the intervention all participants were provided with homework and were instructed to spend at least 15 minutes per day listening to the recordings ,individually at home, seated and wearing headphones. At the end of the 3-week intervention participants in both conditions were asked to make a quit smoking attempt.

Baseline measurements of all variables (mindfulness, stress, & smoking) were assessed pre-intervention at week 1 and again post-intervention at week 4 (7 days post-quit).

To ensure any changes could be attributed specifically to the mindfulness intervention the control condition followed a structurally similar format. For example, group sessions were of the same intensity and length and were conducted in controlled environments on the same day of the week. The same written instructions were provided which informed participants whether they were in group A (mindfulness) or group B (control) so they could access the appropriate recordings (see appendix 10). As group support has been found to be a beneficial aspect of an intervention (Chiesa & Serretti, 2009), participants in both conditions were instructed not to discuss the exercises throughout the course of the study.

The Toronto Mindfulness Scale (TMS; Lau et al., 2006) was administered at the end of each group session, immediately after the participants had listened to the recordings. The TMS was used as a manipulation check, to make sure participants were fully engaged with the meditation exercises. To keep the conditions structurally similar the control condition were provided with a set of questions pertaining to their recordings (see appendix 11).

## **Ethics**

Ethical issues were taken into account and BPS guidelines were followed. Informed consent was obtained prior to the onset of the study (Appendix 12) and participants were debriefed once the final set of questionnaires had been collected (Appendix 13). One potential ethical issue was that whilst the mindfulness group received an intervention aimed at improving stress and nicotine dependence, the control group were asked to give up the same amount of time yet were not expected to receive any beneficial changes. However, the control recordings were purposely chosen due to their interesting educational content and participants in the control group were offered information about mindfulness-based interventions after the study had ended. See appendices 14 for AEAF form.

## **Results**

### **Preparation of data**

All raw data from the mindfulness ( $n = 9$ ) and control ( $n=9$ ) groups were entered into IBM SPSS statistics 19.0 to be analysed. All data output can be found in Appendix 15. Following data input from all questionnaires, reverse item questions from the FMI and the PSS were reverse scored, in line with the author's instructions, and total scores for each questionnaire at each assessment time (week 1 and 4) were calculated. To check internal consistency reliability, Cronbach's alpha ( $\alpha$ ) coefficients were generated for each scale at each assessment time. With the exception of the TMS 1 which has an  $\alpha$  coefficient of .81, TMS 2 which has an  $\alpha$  of .08 and the FTND week 1 which has an  $\alpha$  of .81, all scales were found to have an  $\alpha$  significantly above 0.7, representing satisfactory reliability (Nunnally, 1978). This is demonstrated in Table 1.

**Table 1**  
**Internal consistency (reliability) and confidence intervals for all measures at each assessment time**

| Measure <sup>1</sup> |        | Number<br>items<br>measure | of<br>in | Reliability<br>$\alpha$ | 95% Confidence<br>Interval for alpha |       |
|----------------------|--------|----------------------------|----------|-------------------------|--------------------------------------|-------|
|                      |        |                            |          |                         | Lower                                | Upper |
| FMI                  | week 1 | 14                         |          | .89***                  | .80                                  | .95   |
| FMI                  | week 4 | 14                         |          | .96***                  | .92                                  | .98   |
| PSS                  | week 1 | 10                         |          | .85*                    | .73                                  | .94   |
| PSS                  | week 4 | 10                         |          | .94***                  | .90                                  | .98   |
| FTND                 | week 1 | 6                          |          | .81                     | .62                                  | .92   |
| FTND                 | week 4 | 6                          |          | .88**                   | .76                                  | .95   |
| TMS                  |        | 13                         |          | .81                     | .55                                  | .95   |
| TMS 2                |        | 13                         |          | .08                     | -1.14                                | .75   |

Note: F test with true value = 0.7, \*  $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$

Owing to the fact that the TMS (2) demonstrated unacceptable reliability (0.8), the TMS could not be used as a manipulation check for the remainder of the study.

Pre-intervention measurements are referred to as week 1 measurements and post-intervention measurements are referred to as week 4 measurements for the FTND, FMI and PSS from this point forward.

