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ORIGINAL RESEARCH

A Randomised Experiment Evaluating the Mindful Raisin Practice as a Method of Reducing Chocolate Consumption During and After a Mindless Activity

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Abstract
The present study investigated the impact of the mindful raisin exercise on overeating during and after the experiment while controlling for wellbeing. One-hundred and twenty-eight participants were recruited and completed a questionnaire on wellbeing (i.e. depression, anxiety and stress) and state mindfulness. Participants were randomly allocated to either the mindful raisin exercise or a newspaper reading control condition. The State Mindfulness Scale was then completed again, and participants watched a neutral video while exposed to chocolate for 10 min. For those 10 min, results showed that the mindfulness condition translated into lower food consumption during the mindless activity when compared to the control condition. Post experiment, participants were asked to wait for 5 min, and any extra chocolate consumption during this time was recorded. Post-consumption was non-significantly different between the two groups, with those in the mindfulness condition consuming 1.3 g less than those in the control group. Controlling for wellbeing did not alter the impact of the mindfulness intervention on consumption. Implications for future work and practical applications for weight regulation are discussed.

Keywords Mindful raisin exercise · Mindfulness · Mindlessness · Wellbeing · Chocolate

Introduction

Obesity is a growing problem in contemporary society and of a major public health concern (Mokdad et al., 2003; Ogden et al. 2015). The associated health problems with obesity, such as cardiovascular disease and diabetes, are also increasingly problematic, and much of the literature has attributed the problem to an imbalance of calorie intake and expenditure, as well as overeating (e.g. Bray & Champagne, 2005). More in-depth analyses have highlighted that one explanation for overeating is the "obesogenic environment" or environmental stimuli that increase cravings and consumption of (often calorie-dense) foods, while the basic drive of hunger contributes minimally in prediction of consumption (Garg & Wansink, 2007; Nederkoorn, Smulders, Havermans, & Jansen, 2004). At these times, it is suggested that food is being consumed mindlessly, with lack of attention paid to what and how food is being consumed.

Mindless eating is defined as the diverted awareness of the quantity of food one is consuming and a lack of attention on the present eating experience, which can lead to overeating (Vik et al. 2013). Overconsumption is influenced by environmental cues such as eating in front of the TV (Chapman et al. 2014; Mathur and Stevenson 2015) or larger (rather than smaller) plate sizes (Van Ittersum and Wansink 2012). Eating in front of the TV reinforces an attentional distractor and plate size or packaging prompt consumption of larger proportions, both reinforcing behavioural automaticity (see Cohen & Farley, 2008). The evidence for a positive relationship between mindless eating and how much food people consume has been established in the literature (Ogden et al., 2013; Rosenthal & Raynor, 2017; van den Broek et al., 2018) and has been the most problematic in creating appropriate interventions to overcome the mindless consumption and overconsumption.

One method proposed to assist and enable adaptive decision-making around food and eating has been mindfulness. Mindfulness meditation is defined as a practice that entails a purposeful and attentive non-judgemental awareness of the present moment (Kabat-Zinn 1982), and many researchers and

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clinicians propose that mindful eating (i.e. mindfulness foundations applied to eating) may be a method of regulating eating (Hendrickson, & Rasmussen, 2017; Winkens et al., 2019). Mindful eating assists in the gradual change of external eating and environmentally driven responses to food to internal decision-making and eating, promoting healthier eating behaviours (Mantzios and Wilson 2014, 2015a; Mantzios and Giannou 2014), such as a decrease in external and emotional eating (Warren et al. 2017; O'Reilly et al. 2014), an increased intake of fruit and vegetables (Dutt et al. 2018; Gilbert & Waltz, 2010), as well as a reduction in the consumption of high-sugar and energy-dense foods (Mason et al. 2016). Research has found a negative association between mindful eating and fat and sugar consumption (Mantzios et al. 2018a, b), grazing (Mantzios et al. 2018a, b), motivations to eat palatable foods (Mantzios and Egan 2018), as well as weight gain (Mantzios, Wilson, Linnell & Morris, 2014). Overall, mindfulness specific to eating rather than mindfulness targeting more generically the self-regulation of attention has been found to be more effective in improving eating behaviours (Mantzios and Wilson 2015b; O'Reilly et al. 2014). Experimental evidence on mindful eating and actual consumption is scarce, especially when considering the aspect of external eating and environmental drives to overconsumption; while the overall wellbeing (defined through stress, anxiety and stress) which may be a highly relevant factor indicating individual differences in consumption is rarely accounted for in such experiments.

