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Title: Mindfulness moderates the relationship between Emotional Eating and Body Mass Index in a sample of people with Cystic Fibrosis.

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Abstract:

Self-regulation in eating is significant for enhancing life expectancy of people with Cystic Fibrosis (CF), but research with this population is scarce. In a cross-sectional study, this research explored typical eating behaviours and motivations to eat palatable foods as elements that increase calorie intake, and mindfulness, mindful eating and self-compassion as elements that may decrease intake. In addition, the positive relationship between emotional eating and body mass index (BMI), and the potential of moderating such relationship through mindfulness, mindful eating and self-compassion was investigated. Findings suggested that indeed motivations to eat palatable foods and eating behaviours correlate with higher BMI, while mindfulness, mindful eating and self-compassion did not reach significance. Mindfulness and mindful eating moderated the relationship between emotional eating and BMI, while self-compassion did not moderate this relationship. While down-regulating is achieved through mindfulness and mindful eating by proposing healthier eating behaviours, future research needs to focus on external eating, and the potential of enhancing intake in healthy and effective ways.

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Introduction

Cystic Fibrosis (CF) is a common life-limiting genetic disease with increasing numbers across the world [1, 2]. CF gets in the way of producing adequate digestive enzymes, leading to the abnormal digestion and malabsorption of nutrients [3]. CF requires daily "preventative management and symptomatic treatment" [4] with much emphasis on maintaining a healthy body weight by eating a high-energy diet accompanied with pancreatic enzyme replacement therapy and fat soluble vitamins to avoid the development of malnutrition [1]. Maintaining optimal nutritional status and Body Mass Index (BMI) improve the quality of life and prolong life expectancy of people with CF [5]. Undernourishment is significant to the physiological health of people with CF, and while there are concerns with growing rates of obesity in this population and there is a need to balance the benefits of higher BMI with longer term health risks of being obese, a lower BMI continues to present a significant health risk [6]. Despite people with CF learning to adopt highly regulated eating environments at an early age, the research has not focused on 'conventional' eating behaviors such as emotional eating.

Emotional eating is usually described as the reaction of overeating in response to emotions [7]; in other words, the regulation of emotions occurs through a temporary, and often repetitive response, to eat and overeat. In weight regulation literature, emotional eating is associated with weight dysregulation through a number of means including binge eating, unnecessary fluctuations, and an inability to reach and maintain the optimal weight range for the individual [8, 9]. While emotional eating has been a behavioural construct that has been construed as problematic in contemporary eating behaviours, there is little evidence on this with people with CF; how they eat and interact with their

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food is largely unknown. Understanding more about emotional eating and other eating behaviours offers the potential for improving eating behaviours and therefore wellbeing for this population.

Mindfulness may offer a significant resource for supporting the psychological wellbeing for people with CF. Kabat-Zinn [10] described mindfulness as an awareness that emerges through purposefully paying attention in the present moment, non-judgmentally. Relevant to aiding people with emotional eating, Lattimore [11] proposed a mindfulness-based program to assist with stripping away emotions from the actual behavior of eating. Grossman et al, [12] found that mindfulness-based stress reduction helped individuals cope with clinical and nonclinical worries, and suggested that mindfulness training could help people cope with chronic disease and stress. Systematic reviews and meta-analyses of randomised controlled trials provided an evidence base suggesting mindfulness practices supported those with depression and anxiety [13, 14]. Other research around mindfulness programmes similarly suggests that there is a plethora of benefits when dealing with long-term conditions. The effectiveness of (a) Mindfulness-Based Stress Reduction (MBSR) [15 for stress [16], (b) Mindfulness-Based Cognitive Therapy (MBCT) [17, 18]; for depression [19] and (c) Mindfulness-Based Eating Awareness Training (MB-EAT) [20]; or mindfulness and self-compassionate interventions [21, 22] for nutritional adherence demonstrates an improvement in psychological and physiological health through the use of mindful practices.