## Hypothesis One

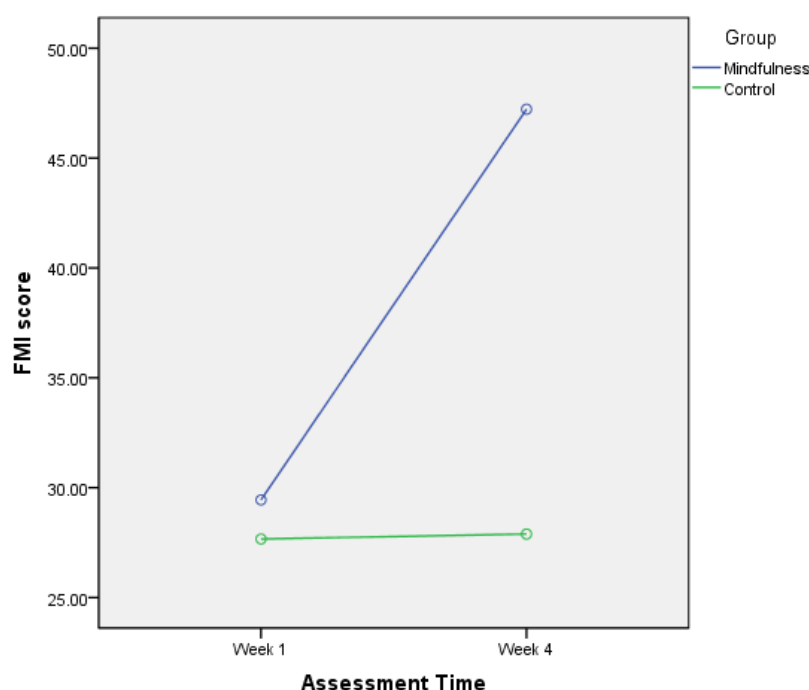
To determine whether trait mindfulness had significantly increased from week 1 to week 4, FMI scores were measured pre-intervention and post-intervention in both conditions. Table 2 provides the means and standard deviations for the FMI at week 1 and 4.

<sup>1</sup> FTND= Fagerstrom Test for Nicotine Dependence, PSS= Perceived Stress Scale, FMI= Freiburg Mindfulness Inventory.

**Table 2**  
**Descriptive statistics for the FMI at week 1 and week**

| <b>Participant group</b> |             |           |          |           |              |           |
|--------------------------|-------------|-----------|----------|-----------|--------------|-----------|
|                          | Mindfulness |           | Control  |           | Total Sample |           |
|                          | (n = 18)    |           | (n = 18) |           | (N = 18)     |           |
| <b>Assessment Time</b>   | <i>M</i>    | <i>SD</i> | <i>M</i> | <i>SD</i> | <i>M</i>     | <i>SD</i> |
| <b>FMI week 1</b>        | 29.44       | 8.55      | 27.67    | 7.00      | 28.56        | 7.46      |
| <b>FMI week 4</b>        | 47.22       | 2.91      | 27.89    | 7.69      | 37.56        | 11.43     |

A 2 X 2 mixed factorial ANOVA<sup>2</sup> was conducted, where the within-subjects independent variable was assessment time (week 1 and week 4), the between-subjects independent variable was condition (mindfulness or control) and the dependant variable was the FMI score.<sup>3</sup> A significant main effect for assessment time was found,  $F(1, 16) = 48.49$ ,  $p < .001$  and for condition  $F(1,16) = 13.02$ ,  $p = .002$ . A significant interaction effect was also observed,  $F(1,16) = 46.12$ ,  $p < .001$ . Figure 1 illustrates this interaction.



<sup>2</sup> ANOVA (analysis for variance) is employed for analysis when there are more than two conditions. It is a powerful technique which allows the researcher to identify changes between variables from pre-post intervention. (Coolican, 2009)

<sup>3</sup> All significance values reported are two-tailed with an alpha level of .05 unless otherwise stated.

**Figure 1: A plot to illustrate the interaction between condition (mindfulness or control) and assessment time (week 1 and week 4) for the FMI**

### Post-hoc Tests

To determine the source of significance found within the ANOVA, appropriate post-hoc tests were conducted. Two independent t-tests and two paired-sample t-tests were conducted.<sup>4</sup> The first independent t-test was conducted on FMI scores week 1 where the independent variable was condition (mindfulness or control) and the dependant variable was FMI scores. FMI scores were not significantly different between the mindfulness ( $M = 29.44$ ) and the control condition ( $M = 27.66$ ) at week 1,  $t(16) = .49$ ,  $p = .63$ .<sup>5</sup> The second independent t-test was conducted on FMI scores week 4 where the independent variable was condition (mindfulness or control) and the dependent variable was FMI scores. FMI scores were significantly higher for the mindfulness condition ( $M = 47.22$ ) compared to the control condition ( $M = 27.89$ ) at week 4, with a small effect size<sup>6</sup>,  $t(10) = 7.06$ ,  $p < .001$ ,  $d = 0.33$ .<sup>7</sup>