Mental health and wellbeing are inextricably linked with eating behaviours in both clinical and non-clinical populations, and there is prolific research investigating the interaction between wellbeing and food consumption. Overeating is associated with higher levels of stress, anxiety and depression in a number of large-scale studies (e.g. Jung et al. 2017; Lee-Winn et al. 2016), while the association between binge eating and psychological distress is also clearly recognised (Elliot et al. 2013; Gan et al. 2018). Literature has evidenced the impact of depression, anxiety and stress, or "wellbeing" on overeating and binge eating and provides a clear rationale for controlling for these effects in any experimental studies in eating behaviours.

The relationship between mindful eating and psychological wellbeing has overall suggested positive results (e.g. Khan and Zadeh 2014) and improved clinical outcomes such as diabetes self-management (Miller 2017). Applying mindfulness to eating behaviours promotes healthy regulated eating and discourages automatic and inattentive eating such as emotional, habitual, impulsive and binge eating (see also Mason et al. 2017a, b). Mindful eating is defined as the act of responding to physiological cues such as hunger, taste and fullness while maintaining non-judgemental attention throughout the duration of eating. Mindful eating has a plethora of different practices which are aimed at focusing the attention on the experience of eating. The raisin exercise is a principle example of a mindful eating practice, whereby the individual focuses on the present moment, attending to the colour, texture, smell and taste of the raisin using their sensory modalities such as touch, sound, sight, smell and taste (Kabat-Zinn 2005; Albers 2003). The aim of the raisin exercise, and mindful eating more broadly, is to focus attention on the sensual awareness of the food, without judgement, and, in the longer term, to diminish distractions and emotional responses to eating. Also, attending to internal (rather that external) cues such as hunger and satiety over environmental decision-making practices that drive people to eat because it is lunchtime, it is movie night, or the food is simply available and/or irresistible is one of the primary functions of the practice. There is some evidence that the raisin exercise as a mindful intervention does increase the sensory experience of eating and leads to a decrease in food consumption (Arch et al. 2016), but findings are limited to the link between mindfulness and the impact of external cues on eating behaviours.

The use of a raisin for this exercise is restrictive when considering the potential impact of external eating on overconsumption, and the potential investigation with other, more attractive and calorie-dense foods, such as chocolate, may enhance our understanding around the foods that are more problematic in regulating. Chocolate in itself has been described as one of the most craved foods (Pelchat 1997) and has been associated to improving mood (Macht and Dettmer 2006), while other research has indicated that healthy dietary intentions did not deter higher consumption and associated higher body weight in the presence of chocolate (Allan et al. 2010). Recent research which aimed to overcome difficulties observed in past studies, and explored mindful chocolate consumption and improvements in mood, proposed that there is a need to explore portion size and consumption further in future research (Meier et al. 2017). In other words, chocolate is craved, enhances mood and therefore acts as an emotion regulation food, while it is difficult to regulate its consumption, all elements that are not true for the majority of people who are eating raisins. Adapting the practice to enable regulated consumption of troublesome foods may be an effective way of utilising this mindful eating practice. Research has shown that mindfulness interventions (such as decentering) can decrease consumption and cravings of chocolate (e.g. Schumacher et al. 2017; Tapper and Turner 2018), but the effectiveness of the raisin exercise in moderating consumption and the association with chocolate consumption has not been explored.

The proposed study utilised a modified version of the raisin exercise using chocolate to gain an insight into the relationship between food consumption and the raisin exercise during a mindless experience (i.e. watching a video). Measurements of consumption occurred at two points (during the mindless experience and during a bogus wait time) at the end of the experimental session while accounting for the interaction of wellbeing. The modified version of the raisin exercise aimed to provide a further understanding of mindfulness and chocolate consumption.