Mantzios, Egan and Patchell [23] proposed that there is much unexplored value to the literature that has attempted to explain the obesity ‘epidemic’, and research explaining how mindless eating disadvantages most people in resisting food, may be one way of aiding people with CF to eat the amounts needed to avoid malnourishment. Other literature also proposed how the importance of offering psychosocial support alongside physiological care through mindfulness is relevant to CF quality of life and life expectancy [24]. Egan and Mantzios [25] further suggested that there is much potential to eating mindfully, whereby eating-specific mindfulness may enhance the pleasure and non-medicalized perceptions of food, and introduce or reinforce a healthy relationship with food.

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Exploring mindfulness and mindful eating further was inevitably judged as the next step of aiding people with CF to manage eating behaviours and optimal weight and consumption.

The present research aimed to firstly explore eating attitudes and behaviors, and the way they relate to Body Mass Index (BMI). Furthermore, as a second stage within such explorations, the research set out to explore the moderating effect of mindfulness and mindful eating.

Methods

Participants

Ninety-two individuals with Cystic Fibrosis were recruited through Heartlands Hospital (Birmingham, United Kingdom) scheduled appointments. The sample (M_{age} = 30.80, *SD* = 10.65; M_{BMI} = 23.19, *SD* = 4.03; females = 45, males = 33, not disclosed = 14) consisted of White British (n= 83) and nine participants who did not disclose any ethnic background. Participants were recruited on a voluntary basis, and did not receive any financial rewards.

Materials

Participant information sheet. Participants were asked to report their age, gender, height, weight, ethnicity, smoking and exercising habits.

Self-compassion scale (SCS). [26] The SCS scale is a 26 item self-report measure. Responses range from 1 (*almost never*) to 5 (*almost always*), with overall scores ranging from 26 to 130. Sample items include '*I try to be loving towards myself when I'm feeling emotional pain*' (i.e. self-kindness) and '*When I'm down and out, I remind myself that there are lots of other people in the world feeling like I am*' (i.e. common humanity). The scale is composed of six subscales, with alphas of: self-kindness (α=.70), self-judgment (α=.89), common humanity (α=.72), isolation (α=.81), mindfulness (α=.72) and over-identification (α=.83). The present study produced an overall Cronbach's alpha of .93 for the total score.

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Five Facet Mindfulness Questionnaire - Short Form (FFMQ-SF) [27];. The FFMQ-SF is a 24-item questionnaire measuring five main characteristics of mindfulness, and is based on the original 39-item version (*FFMQ)* [28]. Responses range from 1 (*never or rarely true*) to 5 (*very often or always true*), with total scores varying from 24 to 120. Sample items are '*I find it difficult to stay focused on what's happening in the present moment'* (i.e. acting with awareness) and '*usually when I have distressing thoughts or images I can just notice them without reacting'* (i.e. non-reactive), and higher scores indicate higher levels of mindfulness. The five measured facets produced an alpha: observing (α=.71), describing (α=.83), acting with awareness (α=.86), non-judging (α=.82) and non-reactivity (α=.74). The present study produced an overall Cronbach's alpha of .87 for the overall score.

Mindfulness Eating Scale (MES) [29];. The MES is a 28 item scale, and is combined with five subscales, with responses ranging from 1 (*Never*) to 4 (*Usually*), and overall scores varying from 28 to 112. Sample items include '*I wish I could control my eating more easily'* (i.e. acceptance) and '*I notice flavours and textures when I'm eating my food'* (i.e. awareness). Higher scores indicate higher levels of mindful eating. The five subscales produced an alpha of: acceptance (α=.93), awareness (α=.82), non-reactivity (α=.75), routine (.85), distractibility (α=.93) and unstructured (.71). The present study produced an overall Cronbach's alpha of .93 for the total score.

Three factor eating questionnaire – Short form (TFEQ-R18) [30]. The TFEQ-R18 is an 18 item questionnaire and measures the concepts of restrained eating, emotional eating and uncontrolled eating, and is based on the original 51 item–version (*TFEQ)* [31]. It includes items such as '*When I smell a delicious food, I find it very difficult to keep from eating, even if I have just finished a meal.'* (i.e., restrained eating) and '*When I feel lonely, I console myself by eating'* (i.e. emotional eating). Responses range from 1 (*definitely false)* to 4 (*definitely true*), with overall scores ranging from 18 to 76. The three subscales produced an alpha of: restrained eating (α=.77), emotional eating (α=.86) and uncontrolled eating (α=.77). The present study produced an overall Cronbach's alpha of .83 for the overall score.