Two paired-sample t-tests were then performed separately on both groups. The independent variable was assessment time (week 1 & week 4) and the dependant variable was FMI scores. A significant increase in FMI scores was found for the mindfulness condition from week 1 ( $M = 29.44$ ) to week 4 ( $M = 47.22$ ), with a medium effect size,  $t(8) = 7.28$ ,  $p < .001$ ,  $d = .52$ . No significant difference was found for the control condition from week 1 ( $M = 27.67$ ) to week 4 ( $M = 27.89$ ),  $t(8) = .26$ ,  $p = .799$ . Overall, the two groups did not significantly differ in FMI scores at week 1 but did significantly differ at week 2 with the mindfulness condition showing a significant increase in FMI scores.

### Hypothesis Two

To determine whether stress levels significantly decreased from week 1 to week 4, PSS scores were measured from pre-post intervention in both conditions. Table 3 provides the means and standard deviations for the PSS for both the mindfulness and control condition at weeks 1 and 4.

**Table 3**  
**Descriptive statistics for the PSS at week 1 and week 4**

| Participant group |   |          |   |              |   |    |
|-------------------|---|----------|---|--------------|---|----|
| Mindfulness       |   | Control  |   | Total Sample |   |    |
| (n = 18)          |   | (n = 18) |   | (N = 18)     |   |    |
| Assessment Time   | M | SD       | M | SD           | M | SD |

<sup>4</sup> To control for four pairwise comparisons the Bonferroni correction provided a new significance value of 0.0125.

<sup>5</sup> Levenes test for equality of variance was not significant, thus equal variances were assumed.

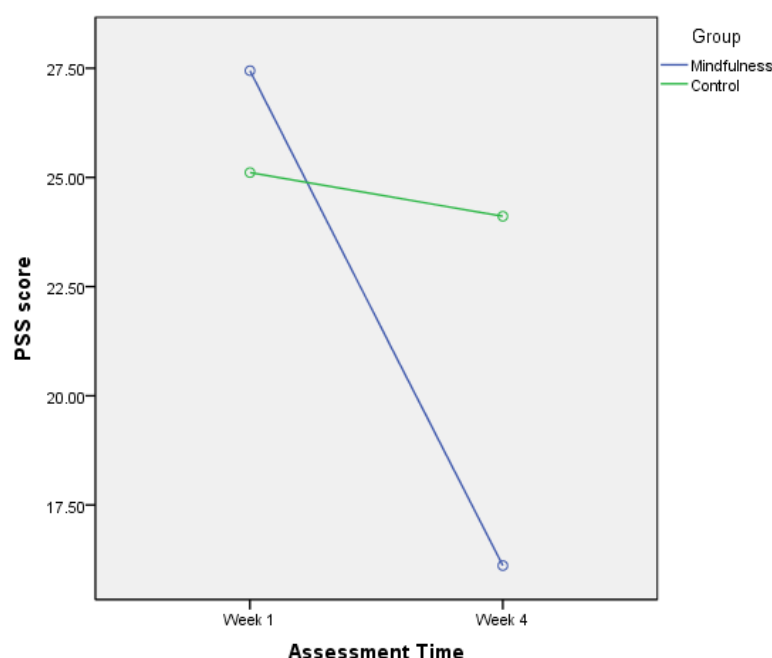
<sup>6</sup> All effect sizes were calculated using online effect size calculators (Effect Size Link, 2011 & Defife, 2009) and interpreted according to guidelines (Cohen, 1988) where a small effect size = .25, medium = .50 and large = .80.

<sup>7</sup> Levenes test for equality of variance was significant, thus equal variances were not assumed.

|                   |       |      |       |      |       |      |
|-------------------|-------|------|-------|------|-------|------|
| <b>PSS week 1</b> | 27.44 | 2.30 | 25.11 | 6.72 | 26.28 | 5.02 |
| <b>PSS week 4</b> | 16.11 | 6.41 | 24.11 | 7.06 | 20.11 | 7.73 |

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A 2 X 2 mixed factorial ANOVA was conducted, where the within-subjects independent variable was assessment time (week 1 and week 4), the between-subjects independent variable was condition (mindfulness or control) and the dependant variable was the PSS score. A significant main effect for assessment time was observed,  $F(1, 16) = 41.80$ ,  $p < .001$ , but not for condition  $F(1,16) = 1.16$ ,  $p = .298$ . A significant interaction effect was observed,  $F(1,16) = 29.34$ ,  $p < .001$ . Figure 2 illustrates this interaction.