Methodology

Participants

A sample of 128 undergraduate students (males n = 45, females n = 83) from a UK university in the West Midlands participated in the current study. Participants were recruited using an online research participant scheme and study advertisement. The mean age of participant was 20.56 (SD = 4.38), with a mean BMI of 24.73 (SD = 4.07). Participants received research credit in return for their involvement in the study and received no other incentives as a result of taking part. This scheme by which students receive research credits resulted in a dataset that had no missing values, and none of the students dropped out or asked for their data to be excluded. Exclusion criteria included allergy to nuts and a former diagnosis with an eating disorder, but none of the participants indicated any allergies or diagnoses when asked prior to starting the experiment.

Instruments

The State Mindfulness Scale (*SMS*; Tanay and Bernstein 2013)

The scale is 21-items and measures state mindfulness. This scale addresses current sensations felt by the responder in the past 15 min. Responses are measured on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very well*) and include items such as "*I was aware of different emotions that arose in me" and "I tried to pay attention to pleasant and unpleasant sensations*". This scale displays strong internal consistency in past research Cronbach's alpha of 0.90 and 0.95 (Tanay and Bernstein 2013) and good construct validity through positive correlations with the Toronto Mindfulness Inventory (Lau et al. 2006; Tanay and Bernstein 2013). The higher the score the more mindful participants are, and the Cronbach's alpha for the current study was 0.95 pre- and 0.91 post-intervention.

Depression, Anxiety and Stress Scale (*DASS*; Lovibond and Lovibond 1995)

The scale consists of 21 items which are divided into 3 subscales (measuring depression, anxiety and stress). The depression scale assesses dysphoria, anhedonia and hopelessness. The anxiety scale appraises situational anxiety and anxious affect, while the stress scale measures trouble relaxing, nervousness and emotional reactivity (Nieuwenhuijseen et al. 2003). The responses are measured on a 3-point Likert scale ranging from 0 (*never*) to 3 (*almost always*) with items like "*I couldn't seem to experience any positive feeling at all" and "I was scared without any good reason*". The DASS scale has demonstrated an average internal consistency of 0.88, indicating the reliability of this scale being very good to employ as a measurement of depression, anxiety and stress ,with three separate corresponding scores (Andrade da Silva et al. 2016; Tran et al. 2013). The Cronbach's alpha was 0.90 for stress, 0.89 for anxiety and 0.92 for stress.

Video File

A neutral YouTube video was employed during the study to serve the purpose of having attention directed away from the food and to enable the creation of a mindless experience. Participants were presented with a 100 gramme package of M&M's to consume while watching the video. The video was neutral, aiming not to stimulate any emotions that would affect the results. The video demonstrated how wooden bowls are made in factory settings (How It's Made 2015).

Mindful Chocolate Exercise (based on the mindful raising exercise – Mantzios 2017)

. The audio file described the sensations felt during the stages before and during the consumption of the chocolate. The aim of this condition was to bring participants' awareness towards the eating sensory experience by using various phrases throughout the audio file such as "place the chocolate in the middle of your palm and observe for a few seconds" and "smell the chocolate, does it smell like chocolate?" (Mantzios 2017; Williams et al. 2007).

BBC Newspaper Article

Diesel vehicles are important for UK economy, says industry. The purpose of this article was to provide the control condition with a bogus task of a similar duration (BBC 2017), without creating any emotional implications that could affect the results of the present study.

Table 1 Independent samples t-test for the difference between mindfulness and control conditions in pre-consumption

	Mindfulness		Control				
Variable	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Pre-consumption in grammes	16.44	15.76	26.64	18.38	− 3.37	< 0.001	0.60

Table 2 Independent samples t-test for the difference between mindfulness and control conditions in post-consumption

	Mindfulness		Control				
Variable	*M*	*SD*	*M*	*SD*	*t*	*p*	*d*
Post-consumption in grammes	5.11	10.20	6.38	8.54	− 0.76	0.448	0.13

Procedure

Participants were presented with the information sheet, consent form and demographic sheet followed by the state mindfulness and DASS questionnaires. The participants were randomly allocated into two groups (newspaper vs. mindfulness) followed by either completing a reading task (reading a BBC newspaper article) or a mindfulness chocolate exercise. After the task, both groups were given the State Mindfulness Scale again and were required to watch a 10-min neutral video while being presented with the food. The measurement of the food consumed at this stage will hereafter be referred to as pre-consumption. The debrief sheet was given following the video and presentation of food. The participants were told they should stay for another 5 min while the researcher ensured that the data was registered in the database and they could help themselves to more food if they wished to do so (hereafter referred to as post-consumption). Finally, the participants were made aware after 5 min that the second intake would be recorded (if willing) and were asked to sign a second informed consent.