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The Palatable Eating Motives Scale (PEMS) [32]. The PEMS consists of 19 items which assess motives for eating palatable but unhealthy foods for reasons other than hunger. On a 5-point Likert scale, responses range from 1 (never/almost never) to 5 (always/almost always) and scores range from 19 to 95. A variety of foods are listed (e.g., sweets like ice cream, chocolate, doughnuts, cookies, cake, candy, muffins, scones, fudge, brownies, and other desserts), with instructions stating for participants to think about times they have eaten any of the listed foods, and for them to mark how often they have consumed the foods for the following reasons. Sample items include 'I consume these foods/drinks to forget my worries' and 'I consume these foods/drinks to get "high like" or euphoric feelings'. The PEMS factors into four motives, alpha scores and descriptions for each motive are presented: coping motives (a=.92) include consuming the listed foods to help deal with negative states (e.g., to help with worry, depression or nervousness), reward enhancement motives (a=.87) include consuming the palatable foods and beverages in order to enhance a positive experience or emotion, because it is rewarding (e.g., because it is fun, or feels pleasant), social motives (a =.93) relate to eating the palatable foods or beverages for social reasons, (e.g., to enjoy a party or to be more sociable) and conformity motives (a=.85) pertain to eating the foods and drinks because of pressure by others (e.g., to fit in). The present study produced an alpha of (a=.95) for the PEMS.

Procedure

Convenience sampling was used to approach patients attending a meeting with health care professionals in the West Midlands region Hospital of the United Kingdom. Potential participants responded to an advertisement and received a participant information form, consent form, followed by the demographic information page and the questionnaires. Once participants completed the study, they were directed to a debriefing form, which provided them with further information about the aim and purpose of the current study. Participants were also given the opportunity to record an arbitrary number, which would allow them to withdraw their data at a later stage and retain the anonymity of participation. Ethical approval was granted by the Ethical Committee based within the University and by the National Institute for Health Research (NIHR).

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Analyses

All statistical analyses were conducted using IBM SPSS 24. Data was initially explored through bivariate correlations. Moderation effects were interpreted using PROCESS (Model 1) with a bootstrap sample of 5000 where variables were centred to their means [33]. Simple effects coefficients were computed for three values of the moderator (i.e., 1 *SD* below the mean, at the mean, and 1 *SD* above the mean). For all analyses, p-values $\leq .05$ were considered statistically significant; nevertheless, the bootstrapping procedure and use of bias-corrected confidence intervals (*CI*) was determined to attribute statistical significance of the moderator [34]. Partial η^2 was used as the effect size measure in all analyses. Benchmarks for partial η^2 are .01, small; .06, medium; and .14, large.

Results

Bivariate correlations between variables, as well as means and standard deviations are presented in Table 1. Having a primary interest in BMI, and the potential of enabling optimal weight regulation, significant positive associations were observed between BMI and motivations to eat palatable foods, cognitive restraint, and emotional eating. In other words, these eating behaviors are associated with higher weight. On the other hand, mindful eating, and traits such as mindfulness and self-compassion did not significantly relate to BMI (although mindful eating and mindfulness appeared to have a negative coefficient, while self-compassion did not).

Insert Table 1 Here

Further explorations related to testing mindful eating, mindfulness and self-compassion as moderators of observed relationships. While observing higher weight being significantly associated with emotional eating, and the potential physiological benefits, the potential moderation of this relationship was seen as a crucial element of achieving a healthy relationship to food and at the same time of an

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optimal weight. Therefore, we explored the potential moderating effect of self-compassion, mindfulness, and mindful eating. Self-compassion was not a significant moderator, which failed at the highest order interaction ($F(1, 67) = 1.42$, $p = .24$, $\Delta R^2 = .02$), while mindfulness and mindful eating were significant (See Tables 2 & 3; Figure 1 & 2, respectively). Results indicate that the significant positive relationship between emotional eating and BMI becomes insignificant as mindfulness or mindful eating scores increase.