**Figure 2: A plot to illustrate the significant interaction between condition (mindfulness or control) and assessment time (week 1 and week 4) for the PSS**

### Post-hoc

### tests

To determine the source of significance found within the ANOVA, appropriate post-hoc tests were conducted. Two independent t-tests and two paired-sample t-tests were conducted.<sup>8</sup> The first independent t-test was conducted on PSS scores week 1 where the independent variable was condition (mindfulness or control) and the dependant variable was PSS scores. PSS scores were not significantly different between the mindfulness condition ( $M = 27.44$ ) and the control condition ( $M = 25.11$ ) at week 1,  $t(16) = .99$ ,  $p = .339$ .<sup>9</sup> The second independent t-test was conducted on

<sup>8</sup> To control for four pairwise comparisons the Bonferroni correction provided a new significance value of 0.0125.

<sup>9</sup> Levenes test for equality of variance was not significant, thus equal variances were assumed.

PSS scores week 4 where the independent variable was condition (mindfulness or control) and the dependent variable was PSS scores. PSS scores

were not significantly different between the mindfulness condition ( $M = 16.11$ ) and the control condition ( $M = 24.11$ ) at week 4,  $t(16) = 2.52$ ,  $p = .023$ .<sup>10</sup>

Two paired-sample t-tests were then performed separately on both groups. The independent variable was assessment time (week 1 & week 4) and the dependant variable was PSS scores. A significant decrease in PSS scores was found for the mindfulness condition from week 1 ( $M = 27.44$ ) to week 4 ( $M = 16.11$ ), with a small effect size,  $t(8) = 6.63$ ,  $p < .001$ ,  $d = .47$ . No significant difference was found for the control condition from week 1 ( $M = 25.11$ ) to week 4 ( $M = 24.11$ ),  $t(8) = 1.18$ ,  $p = .273$ . This indicates that only the mindfulness condition experienced a significant decrease in stress from week 1 to week 4.

### Hypothesis Three

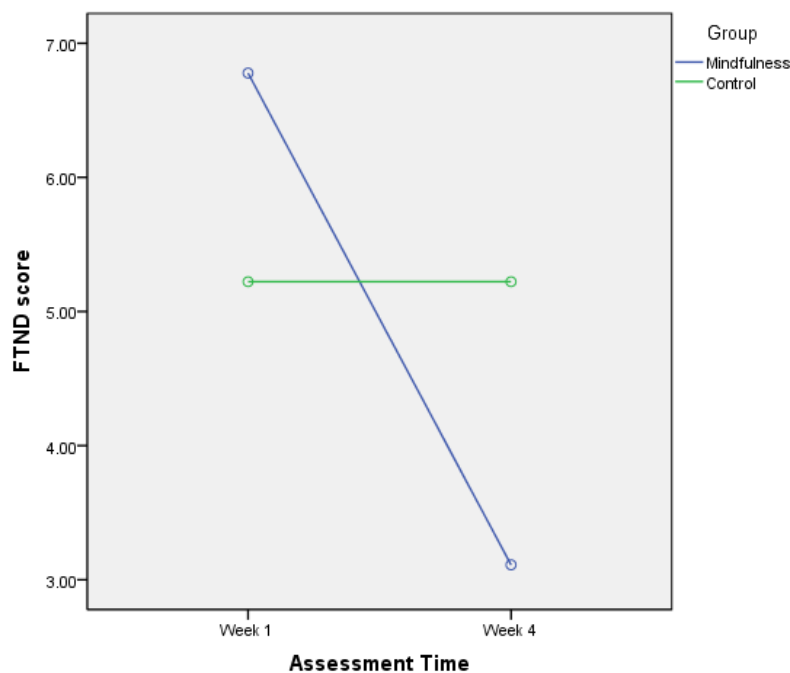
To determine whether smoking significantly reduced from week 1 to week 4, FTND scores were measured pre-intervention and post-intervention in both conditions. Table 4 presents the means and standard deviations for the FTND for both the mindfulness and control groups at weeks 1 and 4.