Design

Two independent samples t-tests were conducted to examine whether the mean of pre- and post-consumption was significantly different between the mindfulness and newspaper conditions. Please change the sentence to: "Two two-way between groups ANCOVA (condition: newspaper, mindfulness raisin) were utilised to control for the influence of wellbeing on pre- and post-consumption. This study used a 2 (Intervention: mindfulness, control) × 2 (time: pre, post) mixed-design ANOVA to examine state mindfulness. Deciding for the appropriate sample size and considering the analyses, a medium effect size set at power equalling 0.80, as well as considering previous similar studies with large effects (such as Robinson et al. 2013; $d = 0.73$), led us to 64 participants for each group, with the significance set at 0.05 (see also Cohen, 1992).

Results

The result of the independent samples t-test between the two conditions was significant for pre-consumption, $t(126) = -3.37$, $p < 0.001$. This finding suggests the mean of pre-consumption was significantly different between the mindfulness and newspaper condition, where the mean of pre-consumption in the mindfulness condition was significantly lower than in the newspaper condition. Table 1 presents the results of the two-tailed independent samples t-test.

Contrary, the result of the independent samples t-test between the two conditions was non-significant for post-consumption, $t(126) = -0.76$, $p = 0.448$. This finding suggests the mean of post-consumption was non-significantly different between the mindfulness and newspaper condition. Table 2 presents the results of the two-tailed independent samples t-test.

The results of the ANCOVA on pre-consumption were significant, $F(4, 123) = 3.18$, $p = 0.016$, indicating significant differences among conditions. The main effect $F(1, 123) = 9.78$, $p = 0.002$, $\eta_p^2 = 0.07$ indicated there were significant differences in pre-consumption by condition levels, where the mean of pre-consumption for mindfulness ($M = 16.66$, $SD = 17.43$) was significantly smaller than for newspaper ($M = 26.41$, $SD = 17.43$), $p = 0.002$. Controlling for anxiety, stress and depression did not influence the results (see Table 3).

Last, an ANOVA was conducted to assess state mindfulness across the two different conditions (i.e. mindfulness and control) and between the two times (i.e. pre- and post-intervention – see Table 4 for descriptive statistics). Results showed a non-significant difference in time, $F(1, 126) = 3.03$, $p = 0.084$, $\eta_p^2 = 0.024$. A significant main effect was observed between the conditions ($F(1, 126) = 7.42$, $p = 0.007$, $\eta_p^2 = 0.056$), with a significant interaction between time and conditions ($F(1, 126) = 71.84$, $p < 0.001$, $\eta_p^2 = 0.363$). Results indicate that those who were assigned to the mindfulness condition reported a significantly higher increase in state mindfulness than those who were in the control condition.

Table 3 Analysis of variance table for pre-consumption by condition while controlling for depression, anxiety and stress

	df	*F*	*p*	η_p^2
Condition	1	9.78	0.002	0.07
Depression	1	0.27	0.602	0.00
Anxiety	1	0.40	0.528	0.00
Stress	1	0.61	0.437	0.00

Table 4 State mindfulness scores mean (*M*), standard deviation (*SD*) and 95% confidence intervals for mindfulness and control condition across two times

Conditions	Pre mindfulness scale *M* (*SD*)	95% confidence intervals for mean pre-mindfulness Lower upper	Post mindfulness scale *M* (*SD*)	95% Confidence intervals for mean post-mindfulness Lower upper
Mindfulness	58.30 (15.06)	53.94, 62.66	69.25 (17.03)	64.75, 73.75
Control	59.27 (19.86)	54.91, 63.63	52.05 (20.07)	47.55, 56.55

Discussion

The aim of the current research was to investigate the impact of mindfulness on food consumption at a pre- and post-consumption level while also accounting for the covariance of wellbeing (i.e. depression, anxiety and stress). It was proposed that the mindfulness condition would be associated with lower food consumption when compared to the control condition. A significant effect was found as those in the mindfulness condition ate on average 10.2 g (approx. 50 calories) less than those in the control condition. The results were consistent with previous literature exploring mindfulness and eating behaviour, especially in regard to mindless eating (Chapman et al. 2014; Daubenmier et al. 2011; Havermans et al. 2015; Katterman et al. 2014; Mathur and Stevenson 2015).