Insert Table 2 & 3 Here

Insert Figure 1 & 2 Here

Discussion

The aim of this research was to explore eating attitudes and behaviors in relation to BMI, and the corresponding moderating role of mindfulness and mindful eating. Findings indicated that for people with CF the relationships had some similarities with non-clinical populations. With a primary focus on BMI, and the potential of discovering relationships that are relevant to weight regulation, motivations to eat palatable foods, cognitive restraint, and emotional eating were positively attributed to higher weight, which has been observed in other research [35-40]. In other words, these eating behaviors are associated with higher weight for people with CF. Mindfulness, self-compassion and mindful eating did not significantly relate to BMI, but mindful eating and mindfulness appeared to have a negative coefficient, while self-compassion did not, which further corresponds to previous research with non-clinical samples [37, 38, 41]. The differential relationship observed with self-compassion also corresponds to other research and literature in the field of eating and weight regulation [42, 43]. Further explorations showed that mindfulness and mindful eating are moderators of the relationship between emotional eating and BMI. In other words, for people with CF who score

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low in mindfulness and/or mindful eating, there is a significant relationship between emotional eating and BMI, while higher scores make this relationship non-significant. Results are in line with other literature that has explored the associations between emotional eating and wellbeing as well as emotional eating and mindfulness based interventions [44, 45].

A limitation of this work is that it is cross-sectional in nature, though this was a necessary first step, future research should explore current findings further by utilizing different interventions and practices to enhance the support for people with CF. The ability to use short and easily implemented practices, rather than prolonged programs that run over several weeks [46], and to develop them in ways that are adjusted to the CF population is another potential path to further research and clinical advice. Furthermore, the potential benefits for CF patients through mindfulness practices are apparent, though particular consideration should be given to elements of some practices that may prove problematic (such as difficulties with breathing practices or reduced mobility during yoga), these can be resolved through alternative, and potentially easier, informal practices [47-49].

Effective integration of accessible mindfulness practices into existing medical, nutritional and psychological care has been suggested to have a transformative value for people with CF, and other qualitative research presents a more detailed insight into how people with CF feel about eating and food and offers some suggestions for how mindfulness practices may improve the experience of eating and therefore outcomes for people with CF (see Egan & Mantzios, 2020).

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Table 1. Bivariate correlations, means and standard deviations of variable

	1	2	3	4	5	6	7	*M*	*SD*
(1) Mindfulness	1							74.18	15.12
(2) Self-Compassion	.475**	1						74.88	18.08
(3) Mindful Eating	.276*	.431**	1					84.15	10.81

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(4) BMI	-.065	.002	-.151	1				23.19	4.03
(5) Motives to eat palatable foods	-.122	-.065	-.639**	.252*	1			42.70	15.17
(6) Cognitive Restraint	-.106	-.237*	-.319**	.315**	.212	1		9.37	3.45
(7) Uncontrolled Eating	-.085	-.097	-.490**	.010	.405**	-.011	1	18.52	5.31
(8) Emotional Eating	-.161	-.235*	-.595**	.283*	.564**	.065	.578**	5.39	2.55

****. Correlation is significant at the 0.01 level.**

***. Correlation is significant at the 0.05 level.**

Table 2. Conditional effects of Mindfulness on the relationship between Emotional Eating and BMI.

Mindfulness	β	*p*	95% *CI*	
-1 *SD*	.95	< .001	.37	1.54
At the mean	.35	.06	-.01	.72
+1 *SD*	-.25	.50	-.97	.47

Table 3. Conditional effects of Mindful Eating on the relationship between Emotional Eating and BMI.