**Table 4**  
**Descriptive statistics for the FTND at week 1 and week 4**

| Participant group  |                             |           |                         |           |                              |           |
|--------------------|-----------------------------|-----------|-------------------------|-----------|------------------------------|-----------|
| Assessment Time    | Mindfulness<br>( $n = 18$ ) |           | Control<br>( $n = 18$ ) |           | Total Sample<br>( $N = 18$ ) |           |
|                    | <i>M</i>                    | <i>SD</i> | <i>M</i>                | <i>SD</i> | <i>M</i>                     | <i>SD</i> |
| <b>FTND week 1</b> | 6.78                        | 2.11      | 5.22                    | 3.35      | 6.00                         | 2.83      |
| <b>FTND week 4</b> | 3.11                        | 2.47      | 5.22                    | 3.35      | 4.17                         | 3.05      |

A 2 X 2 mixed factorial ANOVA was conducted, where the within-subjects independent variable was assessment time (week 1 and week 4), the between-subjects independent variable was condition (mindfulness or control) and the dependant variable was the FTND score. A significant main effect for assessment time was found,  $F(1, 16) = 21.04$ ,  $p < .001$ , but not for condition  $F(1,16) = .05$ ,  $p = .83$ . A significant interaction effect was observed,  $F(1, 16) = 21.04$ ,  $p < .001$ . Figure 3 illustrates this interaction.

<sup>10</sup> Levenes test for equality of variance was not significant, thus equal variances were assumed.



**Figure 3: A plot to illustrate the significant interaction between condition (mindfulness or control) and assessment time (week 1 and week 4) for the FTND**

### Post-hoc tests

To determine the source of significance found within the ANOVA, appropriate post-hoc tests were conducted. Two independent t-tests and one paired-sample t-test was conducted.<sup>11</sup> The first independent t-test was conducted on FTND scores week 1 where the independent variable was condition (mindfulness or control) and the dependant variable was FTND scores. FTND scores were not significantly different between the mindfulness condition ( $M = 6.78$ ) and the control condition ( $M = 5.22$ ) at week 1,  $t(16) = 1.18$ ,  $p = .255$ .<sup>12</sup> The second independent t-test was conducted on FTND scores week 4 where the independent variable was condition (mindfulness or control) and the dependent variable was FTND scores. FTND scores were not significantly different between the mindfulness condition ( $M = 3.11$ ) and the control condition ( $M = 5.22$ ) at week 4,  $t(16) = 1.52$ ,  $p = .147$ .<sup>13</sup>

A paired-sample t-test was then performed on the mindfulness condition. The independent variable was assessment time (week 1 & week 4) and the dependant variable was PSS scores. A significant decrease in FTND scores was found for the mindfulness condition from week 1 ( $M = 6.78$ ) to week 4 ( $M = 3.11$ ), with a small effect size,  $t(8) = 4.59$ ,  $p = .002$ ,  $d = .33$ . The control condition mean scores on the

<sup>11</sup> To control for three pairwise comparisons the Bonferroni correction provided a new significance value of 0.0166 recurring.

<sup>12</sup> Levenes test for equality of variance was not significant, thus equal variances were assumed.

<sup>13</sup> Levenes test for equality of variance was not significant, thus equal variances were assumed.

FTND did not change from week 1 ( $M = 5.22$ ) to week 4 ( $M = 5.22$ ), therefore a paired-sample t-test was not required. This indicates that only the mindfulness condition experienced a significant decrease in nicotine dependence from week 1 to week 4.

## Discussion

The current study aimed to assess the effects of a short-term mindfulness-based intervention on trait mindfulness, stress and smoking in a population of young adult smokers, as compared to a control group. The results observed supported all three hypotheses, mindfulness, stress and smoking.

### Hypothesis One: Mindfulness

As hypothesised it was found that trait mindfulness, as measured by the FMI, significantly increased from week 1 to week 4 in the mindfulness condition but not in the control condition. This supports the findings of Keng, Ekblad & Brantley (2012) who also found that mindfulness training increased self-reported trait mindfulness. Results from the current study also support the findings from the majority of mindfulness-based smoking cessation programmes, particularly those of Davis *et al.*, (2013) who found increases in trait mindfulness in a population of young adult smokers, also using the FMI from pre-post intervention.

### Hypothesis Two: Stress

As predicted, it was found that self-reported stress, as measured by the PSS, significantly decreased in the mindfulness condition from week 1 to week 4 but not in the control condition. This supports research conducted by Tang *et al.*, (2007) who also found that a short-term mindfulness intervention significantly decreased stress, compared to a control group, in a group of undergraduate students. More importantly, parallel with previous smoking cessation interventions (Davis *et al.*, 2007), results demonstrate that mindfulness training is efficacious in targeting stress in smokers.