The second analysis revealed non-significant results when exploring the effect of condition (mindfulness vs. newspaper) on post-consumption. Although the results were insignificant, those in the newspaper condition ate on average 1.3 grammes more than those in the mindfulness condition. Importantly, the mindful condition led to a very small reduction in chocolate consumed in the second measurement (while participants were waiting for the researcher to complete paperwork) and suggests an element that is exceeding any potential restraint disinhibition that usually occurs in weight regulation research.

Levels of wellbeing had no significant impact on consumption, and this is contradictory to previous findings showing lower wellbeing associated with higher food consumption (Elliot et al. 2013; Gan et al. 2018; Jung et al. 2017; Lee-Winn et al. 2016). Results also indicated that state mindfulness significantly increases when the mindful raisin practice was implemented, compared to a neutral news article that control participants were instructed to read, which had the exact opposite effect. Overall, what these results do show is that mindfulness has the potential to provide strong and effective interventions for weight regulation, even when a person is experiencing high levels of stress, anxiety and depression. Strengthening the ability to regulate consumption through the potential of mindful eating in a mindless environment may propose a novel method of being able to momentarily refocus on the food, regardless of whether the environment or situation is nudging participants to eat and overeat or the predisposition to consume automatically and mindlessly in the situation. The ability to adapt a simple and short mind-set of mindful eating, and the systematic practice as suggested in other literature (see Mantzios and Giannou 2018), suggests a habitual responding to food that will be mindful and, therefore, more regulatory in nature, without the typical occurrence of the disinhibition effect.

Future Direction and Limitations

Future studies should explore the differential results by investigating coping mechanisms for depression, anxiety and stress and the association with overeating and binge eating type behaviours as demonstrated in previous literature (Elliot et al. 2013; Gan et al. 2018; Jung et al. 2017; Lee-Winn et al. 2016). Additionally, exploring the Delboeuf illusion and plate-size bias would allow researchers to see whether plate-size and serving bias contribute to overeating as previously demonstrated, where smaller plates led to lower consumption (Ali et al. 2017; Delboeuf, 1865; Watt et al. 2000). Another consideration would be the post-consumption to be controlled more tightly. Some participants, since the study was over, felt comfortable engaging with their smart phones, which may have interfered with the post-consumption results. Future research could have a set-up where participants will need to drop off any technology prior to entering the experiment in a lab next door as a precaution to sensitive equipment in the lab and potentially use this as an excuse to allow for 5 min of further unsuspected engagement with the food without any interference between the participant and the food. The current research also used undergraduate student participants who tend to be more anxious that the general population (Bayram & Bilgel, 2008), overall creating a need to explore other populations further to generalise the results with confidence. Furthermore, future research could employ another intervention as a control condition, potentially one that is neutral or mindless (relating to eating and/or not) or one that proposes a different methodology to enhance mindful eating (e.g. Mantzios and Wilson 2014; Hussain, Egan & Mantzios, 2017). Last, but not least, the potential of using an emotional (rather than a neutral) video in the protocol of the current study

and potentially investigating a "normal" day that may have some naturally occurring emotional fluctuations in association to the externally set environment may form a more realistic experiment.

Future work may also benefit from developing the current study by exploring the impact of boredom, as this was a factor unaccounted for, and previous research has shown that boredom encourages excessive food consumption (Chapman et al. 2014). As both conditions in the present study watched a neutral non-engaging video, this could be perceived as a boring task, aligning it more with a state that further predisposed participants to overconsumption. Future research needs to explore experimental tools further and align mindless and inattentive eating to boredom.

Conclusion

The findings of the present study demonstrate that a brief, single administration of a mindful eating intervention can significantly lower chocolate consumption in a deliberately fixed mindless experimental setting and that psychological wellbeing does not alter this effect. The findings provided also support that the employment of mindfulness interventions in mindless eating environments is beneficial when the food that is consumed is mood-altering and highly craved such as chocolate. Overall, mindful eating practices need to be challenged in environments that are challenging and demanding, to withstand and enable alterations to become useful tools in weight regulation.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval The study was approved by the ethical review board of the University and was in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments. This article does not contain any studies with animals.

Statement of Informed consent Informed consent was obtained from all individual participants included in the study.

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