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Mindful Eating	β	*p*	95% *CI*	
-1 *SD*	.63	< .01	.18	1.09
At the mean	.35	.13	-.11	.81
+1 *SD*	.07	.82	-.54	.68

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Figure 1. Moderation model of Emotional Eating predicting BMI for 1 *SD* below the mean of Mindfulness, the mean of Mindfulness, and 1 *SD* above the mean of Mindfulness. ($p < .05$)

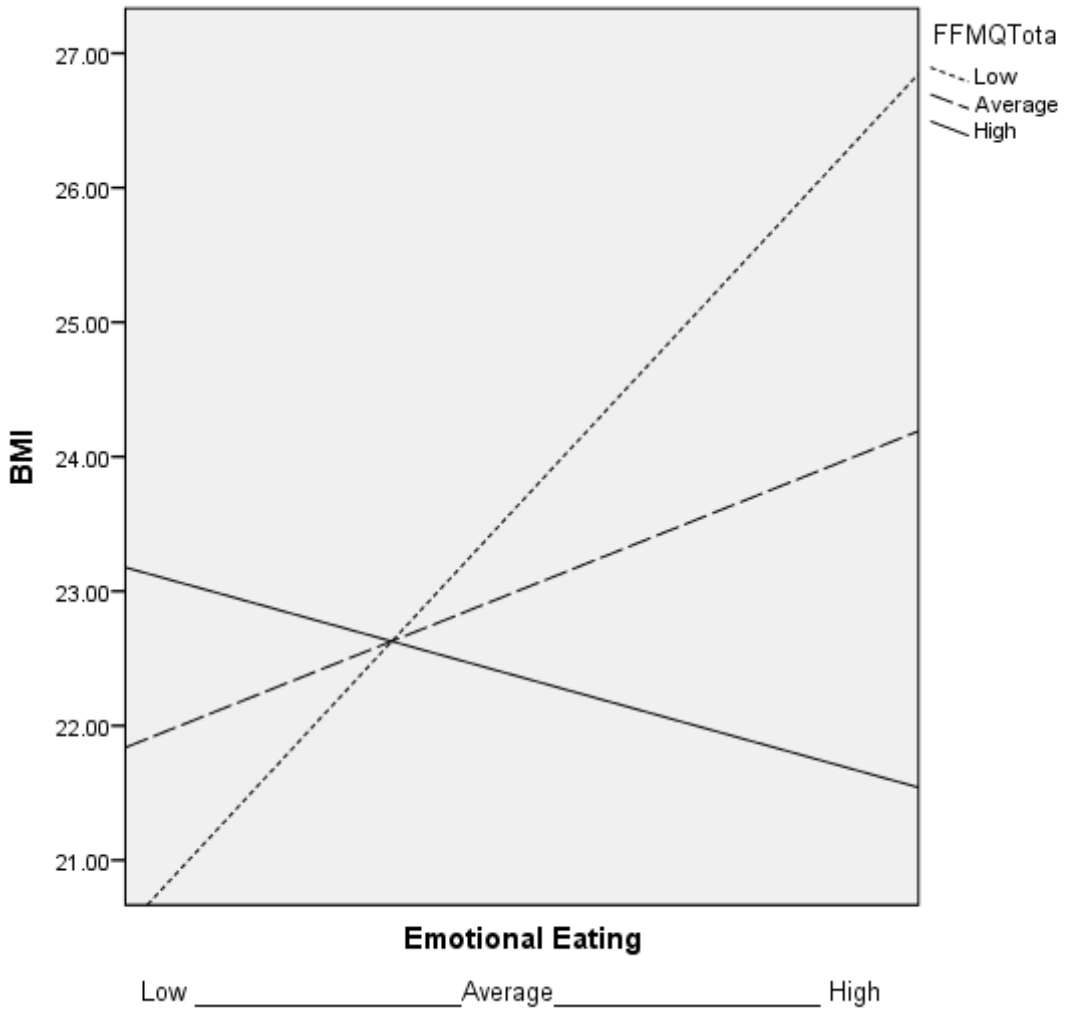

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Figure 2. Moderation model of Emotional Eating predicting BMI for 1 *SD* below the mean of Mindful Eating, the mean of Mindful Eating, and 1 *SD* above the mean of Mindful Eating. ($p < .05$)