Findings may be explained by the transactional theory of stress (Lazarus & Folkman, 1984) where mindfulness reduces negative cognitive appraisals of stressful events and experiences. Therefore it may be possible that a less defensive responding to challenging situations may be one way through which mindfulness produces salutary effects on stress. Secondly, a possible explanation of this data relates to the argument that mindfulness may foster an enhanced capacity to cope with situations perceived as threatening (Weinstein, Brown & Ryan, 2009).

### Hypothesis Three: Smoking

Supporting the final hypothesis, it was found that smoking, as measured by the FTND, significantly reduced from week 1 to week 4 for the mindfulness condition, but not for the control condition. This replicates previous findings of reduced smoking after brief mindfulness sessions (Bowen & Martlett, 2009; Tang, Tang & Posner, 2013) and interventions targeted at young adults (Davis *et al.*, 2013). Particularly, these results are parallel to those of Tang, Tang & Posner (2013) who found that after only two weeks of mindfulness training, the self-report FTND result showed a significant smoking reduction for the mindfulness group but not the control group. However, these studies also measured exhaled carbon monoxide (CO) to confirm smoking reduction. To validate the self-reported smoking behaviour, future studies

could utilize a CO monitor (Micro+ Smokerlyzer, Bedfont Instruments) as an objective indicator of smoking cessation (Tang, Tang & Posner 2013).

A theoretical explanation of the current findings is that the non-reactive, non-judgemental awareness of bodily sensations and negative thoughts that is brought about as a result of mindfulness training may enable individuals to manage the cravings, urges and emotional distress that accompany nicotine withdrawal (Bowen *et al.*, 2011). In addition, given that stress is important in tobacco use (Niaura *et al.*, 2002; Brady & Sinha, 2005; Ansell Gu & Sinha, 2012), the finding that both stress and smoking reduced in the mindfulness condition suggests the possibility that mindfulness training may exert its effect on smoking outcomes through stress reduction. This is in line with the findings of Davis *et al.*, (2007) who found that decreases in stress was associated with smoking abstinence.

### **Strengths and Limitations**

A major strength of this study include random allocation of study participants to treatment groups and the presence of an active control group. However, in addition to the suggestions already mentioned, there are several issues to address before conducting future interventions.

Firstly, a potential limitation of this study is the exclusive reliance on self-report measures. Although almost all mindfulness interventions utilize self-rating indices, it is difficult to assess the accuracy of participants' responses as retrospective accounts are subject to bias by memory distortions (Brown & Ryan, 2003). Thus, to improve validity, future research may benefit from the use of physiological and neurobiological techniques, which will provide a richer understanding of the effects of mindfulness meditation (Brown & Ryan, 2003).

Secondly, owing to the fact that the TMS (2) was statistically unreliable (0.08) the measure could not be used as a manipulation check, thus the current study was unable to assess whether participants were fully engaged with the mindfulness meditation practice in the group sessions. Future research should ensure participants are encouraged to answer the TMS in a truly honest manner.

A final limitation of the current study is small sample size ( $N=18$ ) which may potentially limit the generalizability of the research findings. Cohen (1988) suggests that a minimum of 33 participants is required in each sample to identify a medium-large treatment effect. Thus, additional intervention studies, with larger sample sizes to ensure adequate power, are required to continue to assess the effect of mindfulness on smoking reduction. Nevertheless, as with previous research (Davis *et al.*, 2007), mindfulness, stress and smoking outcomes did reach statistical significance using a small number of participants.

### **Implications**

While there have been considerable advances in tobacco dependence pharmacotherapy, there has been little development towards effective smoking cessation interventions for young adults smokers. (Davis *et al.*, 2013). The present study does indicate that a short-term mindfulness intervention is effective in eliciting a significant reduction in smoking, which is concurrent with research by Tang, Tang & Posner (2013). Therefore the current study offers a rationale for employing short-term, mindfulness-based interventions aimed at reducing smoking in young adults.

## Conclusion

The current study demonstrated that a short-term, low-cost mindfulness intervention, compared to a closely matched control, was successful in significantly increasing levels of trait mindfulness and reducing stress and smoking in young adults. Results suggest that reductions in stress may be a therapeutic mechanism by which mindfulness training has its potential effect; this warrants further investigation. Similar research that not only replicates the current findings, but focuses on the longer term efficacy of short-term interventions on smoking reduction (i.e., 6-months post-quit assessment) is also warranted.

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